THE ELECTRICIAN

AND

ELECTRICAL ENGINEER.

A Monthly Review of Theoretical and Applied Science.

VOLUME III.—1884.

(January to December.)

NEW YORK:
ELECTRICAL PUBLISHING COMPANY,
115 Nassau Street.

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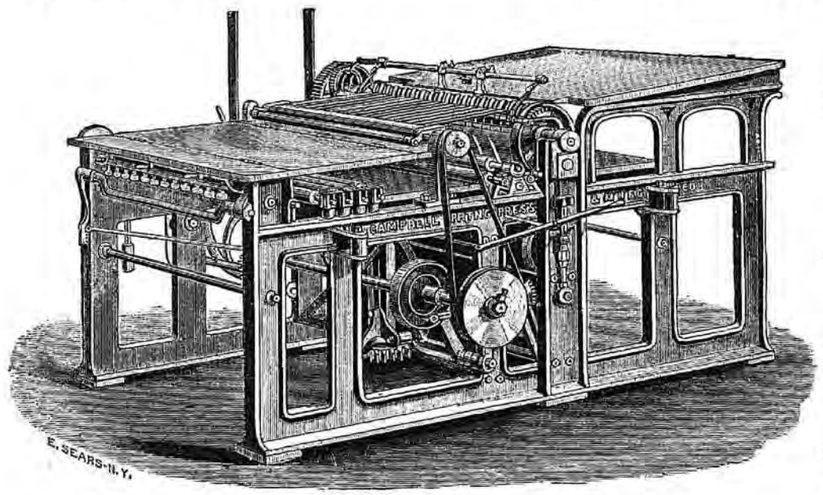

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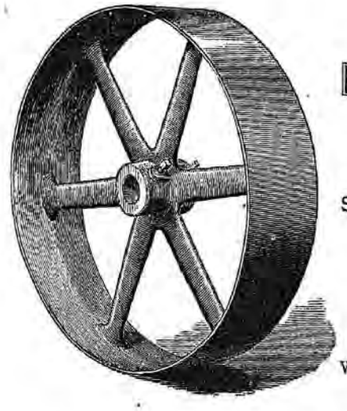

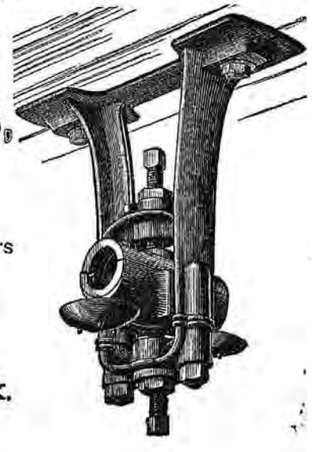

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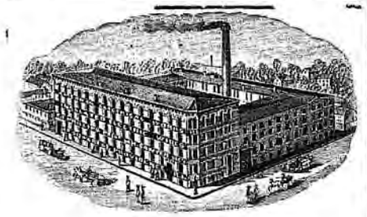

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THE ELECTRICIAN
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ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO,

115 Nassau Street, New York City.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

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NEW YORK, FEBRUARY, 1884.

ELECTRICAL SCIENCE FOR AMATEURS.

IT is a well ascertained fact, that recreation in some form is not only conducive to the health and long life of the industrious worker, but that in many cases it may be considered absolutely necessary to the enjoyment of these blessings. Such recreation may or may not be useful or lead to useful results. The labor or profession of one person often serves as the restful occupation, or "hobby" of another. Most active minds during leisure hours are devoted to some congenial amusement, which is often of material benefit rather than a mere pastime. The study of the various branches of science and the experiments which are usually carried on in connection with such study have profitably employed the surplus energy of many brilliant minds.

There is in our opinion no department of science which at once so completely satisfies the scientific, literary and mechanical tastes, as electrical research. The general public little realizes the extent to which the world is indebted for practical results of value, to the researches of amateurs in this, as well as in all other departments of science. Professor Morse, while an artist, directed his attention to electrical experiments, and the modern telegraphic system was the result. Professor Bell wandered from vocal physiology into the field of electricity, and ultimately produced the speaking telephone, an instrument of such surprising simplicity and effectiveness as to arouse, as it were, instantly, the attention of the whole civilized world. This discovery has brought to most people their first personal experience of the extraordinary rapidity of electrical transmission. It has awakened a far greater general interest in electrical knowledge than any other one yet made known. Hundreds of similar instances might be cited, to prove, if proof were necessary, that the enthusiasm and the intelligence with which the amateur scientist grapples a subject, are not always to be overmatched even by the skilful technical training and long experience of the acknowledged expert.

The study of electrical science is also of more than ordinary interest to the amateur investigator, by reason of its many and various sub-divisions. The voltaic battery, the telegraph, the various devices for multiple transmission, the telephone, the dynamo machine, and its adaptation to various purposes, the electric light, each offers its peculiar attractions for the scientific mind. If, however, the practical and financial success of his researches are regarded as important, the experimentalist should keep himself thoroughly informed with reference to the state of the art, and should not allow his partiality for the offspring of his own brain to get the better of his judgment. If he neglects to ascertain what has been accomplished in the same direction by others, perhaps years before he was born, he is certain to meet with numerous disappointments, and to find that in many instances his labor has been in vain. He who enters for the first time upon what is to him a new and fascinating field of investigation, is very apt to underrate the extent of the work which has been done by his predecessors, and hence to greatly over-estimate the importance of his own discoveries. The field, however, is so wide, and in parts so little explored, that no one need despair of their ability to discover something, which, though it may not bring him fame and fortune, will, nevertheless, add a substantial contribution to the increasing sum of human knowledge.

LONG DISTANCE TELEPHONY.

THE practical utility of the telephone as a means of instantaneous oral communication had scarcely been demonstrated, before the general public became perfectly satisfied in its own estimation that the existing systems of commercial telegraphy were doomed at an early day to be entirely superseded by what was hastily assumed to be a more rapid, convenient and reliable method of electric transmission. It was argued that telephonic communications could be made more quickly, and that customers would be better satisfied by direct conversation than by being compelled to entrust written communications to a third party. Considerable attention has been accordingly directed to the development of long distance telephony, and some actual progress in that direction has been made by enthusiastic experimenters. Even, however, if it be admitted that the expectations of these persons are destined to be realized, and that we shall ultimately be able to converse in audible tones between New York and San Francisco, or even across the Atlantic, it is extremely doubtful whether the exchange system, at least under its present organization, can be profitably adapted to very long trunk lines. The time occupied in connecting and disconnecting subscribers, and in transferring the wires from one party to another, is too valuable in the case of long lines to admit of the adoption of a toll-rate which would at once be remunerative and popular. In point of fact the telephone now occupies a particular field to which by its very nature it is especially adapted, and serves its purpose much more perfectly than could be

done by the Morse or any other known system. Local telegraphic service in past years has never proved very profitable or satisfactory either to the public or the companies undertaking it. The tariff has necessarily been low, and the demand for the service comparatively small, partly on account of its slowness, and partly for the reason that the services of a messenger were in most cases more convenient, while the office rentals, salaries, and expense of maintenance have been very great.

As an auxiliary service for facilitating the delivery of messages in sparsely settled districts, or for connection with outlying villages, the telephone has proved itself to be of great value, and few will dispute its general usefulness in connection with modern business and social life. The prosperous financial condition of the corporations founded in great part on its prospective future, should cause them at least to be well satisfied with the reception it has met with at the hands of the public in the field which it has already so successfully occupied.

TELEGRAPHY ON A CHEAP BASIS.

As usual, the most prominent point in the various arguments in favor of governmental control of the telegraph is the possibility of the service being made cheaper. Little, however, is said in regard to the possibility of the service being performed equally as well; although, perhaps, that is not to be expected, when a postal-card telegram is suggested as one of the prospective improvements, which card may be dropped in a street box, to eventually find its way to the telegraph office. This does not appear to us to be the proper spirit in which to undertake what is supposed to be a great public reform movement. From the very nature of the telegraphic service, the first and most important consideration is promptness. So far as electricity is concerned, no fault can be found in that respect. If it acts at all it acts instantaneously; but unfortunately the weakness of human agency sometimes makes itself felt, the celerity of transmission is neutralized by tardy delivery, and the value of the service is depreciated accordingly. All of these details could, no doubt, be readily arranged; but we call attention to them for the reason that they form a very important element in the actual cost of reforming the service, and have always been subjects of grave consideration by conscientious office managers. In towns and cities where the delivery is not effected through the agency of a district messenger service, it very often occurs that a sudden increase of business may overtax the capacity of the regular delivery force, and hence delays ensue which cannot be readily provided for. Corporate management has always been sufficiently conservative upon the question of an increase in the working force, which rarely does more than keep well abreast of the growth of business. It is not at all probable that cheaper rates will tend towards improvement in this respect.

With an automatic system of telegraphy which at least received credit for cheapening the transmission of messages, the American Rapid Telegraph Company established its rates upon what was expected to be a paying basis. Actual experience, however, taught its management that the rates had been placed too low, and it was deemed wise to increase them, notwithstanding the fact that the automatic system lost prestige from the change. Rates should be uniform as far as possible, and stable. The public expects, and is perfectly willing, to pay a fair living profit for telegraphic service. If good work can be promptly done at a low rate, and return a fair percentage to the owners of the line, it may be proper to undertake it; but it does not appear wise to attempt the introduction of a cheap and inferior service. The government organization of labor is not sufficiently elastic to meet emergencies which are continually arising, or in some cases even to maintain existing accommodations. A case in point was reported as follows, in the New York papers, a few days since:

"The Postmaster of Jersey City has found it necessary to discontinue the sub-stations on Newark, Pavonia, and Communipaw Avenues, for the reason that the Superintendents refuse to render service longer for the salary allowed, and which the Postmaster cannot increase."

It is understood that the salaries in question were $6 per annum. While the government may not actually lose any revenue by the closing of the stations, the inconvenience to the public is considerable. It is evident that there are weak points in the postal service which need the attention of reformers, before the telegraphs of the country are placed under similar management.

A POSSIBLE REVOLUTION IN LINE CONSTRUCTION

There appears to be a strong probability that we shall, at an early day, witness a return to the use of copper conductors for ordinary aerial telegraphic construction. It will be remembered that the early lines established under the Morse patent were constructed of copper wire, which, however, was soon superseded by iron, on account of the insufficient tensile strength of the copper. The requirements of modern electrical intercommunication, have, however, necessitated a great increase in the electrical capacity of conductors, and hence we now find in use a considerable proportion of iron wire of No. 4 gauge, where, a few years since, nothing larger than No. 8 was considered desirable or even practicable. It is well known, however, that copper possessing fully seven times the conductivity of iron, can now be purchased at about five times its cost, consequently, other things being equal, it will be found by far the cheaper metal to use.

Copper wire can now be drawn by a process which gives it a tensile strength even greater than that of the best iron wire, and this being the case, the former appears to possess every advantage over iron for aerial line construction. By reason of its lesser comparative weight, the cost of fixtures and supports is greatly reduced, while the item of saving in transportation in new countries is another important consideration. English experts are of the opinion that a wire of this character would, in a great measure, remove the objections made to overhead lines, for the reason that when suspended at the ordinary height from the street they can hardly be seen. Experience has shown that such wires are less likely to be prostrated by wind storms, and it will no doubt be found that sleet will not accumulate so readily upon them. Copper wire is practically proof against the corrosive effect of the atmosphere, which is a further very important consideration. In certain branches of electrical work, such as the telephone, district, and exchange quotation systems, the use of particular lines is often discontinued for various reasons, and it is usually considered advisable to remove them. A single company in New York city has taken down 40,000 pounds of such dead line wire in one year, out of which only about 8,000 pounds could be utilized for future work. The price realized for old iron wire is about ½ of a cent per pound, and it is somewhat difficult to find a willing purchaser at any price. In the case of copper, however, there is no difficulty in obtaining at least one third of the original price, which circumstance presents an additional argument in its favor well worthy of attention. There was formerly a limited market for old iron wire among farmers, who used it for fencing purposes; but the superiority and cheapness of barbed wire has led to its adoption for such use in preference to anything else. Unless some objection arises in practice which cannot now be foreseen, there appears to be no reason why lines built of hard drawn copper wire should not rapidly come into general favor.

ELECTRICITY IN THE WEST.

The electric light has at last arrived at Elgin, Ill. This thriving city is now illuminated by 23 arc lights, arranged in groups at the respective summits of 7 lofty towers. The inauguration of this service was the occasion of a day of jubilee, and the local press gave a loose rein to the imaginations of its reporters, the result being some lofty flights into the empyrean of flowery literature.

"The queen city of the North-west now radiant twenty-four hours a day," is the first greeting which meets the eye. The narrative of the opening is absolutely thrilling. "It was not till 7.27 that Miss Anna C. Bowen, daughter of Mr. George S. Bowen, moved the lever at the dynamo connecting with the circuit. The wires pulsated with the current and the beautiful mellow emulgence (*sic*) on seven towers instantaneously transformed darkness into moonlight." After this spectacle, who can say that the age of miracles is past. Unfortunately two of the lamps did not work perfectly; had they done so, language would have failed in its futile effort to describe the scene; as it was, however, "the fronts of the blocks were brightened by the halo; the fulgor (*sic*) stole across the black river and made silvery pathways; the very air seemed warmed by the gentle influence; and when one stood where he could see all the towers at a distance, the lights appeared merged into one large ball on each structure, and to stand like sentinels at convenient intervals, watching over the destinies of a busy city."

The poet-laureate of the busy city also took advantage of the great event to immortalize himself in the lines "What's the Matter?" Being artistically rendered by a quartette, the exquisite harmony cannot be conveyed to our readers, but a selected verse will perhaps give a slight idea of the hilarity of the occasion:

> George S. Bowen has come to town, that's what's the matter!
> And placed electric towers around, that's what's the matter!
> We now see night turned into day, and also hear the people say
> "Other lights must now give way," that's what's the matter!

Even this brilliant display, has, however, its dark side. Frank Crosby was engaged in the lucrative business of raising fancy poultry. After the beams of the electric light flashed over the city, he found one of his Plymouth Rock hens on her nest, under the delusion that morning had come, and that it was time to lay her diurnal egg. He fears that the constitutions of his fowls may be undermined by this excess of ambition. At the close of the banquet, a vote of thanks to Mr. Bowen, the entertainer of the evening, was moved, and Col. McGliney declared "the P's have it."

This is the usual result upon an occasion of this description; the "I's" generally secure the bulk of the refreshments. It is quite apparent that the city of Elgin requires all the light it can get.

THE CRISIS PASSED.

Since the passage by the Board of Aldermen of an ordinance requiring that all electric light wires be placed underground in two years, the vigilance of the daily press has relaxed to such an extent that no more Munchausen tales are published, in which horses are knocked dead, accompanied by a sharp report, and a halo of purple light. The mortality of the city is not excessive, and a member of the police force, none of whom are supposed to rush heedlessly into danger, was seen a few days since carelessly handling an electric light wire, which hung from a pole at the edge of the sidewalk. Our citizens may now breathe freely, and venture upon the street with a feeling of confidence that they will probably reach home in safety at night. Meanwhile a hundred lives have been lost by shipwreck upon a well-known coast, while en route for Savannah, a point which is accessible by rail.

We have heard nothing either of compelling steamers to sail on dry land, or of forcing passengers to travel by rail. Possibly if they avoided the sea, they would lose their lives in a railway accident. We might expect our affairs to be properly regulated by the newspapers, but we still remember that several lives were lost when the *World* building was destroyed by fire, which might have been avoided by proper arrangements for the escape of the inmates.

A little consideration will show that gross exaggeration has been used in this question of overhead wires, for the furtherance of certain schemes, which will develop themselves in due time. Perhaps an internecine war may break out meanwhile between the thousand-and-one owners of subterranean systems, which will expose the true inwardness of this extreme solicitude for the welfare of the public.

DECISION IN A TELEPHONE CASE.

In the United States Circuit Court at Philadelphia, on January 25, the injunction asked for by the American Bell Telephone Company to restrain the Overland Company from pursuing its telephone operations was refused, in view of the near approach of the trial of the Drawbaugh suit in New York. The result had a depressing influence on the Bell telephone stock, which fell to 145 on a misinterpretation of the decision, but afterwards rallied to 160.

ARTICLES.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

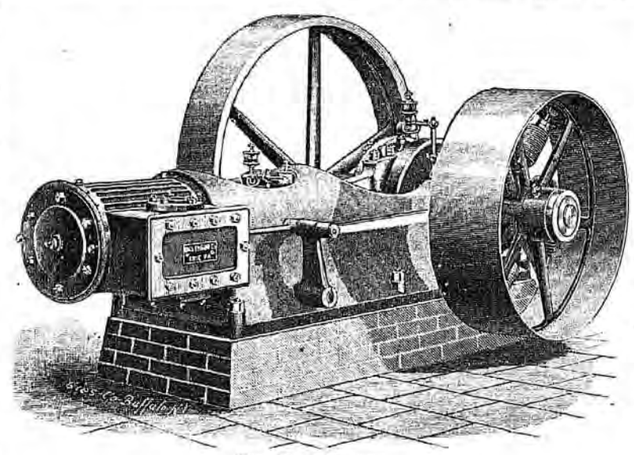
BY ROBERT H. THURSTON.

V.—FAST ENGINES OF PECULIAR DESIGN.

THE BALL ENGINE.

THE forms of steam engine which have been described in the preceding articles have been chosen as being fairly representative of what may be termed standard types of engine as built by makers of reputation. It will be seen that they present to the student of the steam engine several distinct forms of machine, each of which is now acknowledged to be well adapted to produce a certain result in the application of heat energy, through the medium of steam, to the production of power, and that each is especially fitted to do its work under certain definite conditions, which conditions are less completely met by the others. Each is well-known in the market as an engine which has taken its place among those which have passed the experimental stage and may be relied upon to do good work if well built and put in operation under the conditions that it is designed to meet.

They embody ideas and inventions which have grown into form during years of experiment and faithful trial, and the variety of makes to be found in the market belonging to each class, and differing only in the design and construction of details, proves that the main principles upon which each class is based are well established and sound.



THE BALL ENGINE.

The engines now to be examined are distinguished by certain peculiarities of design and construction which mark, in some cases, new departures, in other cases, peculiar ways of reaching the end at which more familiar devices have been aimed.

It has been seen that the regulation of the steam engine has been found to be one of the most important matters to which the attention of the engineer has been called. For many purposes, the uniformity of motion of the engine is an even more important quality than its economy in the use of fuel, or in all running expenses. A slight change of speed in an engine driving dynamo-electric machine will seriously injure the value of the light, in nearly every location, and may sometimes entirely destroy it; a moderate variation of speed in the motor of a cotton mill making fine goods may break more threads in the spinning department, or do more injury in the weaving room, than would be compensated by the difference in economy between the most efficient "automatic" engine ever made and the most wasteful engine in the market. The principle of regulation of the steam engine has been, from the time of the application of the old "fly-ball" governor to the Watt engines of a century ago to the present day, that of making the speed of the engine determine the amount of steam that shall be supplied to it. In the first engines used in the driving of machinery, in the old "Albion Mills" erected by Watt and his partners in London, in 1786, and for 50 years afterwards, the governor adjusted the supply of steam by moving a throttle valve. The governor was next arranged to determine the point of cut-off by Zachariah Allen, of Providence, R. I., in 1834, and by George H. Corliss, in 1849, to adjust the trip of his detachable valve-gear. From this latter date, it has been the universal custom to so apply it in all engines in which uniformity of motion and economy in the expenditure of steam were the controlling considerations in their design. The method of accomplishment of this result has been seen in the preceding pages, as practiced by Corliss and Greene, and by the constructors of positive-motion gears which have been the later outgrowth of modern changes in the application of steam power.

Now, after half a century since the grand step taken by Zachariah Allen has passed, and a generation after that taken by Corliss, a new principle has been introduced into the construction of the steam engine, viz., the control of the speed of the machine, so far as it is due to the varying load, *by that variation of load*, making the cause of the irregularity of motion its own corrective, and placing the regulating principle between the work and the engine in such a way that the latter may be made to preserve any given speed with perfect uniformity, so far as it depends on the load, or causing the speed either to be increased or diminished to any desired extent by any given variation of load.

This idea, like all valuable inventions, has not been the result of a single thought or the product of a single brain; it has been floating in the minds of thoughtful engineers for a long time. It was proposed to the writer by one of the generation of inventors just passed away, years ago; but, in its present form, it became practicable only after the introduction of the high-speed engine had permitted the use of the form of centrifugal governor seen in the engines last described. The engine about to be considered embodies the first practically useful application of this principle, in a practically successful form of engine.

The Ball Automatic Expansion Engine is the invention, so far as it differs essentially from other engines of its class, of Mr. F. H. Ball, of Erie, Pennsylvania. In its general form and in the details of construction, generally, it resembles the last two engines which have been described. It has a single-valve, positive motion valve-gear, and the solid compact structure characteristic of all the so-called high-speed engines. The accompanying illustration will give a correct idea of its form and proportions.

The engine bed is of strong and stiff construction, and very similar to others with which the reader has become familiar. The steam-cylinder is overhung and bolted to a turned flange as in the Porter-Allen engine. The main pillow-blocks are set in the bed of which they form a part, and their caps are placed at an angle with the horizontal plane, as is sometimes done in marine engines, and less frequently in stationary engines. The system of boring the seat for the cylinder, aligning the guides for the cross-head, and boring out shaft-bearings, here adopted, gives perfect alignment; and the preservation of the alignment is insured by this unification of parts formerly detached.

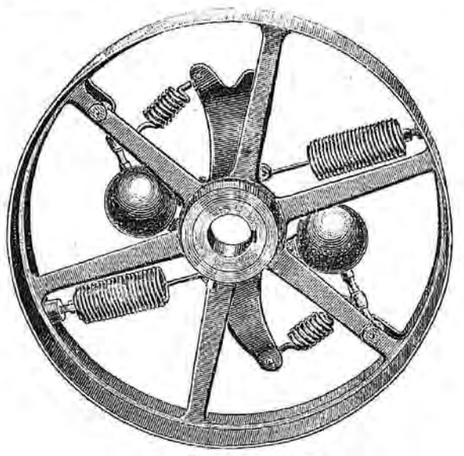
As is the case with all good engines, the fitting parts are made to standard gauge, and a system of inspection insures good work. Packing is dispensed with, and joints are made tight, by securing exactly plane, and perfectly smooth, surfaces, at abutting points. The wearing surfaces of the valves, and other rubbing parts, are scraped to shape and exactness of form, by the aid of surface plates. The valve is made tight under steam-pressure, the form of the valve being such as to permit this rather unusual operation.

The Ball Engine has a short stroke and high speed of rotation, ranging as now built, from 7 to 10 inches diameter of cylinder, 10 to 12 inches stroke of piston, and making 250 to 350 revolutions per minute. These proportions are adopted, probably, principally with a view to meeting the demands of electric lighting.

The essential and most peculiar feature of the Ball engine, and that which gives it a place in this little treatise, is, as has been already stated, its governor.

The Ball Governor is, in the main, like the governors which have been described as controlling the several engines which have been immediately hereinbefore described. It consists of a "governor-pulley," from the arms of which are swung a set of weights, which are arranged to move in the plane transverse to the shaft on which the pulley is carried. These weights, or balls, are restrained from moving outwards, under the influence of centrifugal force, by a set of strong steel helical springs, secured, at one end, to the balls, and at the other, to the rim of the pulley. Any movement of the weights, in either direction, causes a motion of the eccentric, resulting in the alteration of the throw of the valve in such a direction, and to such an extent, as will bring the engine very exactly to speed. To this extent, the Ball governor is identical, in its general construction and in its principles and mode of action, with those already familiar to the reader. To this extent, it is possessed of the same qualities as the others of its class, and it has been such that good workmanship and correct proportions and adjustment may give wonderful nicety of regulation.

To this governor, as commonly built, Mr. Ball adds a remarkably ingenious, and singularly simple yet perfect, invention; it is exhibited in the accompanying figures. The first of these illustrations shows the governor-pulley, detached from its shaft, and does not show the eccentric; it presents only the essentially novel part of the device.



THE BALL GOVERNOR.

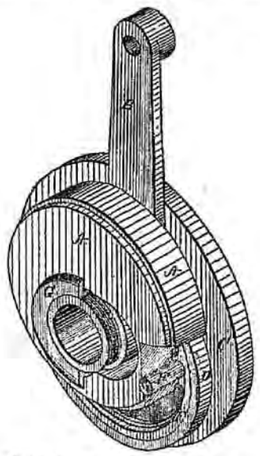
It is seen that, attached to the radius-bar of each ball, is a small spring, connecting a point near the fulcrum of that lever with the extremity of a strong, peculiarly shaped arm, projecting from the hub on the shaft which is seen within the hub of the pulley. The governor-pulley is set loosely on this inner hub, which latter is keyed fast to the shaft. The arrangement is evidently such that, the shaft being turned by the engine, the effort must be transmitted through the small spring to the weight arms, thence to the pulley, and from the latter to the load to be driven, through a belt carried on that pulley. The effect of this curious disposition of parts is easily seen: Suppose the governor to be so adjusted that, at normal speed and under the rated load, the supply of steam and the distribution of that steam, are precisely correct, as intended by the designer of the engine. Now, if a variation of steam-pressure should occur, the governor at once meets the consequent change of speed by a corresponding change of steam-distribution, and the variation of speed is restricted to a range, which, if the governor is well proportioned and well adjusted, may be quite imperceptible to the senses, and hardly measurable by count.

This governor here acts like all the others. But, suppose the steam pressure to be unchanged, and the load to vary—we now have a new movement introduced. The force exerted in driving the load is transmitted through the small springs which are peculiar to this governor, and which connect the main shaft to the driving pulley, through the governor. The instant that any relaxation, or any increased tension, is felt here, the relaxation of the extension of the springs, so produced, causes a change in the position of the weight-arms, and a corresponding alteration in the position of the eccentric; and the steam supply is at once readjusted to meet the variation of load. This may be done so promptly and so exactly, that, however much the load may vary, the speed of the engine remains precisely the same. Load may be thrown on and thrown off to any extent that may be found desirable or necessary, and the engine goes on with its fluctuating task without an instant of visible change. Should both steam-pressure and load vary at the same time, the load-springs set the example of changing the steam distribution to meet the new conditions, and the governor-springs controlling the balls are immediately seen to yield to the effect of the varying steam-pressure, and to continue their motion until the flying weights have set the eccentric in correct adjustment to give the right speed. If the governor is perfectly isochronous, the new adjustment meets the case exactly, and the engine runs at the intended speed as before. The load-springs may even be so adjusted that an increase of load may produce a decrease of speed to any desired extent, or, even more commonly and usefully, so that *an added load may give increased speed*. This latter is done in some cases when driving electric lights, and also in saw-mills, and for other kinds of variable work. In the former case, the engine is adjusted to give standard speed when driving full load, and to reduce its speed as lights are turned off; in the latter, the engine runs at speed while the saw is cutting, and slows down when the work is off.

The next figure shows the eccentric. *A* is the main eccentric having an elongated shaft opening; to this eccentric is attached the arm *B*, of which the onter end is pivoted, allowing the eccentric to swing across the shaft; this motion controls the time during which steam is admitted, each stroke. This swinging motion is controlled by the rotation of the disc, *C*, in the following manner: The disc has a flange, *D*, on its side, which is eccentric to the shaft, and on the inside of this eccentric flange is a ring, *E*, which engages with a stud, *F*, in the main eccentric. Thus the rotation of this disc forward and backward causes the eccentric to swing across the shaft. The disc has a sleeve encircling the shaft and projecting through the elongated shaft opening in the main eccentric, and on the end of the sleeve is a flange nut, *G*, which holds the parts in place. The rotation of the disc is produced and controlled by the governing forces; the centrifugal force of the weights met by suitable springs; and

the resistance of the load equilibriated by the centrifugal force of the weights.

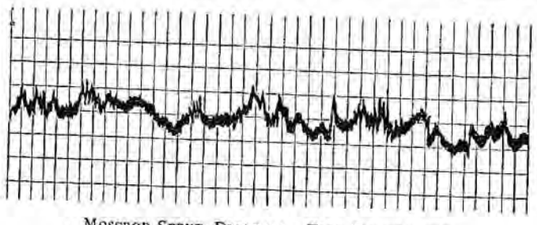
This form of governor is a very safe one, as, should breakage of load-springs occur, the engine slows down or stops. The risk of injury of this kind is unimportant, however, if the springs are properly made, as the load carried by them is insignificant. A 50 h. p. engine, at 300 revolutions per minute, carries a load of but about 500 pounds on each load-spring. If correctly proportionated and made, they should endure indefinitely. The endurance of all these springs is the greater for the periods of rest frequently given them, and for the fact that they are, much of the time, under very uniform tension.



The Ball Eccentric and Connections.

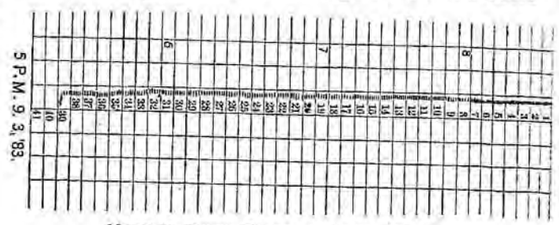
The practical result of this novel modification of old methods of regulating the engine is that the regulation of the steam-engine now can be made to cover more than the simple preservation of a fixed velocity of rotation. It is now possible to determine, within certain limits, not only what degree of variation from normal speed shall be permitted, but also what shall be the normal, and if desired, varying, speed of the machine, with varying load. It may not only be made to run at a certain fixed speed, but may be caused either to increase or diminish the speed, according to a fixed, and economically desirable, law. This new principle will probably find many applications, although such problems have rarely come to the consideration of the designing engineer, hitherto.

The accompanying peculiar diagrams are taken from the recording apparatus of the "Moscrop Indicator," an instrument which automatically and continuously records the speed of the engine and its variations. Each revolution produces a dot, the height of which above the base-line indicates the speed. The first of the two diagrams is



Moscrop Speed Diagram.—Fair Regulation.

from an engine of 250 h. p., fitted with an "automatic cut-off," and furnishing power to a paper mill. It is claimed to do good work; but the writer has no personal knowledge of it. The second is furnished, by the owners of the Ball Engine, as illustrating fairly an equally trying case. The writer has other cards of this kind which, with great variation of steam-pressure, nevertheless are very smooth, although not as smooth as that here reproduced. They are also interesting as showing how useful a record-



Moscrop Speed Diagram.—Ball Engine.

ing speed-indicator may be. Such records are more satisfactory, in comparing speeds of engines, than are even the best of counters, and vastly more satisfactory than counting by the watch, as they exhibit the rate of each revolution, together with the variation of rate for extended periods of time.

This engine, with its novel governor, is one of the most interesting products of mechanical ingenuity that has been seen since the days of Watt. It will probably have little influence on the vitally important matter of steam-engine efficiency, as that term is customarily applied, that is to say, upon the economy of the engine in consumption of steam and of fuel; but it will undoubtedly, in many of its applications, be found to have a very important effect in adapting the engine to its work, and upon its efficiency in that relation.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

No. XII.—ELECTRIC SPARK IGNITION.

PART III—ELECTRIC BLASTING.—*Concluded.*

Spark fuzes are now generally made first of a plug of beech wood well dried, coated carefully on the outside with Japan wax, and grooved upon opposite sides to receive the conducting wires. In order that no accidental strain may displace these wires they are firmly bound to the plug, and in addition secured by being bent half around it in opposite directions in a groove encircling its middle, and then led lengthwise again, so that each wire leaves the plug in the groove opposite to that by which it enters.

The ends of the wires being then cleaned and cut to the proper length, the plug is smeared with glue, and a paper cylinder, contracted at one end to afford a passage for the leading wires, is pushed over it. The large end of the paper cylinder, projecting beyond the plug and the ends of the wires, forms a chamber to receive the priming, which, varying in composition with the class of fuze desired, is next inserted, and covered with a paper cap fixed in position by a drop of collodion.[20] If the priming to be used be like Abel's, a sufficiently good conductor to transmit the discharge, no other bridge is necessary, but if a non-conducting priming, such as a wisp of gun-cotton, be used, a bridge consisting, as in Capt. F. E. Beardsley's fuze, Fig. 95, invented in 1863,[21] of a pencil mark drawn on the wooden plug, or as in Mr. H. J. Smith's fuze, invented in 1867,[22] of a strip of gold leaf glued on the wooden plug, and leading from one terminal wire to the other, must first be made before the priming be inserted.

Over the whole plug thus far constructed, a copper cap called the detonating cap, in the bottom of which 20 grains of fulminate of mercury are placed, is next carefully fitted.

20. Abbott's Report.
21. Ibid; p. 208.
22. Ibid; p. 217.

This charge added to the priming makes usually about 24 grains, which is sufficient to explode any ordinary mine of

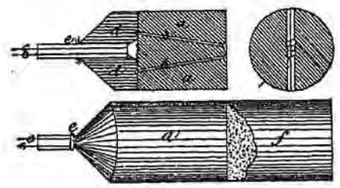


Fig. 95. Capt. Beardsley's Fuze.

dynamite or gunpowder. Thus completed, the fuze is dipped in melted Japan wax, and is thereby given a uniform water-proof coating. This must be very perfect, especially when the fuze is to remain for months under water before being fired.[23]

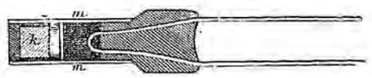


Fig. 96. The Austrian Fuze.

The simple Austrian fuze, Fig. 96, is, however, largely employed in blasting, and a section of a block of steel

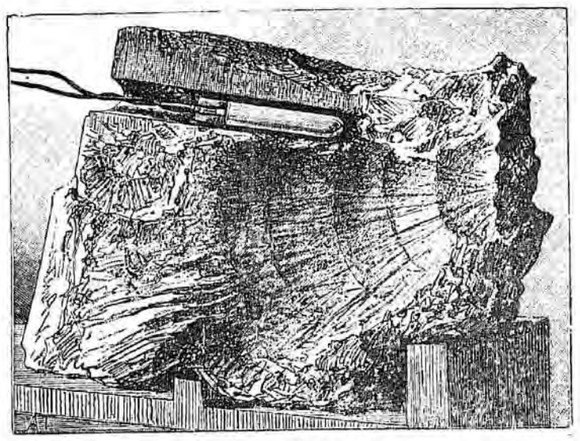


Fig. 97.

separated by a blast, which was exhibited at the Paris Electrical Exhibition in 1881, containing a cartridge ready

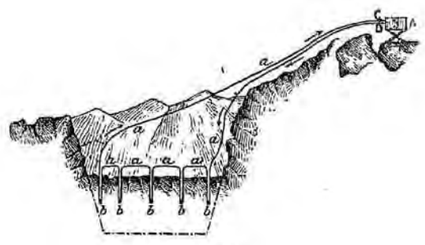


Fig. 98

to be fired by such a fuze, is shown in Fig. 97, while Fig. 98 represents a series of blasts ready for ignition.[24]

23. Abbott's Report.
24. La Lumiere Electrique. 1881.

Several accidents which occurred during an elaborate series of experiments conducted by General Abbott, at Willett's Point, demonstrated that fuzes might be too sensitive, and confirmed the practice of dividing them into three classes, distinguished as high, medium and low tension fuzes.[25] Of these the first two only, technically called "frictional fuzes," are strictly entitled to consideration as *spark fuzes*. So dangerously sensitive are some of the former class that on one occasion several of them hanging from iron nails upon the side of a shed at Willett's Point were exploded by the slight electrical disturbance produced by a passing thunder cloud.[26]

This accident led to a suspicion which a series of experiments has strengthened, that the long accepted theory of spark ignition arising from an elevation of temperature due to the resistance of the combustible matter is not in such cases tenable, but that the ignition is initiated by a subtle molecular disturbance proportional to the quantity of electricity traversing the priming. This being established, it became possible to fix a safety standard of sensibility. The smallest shock sensible to a person is decided to be produced by a charge of 7-10 of a microfarad, and 8-10 of a microfarad is now adopted as the least charge which should cause the ignition of a safe fuze.[27]

The quality of spark or discharge employed is, therefore, a matter of much importance, and since the spark from a Leyden jar, unlike that from a Ruhmkorf coil, will traverse many successive interruptions,[28] such a spark or a discharge of similar quality produced by a friction machine, as Smith's frictional battery,[29] by a magneto-electric machine, as Wheatstone's[30] or Smith's exploder, or by a suitable induction method is preferably employed. The induction spark developed by the opening or closing of a voltaic current through a long well insulated sub-aqueous conductor is curiously, especially qualified to produce the ignition of a "frictional" fuze,[31] and hence, although the use of the "extra current exploder" is restricted by attendant inconveniences, the utmost caution must in all cases be observed in the final adjustment of fuzes, and the leading wires must be kept in contact near the fuze until the last moment to avoid a premature explosion caused by unforeseen electrical disturbances arising from natural causes.[32]

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from Vol. II, page 238.*)

THE PHELPS STOCK PRINTER.

This instrument belongs to the class of step-by-step printers, in which the motive-power is either a spring or weight, the sole function of the electric current being that of regulating the movement of the clock-work train. The instrument requires but one wire to perform all of the varied functions of a stock-quotation printer. It was originally brought out in 1873 as a competitor to the Manhattan Company's printer, already described in these pages, and from its unique design, and various ingeniously contrived devices, warrants the extended description we shall give it.

The general design of the printer is that two type-wheels shall be simultaneously rotated on the same shaft, while a shifting pad is used to print from either type-wheel at will, the type-wheels being driven by a weight or spring, and controlled by alternately positive and negative currents sent over the line wire, a second weight or spring being used to operate the printing, feeding, unison-releasing and

25. Abbott. Ibid; p. 195.
26. Ibid.
27. Ibid; p. 199.
28. Noad. Loc cit.; p. 314.
29. Pat. 1869.
30. Noad. Loc. cit.; p. 310.
31. Faraday. Proc. Roy. Inst. January 20, 1836.
32. Abbott. Loc. cit.

pad-shifting mechanism, the latter power being controlled by a separate magnet placed in the same line wire.

It will be more convenient, and perhaps conducive to a better understanding of the details, to describe the receiving instrument first, and the transmitting apparatus afterward.

It should be first stated that 25 of these printers can be worked on one wire or circuit, and that the length of the line, within the limits of city and suburban telegraphy, to which these instruments are usually applied and for which they were intended, causes no diminution in speed or efficient working. The general construction of the machine is noticeable for lightness of the moving parts, and a high degree of accuracy in fitting of the whole. These characteristics justify the expectation of the high rate of speed in working, which is attained in practice.

The instrument contains three electro-magnets, two called type magnets, having 8 ohms resistance each, and one press magnet of 15 ohms, making a total resistance of 31 ohms. They are best adapted for working with the Calland or gravity battery, using cells having an internal resistance of about 2½ ohms each. The two type magnets are placed in the same horizontal plane, facing each other, and between them is fixed a horse-shoe shaped permanent magnet, which is caused to vibrate from side to side when rapidly reversed currents are sent through the electro-magnets. This polarized armature carries a lever, prolonged downwards to an escapement anchor, whose pallets in moving from side to side, allow the step-by-step rotation of an escape wheel having 14 teeth. This wheel moves by dead-beat through one twenty-eighth part of a revolution, or a distance equal to one-half the space between the apices of two contiguous teeth, at each vibration of the escapement anchor. This escape wheel is on the last axis of a train of clock-work, to which the power of a coiled spring is applied, in a manner to be hereafter described. Two type wheels, placed side by side, are rigidly fixed to the same shaft as the escape wheel, and revolve one twenty-eighth of a revolution for each vibration of the escapement anchor with the latter. The inner wheel, or that nearest to the frame, carries 28 letters and characters, arranged as follows:

. ABODEFGHIJKLMNOPQRSTUVWXYZ

The outer, or figure wheel, carries 28 figures and characters, arranged as follows:

. . 1234567890/CB . 1234567 8 9 0 / S

The letters engraved on the figure wheel are used to indicate abbreviations for the words Cash, Buyer or Bid, and Seller, which are frequently used in printing stock quotations. The inclined dashes are used to separate the numerators of fractions from the denominators.

Two banking pins, driven into the frame of the machine, limit the movement of the escapement anchor. The power which rotates the type wheels, as the escape wheel is released, one tooth at a time, under the influence of positive and negative electrical impulses, sent over the single line wire, originates in a coiled spring placed within a drum, to the periphery of which, one end of a very fine steel pianoforte wire is secured. This wire passes around a spiral groove on the surface of a truncated cone, called a fusee, when the latter is rotated by the winding key. The function of the fusee is to transmit sensibly equable power to the train, no matter whether the spring is fully wound up or nearly run down.

This result is accomplished by the construction of the parts, which are so related, that when the spring is fully wound, the groove of the fusee is all filled by the cord, and the latter is then pulling on the apex of the fusee. The spring is then in the condition of power applied to a lever, in which the power is close to the fulcrum, and the weight at a long distance from it. It is, therefore, so far as "leverage" is concerned, working at a disadvantage. On the other hand, as the spring uncoils, and is nearly "run down," the cord is pulling on the last groove of the spiral on the base of the cone. The spring is then acting like power applied at a great distance from the fulcrum of a lever, while the weight is near the fulcrum, and so far as "leverage" is concerned, it acts at an advantage. That is to say, a smaller power applied through a longer distance, accomplishes the same result as a greater power acting through a shorter distance of movement. If these adjustments are nicely made, the result of the varying power will be the same at all times, since the same conditions of power and leverage must exist at all points on the surface of the fusee cone.

In winding up the spring, the key is applied to the fusee shaft, and all of the wire (called the fusee-cord) is wound up in the spiral groove on its surface, and the spring drum thereby rotated till the spring is wound up. As the spring uncoils when the anchor lets the last wheel escape, the spring-drum revolves in the contrary direction, and unwinds the cord from the fusee, and winds it up again on the spring-drum, thereby rotating the fusee. The fusee has on its base a gear-wheel which forms the first wheel of the train of clock-work, and so gives motion to the whole train. As a matter of fact, the first wheel of the train is not directly attached to the base of the fusee, but is connected to it by a stout spring, the tension of which is exerted against it. The latter is called the maintaining-power spring. Its function is to keep the clock-work in motion while the main-spring is being wound, as without this or an equivalent device, the train, and consequently the type wheels, would stop during the necessary operation of winding, which must often be performed while the instrument is working. This maintaining-power device is known among watch and clock makers as *Harrison's going-barrel*, after the great English chronometer maker who invented it.

The electrical pulsations which allow the escapement-wheel to revolve, also pass through the press magnet of the same machine. They are sent in such rapid succession, however, that they do not affect the latter. The type-magnets are made very short and the press magnet, in comparison, very long. The machines are worked at a speed of 120 revolutions of the type-wheel per minute, and as there are required 28 pulsations to effect one revolution, it follows that there are sent over the wire 3,360 pulsations per minute, or 56 per second. In other words, the type-wheel with 28 characters, revolves twice per second. In order to bring the press-magnet, which is furnished with a neutral soft-iron armature, into operation, the transmitter is so arranged that when the operator depresses a key, the last wave of current sent at the moment the transmitter is stopped, is prolonged and continued as long as the key is held down. This gives the press magnet time to become fully charged and the soft-iron armature is attracted. The same result would take place if the strength of current be very much increased from any cause; as, for instance, if the line wire becomes "grounded" while the pulsations are going over the wire, in which case the press-magnet armature will be attracted at almost every pulsation and nearly all of the letters on the type-wheel will be printed in succession, the number being only limited by the inertia or the freedom of movement in the working parts.

The press train of clock-work is driven by a separate coiled spring acting through another fusee as before described. When the last wave of current sent over the line is sufficiently prolonged the neutral soft-iron armature of the press-magnet is attracted until it touches a stop which prevents it from sticking to the cores. This operation removes a detent attached to the armature lever, from the path of a revolving cam which is placed on the last axis of the press train of clock-work. This shaft makes ¾ of a revolution, when the same cam is stopped by another detent on the press armature lever. When the current ceases, a flat retracting spring pushes the armature away from the magnet, and thus removes the last named detent

from the cam, allowing the latter to accomplish the remaining ¼ revolution, which brings it back against the first-named detent, ready for another movement the next time the press armature is attracted to the magnet. The ¾ revolution of the last axis in the train accomplishes a variety of functions, the stopping of the cam at that portion of its revolution ensuring sufficient time for the proper operation of the parts and stopping the revolution of the train-wheels as soon as these operations are accomplished. The ¼ revolution simply restores the parts to their original position and locks them there, ready to be released again by the next movement of the press armature lever.

The functions performed by the ¾ revolution of the last axis in the press-train are as follows:

First, a pivoted lever receives a sudden, short, downward blow at its upper end. The lower end is thereby tilted up. This end carries a framework containing a horizontally placed transversely sliding pin to which are rigidly fastened side by side the printing pad and a small, deeply grooved wheel. These are both directly under the type-wheels and move at right angles to the plane of rotation of the latter. When the lower end of the lever is tilted up, the pad pushes the paper against one of the type-wheels and at once falls down again. The deeply grooved wheel has the end of a hook always within its groove. This hook is the downward prolongation of an independently pivoted T shaped piece, the pivot being placed at the intersection of the vertical and horizontal lines of the T. The horizontal part of the T is in the path of two pins on the type-wheel shaft. When the operator chooses to print from the letter-wheel only, he rotates the type-wheels until the first of the two dots, called the "letter" dot is opposite the paper, which brings the right-hand extremity of the horizontal part of the T in the path of one of the pins on the type-wheel. That arm of the T piece is thereby depressed and the grooved-wheel and pad, together with the pin to which they are both attached, is slid in its frame, carrying the pad under the letter-wheel. By the time the pad reaches its upward limit of motion, it is in the right position to print from the letter-wheel only. A thin tongue of brass placed between the type-wheels, holds the paper away from them except when one of the margins of the band of paper is pressed upward to take an impression. A reverse movement of the T piece, by impinging on another radial pin on the type-wheel shaft shifts the pad under the figure-wheel.

Second. Another function accomplished by the last axis of the press train in its ¾ revolution is the releasing of the type-wheels when locked at unison, and the raising up of the T-shaped piece just described. (The latter is of course raised every time the press-armature is attracted, but is only operative when the operator has purposely brought one of the radial pins on the type-wheel shaft into its path.) For the above-named purposes a second separate pivoted lever is used. The last axis of the train carries an eccentrically placed pin placed at right angles to the lever and embraced within a slot on its upper and shorter arm. This forms a crank, and when the axis and its pin make a ¾ revolution the lower end of the lever is thrown upward and then down again. This removes the unison arm off the unison stop on the type-wheel shaft, and raises the T-piece as before described.

Third. The last function of the ¾ revolution of the last axis in the press train is the feeding of the paper, which is accomplished by a positive motion in the following manner: The last axis but one in the press train carries a 6-pin Geneva-stop wheel, which gears into a peripherally slotted wheel, with 12 slots, placed on the same axis with a sharp toothed wheel over which the paper passes. The paper is firmly held down on this wheel by a revolving rubber disc pressed down by a flat spring. Of course when the sharp toothed wheel revolves, the paper is both pushed and dragged along by it, as long as the wheel revolves. This rotation is produced by the releasing of the train of clock-work and continues during the whole of the ¾ of a revolution of the last axis.

A disc of felt, slightly wider than the two type-wheels together, rests on and covers both of them, and is pivoted in a frame just above them. This is saturated with ink and serves to ink the type-wheels, rotating with them by the friction of their respective peripheries. An adjustable counterbalance on the ink roller frame allows the inking disc to rest lightly on the type-wheels with sufficient weight to ensure perfect contact with the types, but not enough to add unnecessary weight to the movement of the type-wheels.

The unison device consists of two arms rigidly fixed to the same pivoted shaft, projecting downwards, one on each side of the type-wheels. The shaft slides transversely in a frame, when forced to do so, against the pressure of a spiral spring encircling the shaft, one end of the spring being fastened to the shaft and the other to the frame of the machine. One of the arms rests lightly in a spiral groove or "worm" on the type-wheel shaft, and when the type-wheels revolve this arm travels in these grooves, being thus pushed transversely, until the other arm comes into the path of a pin in the type-wheel shaft and projecting at right angles thereto. When this happens the type-wheels can no longer revolve, the "letter" dot is opposite the paper, and the instrument is said to be "at unison." At this moment also the T-shaped shifting piece is right under and in a line with another pin, previously described, projecting downward from the type-wheel shaft, and is in a position to be tilted by it so as to bring the pad under the letter-wheel. The last described of the two press levers releases the unison-locking device by tripping the unison arm off the unison arm in the type-wheel shaft. This is done by an arm on the second press lever called the "unison tripper." The spiral spring on the unison shaft pushes the latter transversely, so that the arm which travels in the worm is carried back to the first part of the spiral groove. This unison-tripping operation takes place every time the second press lever vibrates, and it is necessary to allow the type-wheels to revolve, without printing, for 2½ or 3 revolutions, to give the unison arm time to travel to the end of the worm, and thus bring its companion arm into the path of the unison pin on the type-wheel shaft.

In order to work these instruments successfully at the rate of speed named, 12 cells of the standard W. U. No. 2 Calland battery per instrument are required, and also the addition of 60 ohms artificial resistance per instrument. Consequently the average circuit of 25 instruments will require 300 No. 2 W. U. Calland cells and 720 ohms artificial resistance. Experience confirms the theory that for such a high rate of speed as 120 revolutions per minute a great many cells of battery will be required in order to obtain a sufficiently high electro-motive force. When the requisite number of standard cells are used, it is found that there is a tendency to charge and operate the printing magnet at every vibration. The quantity of current in circuit is, therefore, reduced by the addition of artificial resistance to the line, which is found more economical and more convenient than the use of a specially constructed cell of higher internal resistance than those now used. Of course, if these instruments were used on long lines, the line wire itself would replace a portion, if not all, of the artificial resistance now required. The lines on which they are actually used in this city are generally 5 miles, and have never exceeded 12 miles in length. They are at present used exclusively on the Cotton and Produce quotation systems. Owing to their delicate mechanism, and the care required in maintaining the current at exactly the proper degree of strength, they require the attention of a careful inspector, equally well skilled in electricity and mechanics. The transmitter used to operate a system of these instruments will be described in a subsequent article.

(To be continued.)

MECHANICAL EXPLANATION OF ELECTRICAL UNITS.

BY F. B. CROCKER AND C. G. CURTIS.

THE purpose of units of magnitude being to serve as mutual standards of comparison, by reference to which ideas of quantative relation may be communicated from one mind to another, it is, to say the least, desirable that each unit should convey the same idea, and be understood in precisely the same sense, by every one who may have occasion to use it. If people do not comprehend the character of the units they have to employ; if they do not appreciate the differences between different kinds of units—whether they signify so much length, or so much volume, so much pressure, or so much work, they will not make a very intelligent use of them. Therefore, whenever any new units are introduced in technical phraseology, it is of the first importance that their meaning should be clearly explained, and the relation between them and former units carefully pointed out.

But how is any one to learn the true meaning of each new unit as it appears? It is often very difficult to do this, on account of a very strongly marked though gradually diminishing tendency among scientists, which does more to complicate physics and retard its progress than any other obstacle against which it has to contend. As an almost general rule, those who are in fact competent to discuss the subject, seem to think it unnecessary to spend time explaining the meaning and application of physical units, or else they consider it beneath their scientific dignity to notice such elementary points. But the ultra-scientific, strictly theoretical, purely mathematical *savant* has a way that he considers far superior to this—whenever it can be employed—and that is, to carefully avoid the possibility of being understood, by expressing his ideas in the fewest possible words, taking care to use none but the most highly conventional words and expressions; so that any ordinary scientific man is compelled to do so much work before he can get at their meaning, that he naturally shrinks from the task, and prefers to wait until he can get his information from some other source. This is a fault that is very easily found with many of the most eminent physicists of the present day. They prefer to digress into side paths of science, which they can develop *ad infinitum*, entirely ignoring what they would themselves acknowledge to be far more important questions, and where they can have full scope to display their profound mathematical skill. The idea that the value of a scientific contribution is anything but proportional to the mathematical intricacy with which the subject is "developed", especially with younger men, but rarely occurs to them. We do not mean to depreciate the value of mathematics to science, when there is any real occasion to resort to it. But when it is done in such a way as to complicate and render unintelligible, things that would otherwise be very plain, just for the sake of expressing such things in mathematical form, it is time to stop. Undoubtedly many of the scientific disquisitions are very able and useful contributions, but many also are not, their authors frequently not having clear ideas of the subject on which they write, and displaying such a degree of ignorance or misapprehension in their treatment of some points, as to destroy all confidence in their treatment of the others.

Before proceeding to speak of the electrical units, let us be sure that our ideas are perfectly clear as to the meaning of the three terms, *force*, *energy* or work, and *power*. For electricity is nothing more than one form of energy, and the sooner we recognize this fact, and consider it in analogy to other forms of force, the sooner shall we be able to make it practically useful, and the more clearly shall we understand it.

In the first place we may consider force as a simple static stress or pressure, equal to so many pounds weight or so many dynes of force, exerted in a given direction without reference to any motion or dynamic effect produced by the force itself. For example, the force due to a weight; the steam pressure upon a piston; the electromagnetic effect of the field upon the armature of an electric motor, etc. All these may be looked upon as simple static effects to distinguish them from dynamic effects. They must be kept entirely distinct from the idea of work or energy. If we suspend a mass of one pound by a string, the force of gravity acting upon the body will produce a static force equal to one pound constantly exerted upon the suspending string, but as long as the weight remains stationary, the force simply continues to act without doing any work, and no energy is consumed. If, however, we sever the supporting string, the force of gravity will overcome the inertia of the body—that is, it will impart a uniformly accelerating motion—and will thereby do work upon and store up energy or living force in the body. But notwithstanding the fact that the body yields to the force, so as to consume energy, gravity still continues to exert upon it a static effect of precisely one pound throughout the entire distance; and this is true however far it may have fallen, and whatever velocity it may have acquired. Hence we may compute the energy stored up in the falling body by multiplying the weight of the body by the vertical height through which it has fallen. When the body has fallen 1 foot, it has absorbed 1 foot-pound of energy; when it has fallen 2 feet, 2 foot-pounds of energy, and so on, the work done being always equal to the static effect multiplied by the distance through which it acts. Now, while the resulting effect of the force is nothing but so many foot-pounds of work, depending upon the height fallen through, yet the static effect, which without motion consumes no energy, can always be separated and treated as entirely distinct from the dynamic effect or work done. This is clearly seen in the case of a steam engine, where the static pressure of the steam upon the piston is measured without regard to the movement of the piston itself, and the dynamic effect or work done is computed by taking the product of this static pressure and the distance traveled through by the piston.

This distinction between force and energy, or static and dynamic effects, lies at the root of all dynamic investigations. It forms the basis of all measurements of energy and power, and a clear appreciation of it in all its aspects is needed before attempting the discussion of such questions. It is just as applicable to electrical measurement as to mechanical measurement or other purposes to which it is commonly applied. Take the case of an electric motor, for example, consisting of an armature revolving in a magnetic field. Here the current which traverses the armature coils develops an attraction (and also, frequently, a repulsion) between these coils and the field, and a static effect proportional to the strength of current is thereby exerted tangentially upon the armature, which tends to cause its rotation. Now this tangential effect or force applied to the armature corresponds in every respect to the steam pressure upon the piston; and so long as the strength of current in the armature remains unchanged, this tangential force will continue to act, no matter how the armature revolves. Consequently, the work done by the motor and the electrical energy thus consumed, may be ascertained by multiplying the tangential effect (which is always capable of being reduced to so many pounds pressure) by the space traversed by the point of application of the force. It is in this sense—in the sense of a static effect—that the term force is properly used.

In the second place, the general term "force" is often used as synonymous with energy, or capacity to do work, equal to so many foot-pounds, or so many ergs of force. We frequently make use of such expressions as "force in the form of heat," "force in the form of electricity," "force in the form of mechanical energy" etc., meaning thereby so much energy in these various forms. As energy is always measured by its capacity to do work, and as work in its strict scientific sense is nothing more than the transformation of one form of energy into another, it is easy to see that the measurement of energy consists simply in finding its equivalent in some other form. Thus we say that a thermal unit can perform 772 foot-pounds of work, which means that if that much heat were converted into mechanical energy, it would be equal to 772 foot-pounds of energy. For convenience we generally refer all other forms of force to foot-pounds of mechanical energy, so that we can speak of a certain amount of electrical energy as so many foot-pounds of electricity, just as we speak of a certain amount of heat in terms of foot-pounds. But the unit of electrical energy has received a name of its own (volt-coulomb) which corresponds with the unit of heat energy, thermal unit; so that we now speak of a volt-coulomb of electricity in just the same sense as a thermal unit of heat. The main point to be borne in mind while considering energy or work in any form, is that the element of *time* has nothing at all to do with it, and to keep it distinct from the idea of *power*. A foot-pound is the same amount of work, whether it is performed in a second or in a year.

In the third place we may take into consideration the element of time in performing work, that is, we may do work at a given *rate*; so many foot-pounds in a minute, or so many ergs per second, and then we arrive at the idea of *power*. Power means simply capacity to do a given amount of work in a given time. The most common unit of power is a horse-power, which is equivalent to 33,000 foot-pounds of work per minute. A horse-power is in no sense a unit of work, any more than a velocity is a unit of distance. It implies simply a rate of working just as a velocity is a rate of moving or traversing distance. When we specify that a certain steam engine is 1 horse-power, we do not mean that it can actually do 33,000 foot-pounds of work, nor that it can work for 1 minute; but we mean that while it does work, it performs it at the rate of 33,000 foot pounds per minute or 550 foot-pounds per second; and this is just as truly a horse-power, whether it is maintained for a second or for a thousand years. It is very common in this connection, to use the word "per" in an improper sense. Correctly used it signifies a *rate*, or a ratio between two quantities—the first divided by the second. This error is well illustrated by such an expression as "one horse-power per second," where it is intended to convey the idea of a certain amount of work—33,000 foot-pounds. The above expression (H. P. per sec.) is equivalent to 33,000 foot-pounds per second *per second*, which is intended to mean that the horse-power *lasts*, or is exerted *for* one second, and that, therefore, 33,000 foot-pounds of work are done. The word per should never be used in such a sense; the expression should be "horse-power for a minute" or "*during* a minute." To say that per is used in this incorrect sense for the sake of brevity is no sufficient excuse.

(To be continued.)

NEW DETERMINATION OF THE OHM.

PREPARATIONS are now being made upon an elaborate scale at the Johns Hopkins University, at Baltimore, under the direction of Prof. Rowland, for the exact determination of the value of the ohm. Two principal methods will be employed. First, the resistance will be found by means of the mechanical equivalent of heat. The apparatus used by Prof. Rowland, in his well-known work on that subject, has been set up for this purpose. It is proposed to heat a non-conducting fluid, such as alcohol or turpentine, by heat developed in a conductor whose extremities are kept at a known difference of potential. The same temperature will then be reproduced under like circumstances by mechanical means. The resistance of the conductor will thus be determined directly from the work equivalent of the heat developed in the conductor.

The second method to be used is that of Kirchoff, as modified by Rowland in his determination of the ohm in 1876, most of the instruments will however be new. If time permits, the earth-inductor method of Weber will also be used. Fifty Plantè cells charged by a small dynamo machine will supply the electricity in the calorimetric method. For measuring large currents, an electrodynamometer has been constructed with the Helmholtz arrangement of 2 large coils and a single small suspended coil.

ABSTRACTS AND EXTRACTS.

IMPROVED CIRCUITS FOR CENTRAL STATION ELECTRIC LIGHTING.

AN improvement has recently been introduced into the Edison system of electric lighting. By the addition of a third main conductor, it is stated that a saving of 62½ per cent. in the amount of copper requisite for the conductors is effected. The E. M. F. ordinarily used in the Edison system has been 110 volts. By placing two dynamos in series, and running a conductor from each of the outside terminals and a third wire from a point between the terminals, the E. M. F. is increased to 220 volts. The Edison lamps, however, are made to burn on a 110-volt current, so that it is necessary to burn two lamps in each series. This would be inconvenient were it not for the third wire, as both would have to be turned on or off at once. By using the third wire, and putting alternate houses in circuit between the 1st and 2nd, and 2nd and 3d wires, each set of lamps may be turned off independently, and the tension of the current in each house can be kept down to 110 volts, and still secure the reduction in the quantity of copper in the mains, and greatly diminish the cost of central station installations.

Edison has also lately introduced in central station plants for general lighting, Ampère meters, by means of which the exact number of lamps in use throughout the town or city is at all times indicated, and the attendant is enabled to keep the proper number of dynamos in circuit to supply the required amount of light. He has also brought into use volt meters, which show the pressure of the current throughout the system in any town, and place it in the power of the employees at the central stations to give a perfectly uniform light.

Improvements have also been made in the methods for locating faults in central station underground plants, a very difficult thing to do, as powerful currents must be constantly kept on the wires in order that the supply of light may not be interfered with. It is claimed that faults have been located within from 5 to 10 feet of the exact spot, resulting in great economy in the practical management of the system. This is accomplished largely by the means of instruments, which indicate the fall of potential. Dynamos are now made up to 1,200-light capacity, and the incandescent lights are now made of 8, 10, 16, 32, 50 and 100 candle power.

THE MAGNETIC POLE.

PROFESSOR Thompson in a recent lecture stated that the magnetic pole is now near Boothia Felix, more than 1,000 miles West of the geographical pole. In 1657 the magnetic pole was due North, it having been East-ward before that. Then it began to move West-ward until 1816, when the maximum was reached. This is now being steadily diminished, and in 1976 it will again point true North. Professor Thompson says that the changes which have been observed not only in the direction but in the strength of the earth's magnetism, show that the same causes which originally magnetized the earth are still at work.

SILICIOUS BRONZE WIRE FOR ELECTRIC LINES.

One of the most important features of the recent Electrical Exhibition at Vienna was the very complete exhibit of silicious bronze wire. Mr. W. H. Preece, chief of the British Post-Office Telegraph service, directed attention to its merits at a public conference, and the administration of French Telegraphs contributed a model of the telephonic system of Rheims furnished with silicious wire. The exhibit was arranged in a very tasteful manner, and was attended by the inventor in person, M. Lazare Weiller, of Angouleme. This wire was also practically used for the various service lines of the exhibition. Each specimen of the different sizes was labeled with a statement embracing particulars of electrical resistance, tensile strength and weight. The comparisons between this wire and others well known in practice, are given in the following table. It will be seen that its tensile strength exceeds that of the best steel used for lines, while its conductivity is nearly equal to that of pure copper:

Description of Wire.	Tensile Strength per Square inch in Tons.	Resistance per Mile in Ohms.	Relative Conductivity.
Pure Copper	17.78	33.1	100
Silicious bronze (telegraph)	28.57	34.5	96
Silicious bronze (telephone)	48.25	103	34
Phosphor-bronze (telephone)	45.71	134	26
Swedish galvanized iron	22.86	216	16
Galvanized Bessemer steel	25.40	249	13
Siemens-Martin steel	26.67	266	12

The market price per pound of the wire is said to be about double that of iron, but taking into consideration its relative superiority in every respect, and the great economy in construction due to its light weight, it appears to be worthy of careful investigation by all interested in electrical construction.

TEN TRANSATLANTIC CABLES.

The first cable, built by the Atlantic Telegraph Company from Ireland to Newfoundland, was completed on Aug. 5, 1858. The second was commenced in 1865 by the Anglo-American Telegraph Company, but it broke when half laid, and was not picked up and completed from Ireland to Newfoundland until the fall of 1866. The third was laid by the same company between the same points, and was also completed in 1866. The fourth was laid by the Societe du Cable Transatlantique, and was completed in 1869 from Brest to St. Pierre and Duxbury. The fifth was laid by the Anglo-American Telegraph Company from Ireland to Newfoundland, and was finished in 1873. The sixth was laid between the same points by the same company, and was finished in 1874. The seventh was laid by the Direct United States Cable Company, and was finished in 1875. The eighth was laid by the Compagnie Francaise du Cable Transatlantique, and was completed in 1879. The ninth and tenth were laid by the American Telegraph and Cable Company, and were finished in 1881 and 1882.—*N. Y. Sun.*

THE COST OF STORED ELECTRICITY.

The following data relating to the cost of electricity for industrial purposes, as produced by accumulators, have been supplied by the new French Electric Light and Power Co.: 1st. The price of one h. p. as supplied by one of these accumulators does not exceed 5*d.*, including current expenses and depreciation. 2nd. In almost all applications in which the accumulators act both as regulators and reservoirs, the price per h. p. per hour does not exceed 4*d.* With these data as standards, it is easy to ascertain the cost of lighting as well as that of dynamical power, and the benefit resulting therefrom.

Lighting.—It has been ascertained that one electric h. p. per hour can supply, for at least one hour, twenty incandescent lamps of 12½ candle-power each, which corresponds to an outlay of one-fifteenth of a farthing per hour and per candle. It is therefore very easy to understand what an immense benefit the consumer must derive from the use of accumulators for lighting purposes.

Distribution of Moving Power.—When accumulators are applied for this purpose, they are taken to the consumer's residence. In this case the cost of one electric h. p. per hour reaches up to 1*s.* It is obvious that this force may be sold again to another consumer for 2*s.*, or about 2½*d.* for one-tenth of a h. p. per hour. This is the average power possessed by a man at his day's work. This price of 2*s.* is sufficiently remunerative for the company, and at the same time it is by no means excessive for smaller trades, seeing that unskilled labor is paid in Paris at the rate of from 4*d.* to 5*d.* per hour.

Traction by Electricity.—The results of experience, as embodied in the reports of engineers, go to show that the cost of traction by electricity, as applied to tramways, is less than 6½*d.* per vehicle and statute mile, whereas traction by horses does not cost less than 1.05 shillings, being a difference of about 4*d.* per vehicle and statute mile in favor of electricity. This represents a saving of 18*s.* 6*d.* per day's work of a tramcar, at an average of 56 miles per day. The last report of the Paris General Omnibus Company shows that in the year 1882 the aggregate number of days during which the tramcars of the company were at work amounted to 91,167, and this figure alone proves conclusively that, in substituting electric traction for horses, a very large amount of profit would be secured, without speaking of other applications—*e.g.*, to railways, stage-coaches and private carriages.—*Ironmonger.*

THE UNDERGROUND PROBLEM.

The following letter from W. C. Behrens, Secretary to the General Committee on Underground Communication in New York, which recently appeared in the London *Times*, is of special interest at present.

"I beg to call your attention to the thoroughness with which the very difficult work undertaken by the General Committee on Underground Electric Communication of this city is being carried out. This committee is composed of twenty-four members, representing (with the sole exception of the Western Union Telegraph Company) all the telegraph, telephone, electric light (arc and incandescent), district messenger, burglar alarm, signal, and time telegraph companies. The problem which it has undertaken to solve is to place all wires of the telephone system, of the several different systems of telegraphic communication, and of the several systems of arc and incandescent electric lighting (systems greatly varying in electromotive force used, and in character and strength of current) in a single conduit or way, and—what is absolutely essential—in a manner so as to be inductively independent of each other, and practically free from retardation. This has never before been attempted. As an example of the necessity of securing freedom from induction and retardation, the telephone may be cited. Being extremely sensitive, it responds to electrical impulses of many thousands in a second, and it is essential that no substantial modification of the electrical impulses shall take place during transmission. As induction varies inversely as the square of the distance, it is evident that the necessary proximity of a large number of telephone, telegraph, and electric light wires in a single underground conduit would very greatly increase the existing annoying interference from induction, not only from the telegraph and electric light wires, but from other telephone wires. With any considerable length of wires comes retardation, due to increased electrical capacity, and, as is well known, an enormous increase of capacity results when an insulated wire is placed underground. Retardation not only delays, but modifies and distorts the signals. The sound produced by the voice must preserve certain and great rapidity of change, and when retardation is so great that signals cannot be transmitted with this necessary rapidity, then said sounds are so imperfectly reproduced as to become partially or wholly unintelligible. The burglar alarm telegraph central office system is based upon the use of a continuous current of constant quantity and intensity, in connection with a delicately constructed galvanometer. Any deflection of its needle, caused by induction destroying the constancy or changing the intensity of the current, gives a false alarm, and thus induction destroys the entire system. The service of the time telegraph, at present employing a metallic circuit, exacts perfectness of operation, and is such that occasional failure of working, except at very long intervals, would be fatal to its usefulness and its existence. Freedom from breakage, leakage, heavy induction, defects in insulation, and ground connection is, therefore, absolutely essential. The particular requirement of the district telegraphs (messenger service) is facility for making connection with every house without disturbing the pavement. Metallic circuits are employed of a length not exceeding one or two miles. These will serve as illustrations. The conduit must be of large capacity and of a practicable form and size in cross-section. If naked wires are employed, moisture must be excluded from them and from all connections. If insulated wires are used, the character of the insulation will determine the necessity of its exclusion. The details of construction must be such as to permit immediate connection or repeated changes with every house or building for all kinds of electrical service, access for repairs and testing, and the laying of additional wires without removal of the pavement. More than 600 patents and devices have been examined, and correspondence with learned societies and individuals throughout the world has resulted in the collection of an immense amount of valuable information. An ideal system is not yet evolved from these investigations, and it will be of the greatest interest to every municipality that all sources of information be placed at the disposal of the committee. Messrs Woodhouse and Rawson have consented to act as agents for the committee in examining and forwarding matter relating to electrical and mechanical devices, and the Hon. Mark Francis Napier, of counsel, may be referred to in matters pertaining to the law."

It is reported that the underground system of Bentley and Knight is favored by Mr. Behrens, as being most nearly adapted to meet the requirements of the New York electrical systems, although it is thought doubtful if the different companies will agree upon the selection of any particular patent.

VENTILATING MINES BY ELECTRICITY.

Siemens and Halske have recently applied the dynamo to the ventilation of the Carola pits in Saxony. Two dynamos of the Siemens No. D 8 type were employed, one being on the pit head, the other coupled to the ventilating fan underground. The armature of the first dynamo is connected direct to the crankshaft of the driving motor, a Dolgoruki rotary piston steam engine giving an available work of 2¼ h. p., with an effective boiler pressure of 3½ atmospheres. The conductor joining the two machines is carried about 2,500 ft., and consists of a copper wire 0.28 in. in diameter, supported on stoneware insulators along the shaft. The return conductor, for part of the way, is an old steel wire pit rope 1.18 in. in diameter, and for the other part a conductor of copper similar to the lead conductor. The second dynamo drives the ventilating fan by a strap, the shaft of the former making 124 revolutions to 100 of the latter. The ventilator is a centrifugal fan about 3 ft. 3 in. in diameter. The loss of power by the circuit from all causes is about 46 per cent. The cost of working is 6*s.* 3*d.* per day, or about 3*d.* per million cubic feet of air delivered.

LITERATURE.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

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CORRESPONDENCE.

NEW YORK AND VICINITY.

From the Western Union to the Baltimore and Ohio.—The Three Great Opposition Companies.—Suits for Infringement.—Pneumatic Tubes.—The Time Telegraph Company.—Consolidation of Telephone Interests.—Electric Lighting for the City.—How an Ambulance is Called.—Underground Fire-alarm Wires.—The Electric Lines Co.

THE future policy of the different telegraph companies has been a theme of general discussion during the present month; the resignation of Assistant General-Manager D. H. Bates of the Western Union Telegraph Company, being a movement which received various interpretations. When it became known that he was to be the general manager of the Baltimore and Ohio telegraph system, the conclusion was immediately jumped at that a working arrangement between the rival companies was on foot, which would eventually develop into a consolidation. It was not thought possible that his intimate relations with General Eckert would be actually severed. He has long been a faithful, earnest, and industrious lieutenant, but has finally yielded to the offer of a more remunerative and untrammeled position, and it is believed will vigorously push the development of the system which he now controls. He well knows what should be done, and where to find the men to carry out his plans; and if properly supported the Baltimore and Ohio will soon become a formidable factor of the triangular opposition now in the field. The Postal Telegraph and Cable Company, with its well equipped lines, will, however, control a vast amount of business should it find a low tariff profitable, by reason of its improved apparatus for increasing the capacity of its wires. A tariff of 25 cents for twenty words between New York and Chicago, should certainly satisfy the public cry for cheap telegraphing. There will be a very general extension of its facilities within three months. Six new wires have been ordered strung to Chicago, and other extensions are also in progress.

The Bankers' and Merchants' Telegraph Company is making rapid strides, by securing control of existing systems as well as building new lines. It has purchased the Lehigh Telegraph line, 300 miles in length, which adds 90 new offices to its list in Eastern Pennsylvania. Savannah and Charleston have already been reached, and the extension to New Orleans is proceeding rapidly, as is also that from Cleveland to Chicago and St. Louis in the West. A thorough trial is being made with the Jones quadruplex, which promises well, and if eventually adopted will largely increase the present facilities of the company. It has secured control of the Commercial Telegram Company in New York, and branch systems for stock quotations are nearly ready for operation in Boston and Philadelphia. The immediate future success of this movement is likely to hinge upon the pending suit brought against the latter company for its alleged infringement of the Calahan patents, owned by the Gold and Stock Telegraph Company. If the "Field" printer now in use is enjoined, others can be devised which will give good service, although it is desirable that the figures and letters be in separate lines upon the printed tape. An alliance has also been formed with the Mutual District Messenger Company, for the collection and delivery of messages. The Western Union Company will strive to cripple this arrangement, by bringing suit against the Mutual District, based on an infringement of that dreadful spectre, known as the Page patent.

A large steam engine is being placed in position in the basement of the Western Union building, to furnish power for operating the pneumatic tube system between the main office and Fifth Avenue Hotel, a distance of nearly three miles. It will replace two quadruplex circuits which are now required for that service.

The recent adoption of standard time has had a good effect in directing the attention of the public to the importance of accuracy in clocks. There is now no excuse for variation, and the Time Telegraph Company was exceedingly fortunate in being prepared to carry out the long cherished idea of an electric time system. By the plan of localizing the distribution to single blocks, governed by a standard clock, the wires are run so securely that interruption is hardly possible. The synchronizing system, by which an ordinary lever clock is set by electricity each hour, seems to insure absolute accuracy, and will no doubt become very generally used.

The absorption of the Law Telegraph Co. by the Metropolitan Telephone and Telegraph Co., will bring the entire telephone service of the city under one management, for the first time in the history of the business.

The meetings of the New York Electrical Society have been very interesting this Winter, and the attendance has increased. The advantages to be derived from such an association should certainly be appreciated at the present day, when the uses of electricity are becoming more and more identified with general business interests. President Small has shown great enterprise and genuine love for the profession, in securing lectures from our scientific men, many of whom do not feel that they can spare the necessary time to devote to preparation, though all express their willingness to assist in this good work.

The recent outcry against electric light wires has diminished considerably, since it has been proved that no greater danger arises from their presence than from various other adjuncts to our business and social life. The city authorities have appropriated $678,816 for street lighting of all kinds during the year. There is a decided feeling in favor of the extension of the use of electricity for this purpose, as it is generally admitted that it is a most efficient aid to the police department in preventing the assemblage of disreputable people, especially in the parks during the Summer. Each arc light displaces six gas lamps in this city, and for a given quantity of light is considerably cheaper.

An effort is being made to introduce a combined telephone and ambulance system in connection with the Police Department. The present arrangement for calling an ambulance is very crude, and liable to cause mistakes and delay. It is merely a makeshift, which answers the purpose because there is nothing better. A call for an ambulance is given to the nearest elevated railway station, where it is telegraphed to either Bleecker Street station on the west, or Houston Street on the east side, and from there repeated to Police Headquarters.

It is probable that some of the Fire-alarm wires will be placed underground in the Spring, and it is understood the lead cable of the Standard Underground Co. will be used for this purpose. Supt. Smith was so well satisfied with his examination of it at Pittsburg, last Fall, that he has recommended it in his report to the Fire Commissioners.

The Electric Lines Co., of 37 Wall Street, held its first annual meeting on January 15. It is said to have been organized for the purpose of furnishing conductors for telephone companies, and it was reported that negotiations were in progress to supply the Metropolitan Company with a trunk line. An officer of the latter company says he knows nothing of such a proposition.

NEW YORK, Jan. 21, 1884.

PHILADELPHIA.

The City Still Granting Privileges for Aerial Lines.—Revenue from the Municipal Pole Tax.—The Telephone Exchange.—Electric Lighting in the State.—The Exhibition Grounds.—University Lectures on Electricity.—New Management of the B. & O. Telegraph Co.

IT may surprise most of your readers to learn that in spite of all the talk of, and preparations made for, a thorough system of electrical underground communication in Philadelphia, the aerial lines are still multiplying very fast. Since my letter of December 18th, City Councils have given authority to the Baxter Overland Telegraph and Telephone Company to run wires over, across and through the streets, provided that they obtain the consent of property-holders to do so, and transmit the Department (Fire and Police) business free of charge. That company is now vigorously at work. The Select Council has also passed an ordinance granting to the Thomson-Houston Electric Light Company the privilege of placing wires on the city's poles. During the same period a sub-committee has reported favorably on an ordinance to permit the "Clay Commercial Telephone Company" to run wires over and across the streets of the city. Here, then, are three new companies granted leave to string aerial wires, and all within one month, notwithstanding all the preparations for placing wires underground, and the vast network of overhead wires already existing in the city. This disposition to be generous to new companies is explained principally by the fact that the city derives a very handsome revenue from their taxation. This fact is demonstrated by the report of the Superintendent of Police and Fire Alarm Department, just issued, which shows that the Department is now almost self-sustaining, having come within $3,000 of paying its expenses last year. Most of this revenue was paid by outside parties for partial use of the city's poles, and while this source of revenue continues aerial lines will remain not altogether unprofitable. In addition to its ordinary receipts from this source the city has also brought suit against the Western Union, Mutual Union and Philadelphia Local Telegraph Companies, and the Bell Telephone Company, to recover the municipal tax of $2.50 per mile of wire and $1 for each pole for the past year. Payment of this tax is, however, resisted by the companies named, on the ground that it is in effect a tax upon inter-State commerce.

In my last letter I made a slight reference to the Bell Telephone Company in this city, of which Mr. George Snyder is Superintendent, but a little more extended notice of the system may be of much interest to your readers. The general office is at Fourth and Chestnut Streets, and there are a number of sub-exchanges throughout the city. There are over 3,000 wires in use, comprising about 3,500 miles of wire within the city limits, with about 3,000 stations. At the main office, Fourth and Chestnut Streets, the average number of calls per day (from 9 A. M. to 7 P. M.) is 15,000. There are 90 operators, 50 inspectors and 50 linemen throughout the whole system. The company is erecting on an average 50 miles of wire per month to meet the growing demands. There are but few pole lines in the system, the great bulk of the wires being carried over the house-tops by means of a complete system of fixture routes, ramifying in all directions.

Winter has put a stop to all underground work in the city.

At Shamokin, Penn., on the 6th inst., the Catholic church was illuminated during evening service for the first time by the electric light. In fact, throughout the interior of Pennsylvania the electric light seems to be gradually superseding the old system of illumination. In Sunbury, for instance, it is reported that the gas people have reduced their price from $3 to 75c. per 1,000 cubic feet, in a desperate effort to recover lost patronage, yet even that great reduction has failed to win back those who came, saw, and were conquered by the electric light.

A site for the International Electrical Exhibition has been leased at 33d and Market Streets, for the nominal sum of $1, and it has been decided to open the Exhibition on September 2d, and close it on October 10th.

As the matter of electrical education has taken up much attention lately, it may not be out of place to refer here to the "University Lectures"—a series of scientific lectures of a high grade given here annually under the auspices of the University of Pennsylvania. The lecturers give their services free, and the pecuniary returns are only expected to balance the expenses for the hall, advertisements, etc. The lecture set down for March 21st will be delivered by Prof. George F. Barker, on "How Electricity is Measured," and should not be missed by any electrician within reach of the city. This course is aimed to rival the lectures of the Royal Society in London, and those of the Lowell Institute in Boston, and, as far as electricians are concerned, must result in increasing the culture, power and usefulness of our profession.

The resignation from the Western Union service of Mr. D. H. Bates, and his acceptance of the Presidency of the B. & O. Telegraph Company, has created much enthusiasm here—his old home—and from all sides there come nothing but good wishes for the youthful magnate. Philadelphians take a particular pride in Mr. Bates, remembering him as the genial and wide-awake Superintendent of the Eighth (now the Sixth) district; and that, too, at an age—23—when most of our young men nowadays have barely got beyond the rudiments of the profession. Next to Mr. Bates, we take particular pride in the restless energy and effective work of Mr. John E. Zeublin, another Philadelphian, by residence at least, who has just resigned the superintendency of the Sixth district (Western Union), to become General Superintendent of the Baltimore and Ohio. Mr. Zeublin proved himself a worthy successor to Mr. Bates in the supervision of this district, and a rival in the esteem of all whose opinions are worth having. Philadelphia has, therefore, some pride in the new telegraphic departure of the Baltimore and Ohio, and if Mr. Bates and Mr. Zeublin are the kind of men whom they seek, they are on the highway to success.

PHILADELPHIA, Jan. 18, 1884.

CHICAGO.

The New Western Union Office.—Impure Battery Chemicals and Their Effect.—Electrical Alarm for Fire Escape.—A New Railway Block System.—New Headquarters for the Municipal Telegraph.—Subterranean Wires.

THE Western Union people are all back again in their old quarters, from which they were so summarily driven last summer by the fire, but the new arrangement of the operating room, far surpassing the old in convenience and comfort, is a just source of pride to all concerned. The present room occupies the entire floor which was in times past cut up by partitions, and included the original battery room, and the local cells room as well. The present space is 100 ft. by 100 ft., well lighted and warmed, and has over 400 operators' tables, as against about 280 before the fire. The switch board capacity has also been increased. The former board embraced 260 terminals, while the present comprises six sections of fifty wires each, with spare room for future growth. One of these sections is devoted to quad wires, and the Metropolitan is found on another. There is a Bunnell spring-jack board with terminals for 200 locals. The wires are brought to the tower—a double-decked structure 12x18 feet—in cables, which fan out to the binding posts of the inclosure made by the several boards. These wires are of Clark's patent, covered with what is claimed to be a fire as well as water-proof insulation, and promise, as far as tested, to render good service in these particulars. The space inclosed by the several boards, directly underneath the tower, is roomy and convenient for inspection and manipulation of the wires and connections. On the floor below many improvements have been made in lunch room, coat room, and other necessary adjuncts to the operating department. Here, too, are the local batteries which formerly cluttered up the floor above, arranged as conveniently as possible, and not in reality any farther away from the tables than before. The officers of the company are more comfortably situated than before, and consequently happier.

The entire pneumatic system has been overhauled and several changes made, all the later improvements being adopted. Each window in the receiver's department has a gate in the tube, and no time is lost in transporting business to the operating room. The down tube from this last has a looking-glass placed at the bottom, by which one can look up the tube to the top of the building. I am aware that this is not new, but it is novel here.

All who have had to do with batteries are aware of the many drawbacks which arise from impure chemicals, mercury, zinc, etc., and the difficulty of locating the fault in an unsatisfactory battery. Much discussion has been indulged in at various times as to the cause of the rapid and uneven consumption of zinc in the telephone batteries hereabouts, and yet, after the most careful selection of the bars, and minute analyses of the metal, nothing was found to indicate the cause of the trouble. A prominent telephone gentleman here finally turned his attention in another direction, and by a few simple chemical tests discovered that the sal ammoniac in use, which was considered commercially pure, by the seller as well as the buyer, contained nearly 7 per cent. of soda sulphate, a salt very destructive in its action, while the battery is at rest, by setting up local currents in the cell; and a trace of iron, sufficient to coat the jar with rust, which, although not detrimental, except in the matter of appearance, would be just as well left out. Other impurities were found, but these are not of a nature to interfere with the efficiency of the cells. A comparative test with two zincs, one in this impure solution, and the other in a better quality of sal ammoniac, showed a wide difference in the lasting qualities of the battery—far more than sufficient to warrant the expense of the better salt.

The extreme low temperature of the past few days, and the usual accompaniment of conflagrations, has drawn attention to the matter of fire escapes and other methods of life-saving apparatus. One of these, which I have lately examined critically, has an electrical attachment, which, though simple, is ingenious. The ladder, each round of which is jointed at the ends, is capable of shutting into a groove, at the side of the building, out of sight. Levers at the various stories are used to throw it out of this groove when needed. When the ladder is closed, a key similar to a door burglar spring opens the contact, which closes when the ladder is opened. From this contact the wire runs to the battery and the alarm bells throughout the house, scattered in the halls of the various floors.

One more block system for double track railways has made its appearance, the invention of a Chicago real estate man. He has a modification of the Gramme ring, horizontally arranged to revolve by means of a field magnet—with its upturned poles on opposite sides of the ring. This field magnet lies, save the poles, directly below, and quite near the ring. The current passes through the field magnet coil, the ring, and to the commutators through the brushes, in direct circuit. At the further extremity of the block section he places his battery, one terminal of which is connected to each rail of the track. At the entering point of the section, he conducts the current from the rails to the binding screws of his machine, which is placed on a post, in full view of the approaching engineer. Above, and on the revolving ring, a frame, consisting of four upright strips of bright metal is erected, which turns with the former. Within this space, and suspended from a sort of umbrella top, hangs a red light. Now, as the engine comes toward the block, the perpendicular strips (like the frame of a street lamp) revolve around the red lantern in their centre, and convert the signal into a species of flash light, by interrupting the rays, provided the block is clear; but the instant the engine strikes the track on that section, it cuts out the lamp by spanning the rails, and the light remains constant until this cut-off is removed. The inventor was offering 10 per cent. of the whole invention, in which he saw millions, to any one who would show him how to successfully operate the apparatus with a moderate amount of gravity battery.

Prof. Barrett, city electrician, is only waiting for a let up in the weather, to commence preparations for removing the fire and police telegraphic apparatus from its present uncomfortable quarters, where they have long been cramped for room, to the spacious offices which have been designated for this purpose, in the new city building. The preparation necessary for this purpose will require some four months' time, while the move proper will be accomplished in a few hours, when all is ready.

The wires from the West Division will be brought to a tower on Chemical Engine No. 1's house, near the Washington Street tunnel. About 300 feet of underground work will debouche at the tunnel, through which the south side will be reached—thence about 1,250 feet more of underground will bring the wires to the new offices.

The wires of the North Division will in like manner be led to an iron pole, at the corner of Lasalle Avenue and Illinois Street, where an underground way will lead these wires, in connection with the tunnel, to the new office.

The south side wires will lead to a similar pole, in front of the

office, and from thence by a sub-way under the building to their places.

These poles of iron are to be hollow, and will conduct the wires out of sight from the last insulator, which will be a great improvement on the former method of leading in.

The conduit to be used will hardly flatter the pride of the thousand and one inventors who have besieged the fire alarm office for the past two or three years. A ditch, a 2-inch plank, creosoted and filled with coal tar, a 9-inch sewer pipe—and that is all there is of mystery in the invention. Put 2½ feet of earth and pavement above it, and the conduit is in general complete.

Man holes will be placed at intervals of 350 feet upon this conduit, which will drain to the street sewer. A horizontal partition will run through the pipe, resting on cross supports of iron. The lower portion of the pipe will contain cables and single wires, the upper will be used for electric light wires to feed incandescent lamps in the man holes, and similar luminaries for the two tunnels.

Ample room has been provided in the new building for the use of the electrical department of the city for fifty years to come. It will be truly a central station, and the aggregation will be the most extensive municipal telegraphic combination in the world, embracing, as it does, the fire alarm, the police alarm, the water works and crib, the Bridewell, the courts and the public school telegraph systems, under one management and control.

The generators for lighting the city building offices, the tunnels and the conduit man holes, will be here; and the alarms will all be struck by dynamic currents, while the same force will be utilized for telephonic calls in the police alarm service. There will be no wires in sight to the casual visitor, as these all lead in from below. Prof. Barrett is justly proud of his future headquarters.

CHICAGO, Jan. 17th, 1884.

BOSTON.

The City Authorities on the Question of Street Illumination.—Electric Light Interests in Canada.—Governor Butler's Telephone Investigations.—Telephone System for a Horse Railway.—Progress of Wiring the Post-office.—The Telephone Exchange seriously Crippled by Fire and Water.—The Domestic Electrical Mfg. Co.

THE annual report of the Boston Lamp Department presents some very interesting facts and figures concerning the use of electric lights in this city, and comparisons with the gas and oil lamps. The aggregate number of public lamps of all kinds is 12,967, an increase of 71 during the past year, the smallest increase in many years. In 1881 several large experimental gas lights were put up by the Boston Gas Light Co., since then others have been added. The expense of these lights, beyond the amount of gas used by the small lamps displaced by them, is borne at present by the gas company. The electric light is spurring the gas interest to produce better lights.

All the electric lights in use for public lighting are placed upon posts, which are an extension of the ordinary gas-lamp posts, so that no additional structures are rendered necessary to encumber the sidewalk other than in the ordinary lighting of the streets. These posts, invented and patented by George H. Allen, are so made that they may be used in case it is deemed expedient to run wires underground, and there are now two lights in Park Square connected in this manner, for the purpose of trying the experiment of underground service.

The laying of underground wires would probably add greatly to the cost of running the circuits.

The result arrived at by the city authorities is as follows:

Gas-lamps each, per annum	$34.61
Oil " " "	14.66
Electric " " "	224.47⅓

The Mayor estimates that one arc lamp will displace 3½ gas-lamps, making the actual comparison: gas, $121.13⅓; electricity, $224.47⅓. This showing is doubtless more favorable to an inferior light, on account of the meanderings of some of the streets, which do not allow full scope to the illuminating power of electricity.

An order was passed by the Board of Aldermen, November 7, 1881, granting to the Thermo and Electric Lighting Company the privilege of testing its system, and a small amount of work was accomplished in the way of laying wire in the streets, but is now apparently abandoned. This method of lighting was in use on a portion of the public lamps in the city of Salem, but is reported to have been discontinued.

Negotiations were closed Jan. 7, at Montreal, P. Q., by which the business, franchises and property of the Thomson & Houston Electric Light Company of Canada are turned over to the American Electric and Illuminating Company of Boston. The company's factory on Dowd Street is completely stocked with machinery and tools, and has a capacity for turning out one dynamo per day, with the accompanying lamps and other apparatus. This transfer carries to the American Electric and Illuminating Company, in addition to the visible property, the ownership of the patents for Canada of the Thomson-Houston system of electric lighting, as well as of all the inventions which Professors Elihu Thomson and E. J. Houston may perfect during the next five years, for the Dominion of Canada.

The American Electric and Illuminating Company have assumed control of the factory and business, and the works will hereafter run to their full capacity. A combination has also been effected with Armington & Sims of Providence, R. I., by which the American company will adopt and use their engines exclusively for their entire business in Canada. The Canadian patents of the Armington & Sims engines will either be merged into the American company's business in Canada, or a separate company will be formed to build the engines.

The *Evening Transcript* gave our late Governor a parting shot, by intimating in its financial column of Dec. 22d, that the telephone syndicate of Lowell had induced him to withhold a veto message which he had prepared to launch against a legislative act supposed to be in the interest of the American Bell Telephone Co. In an interview with a *Herald* representative, Governor Butler admitted that it was his intention to veto the act, but upon examination of the question decided to refrain, not under stress of influence, or consideration for the Forbes family, but because of his tender sympathy for the widows and orphans, whose interests would suffer from depreciation of the stock. A published list of the stockholders does not exhibit any substantial basis for this extreme solicitude for innocent investors.

The original charter granted to the American Bell Telephone Co. by the commonwealth of Massachusetts, restricted its holdings in the stock of any other corporation in the State to 35 per cent. of the stock. The Legislature of 1883 passed a bill abrogating this clause, which was the cause of this tempest in the Boston teapot, and, by the Governor's failure to veto it, has become a law.

The Middlesex Horse Railroad Company has now a complete telephone service connecting, by means of the central exchange, all its offices, stables and shops, so that if a car is now delayed, or there is a breakdown upon the track at any point, the nearest telephone can be used, and the difficulty can be overcome by prompt orders from the superintendent's office.

The Edison Co. are busily engaged in putting in a plant at the Post-office building. They arrange for 500 lights. The acceptance of the apparatus depends upon a test and trial of thirty days' actual use.

Owing to the burning of the wires in the telephone office on Pearl Street, 2 o'clock Friday morning of last week, all central office telephoning was stopped. In the cupola, where the fire started, is a large framework, over which run thousands of insulated wires in every direction. Over this mass of wires the flames ran, burning off the insulating material and leaving the wires bare. In the exchange room, where there are about 40 exchange boards, with all their connections arranged most systematically, the confusion and damage caused by the fire and water is considerable. The exchange boards, which are of the Gilliland type, have been rendered useless in many cases by reason of water; so that, to insure as good service as before the fire, the system will have to be renewed in part. It is hoped to resume operations this week, Tuesday, the 15th.

The Domestic Electrical Manufacturing Company, offices No. 19 Pearl Street, is a new association organized for the manufacture of electrical novelties, their principal article of sale at present being a gas igniter—composed of a handsome cylinder with a nickel-plated rod projecting from one end. The interior of the cylinder contains a chloride of silver battery, and a coil; a switch is arranged to make and break the circuit to produce sparks at the end of the rod. Mr. Boyd, one of the trustees of the company, astonished the writer by showing what appeared to be a glow worm on his neck scarf, but which turned out to be a small electric lamp, connected by concealed wires to a chloride of silver battery in his pocket.

BOSTON, Jan. 14, 1884.

PROVIDENCE.

The Electric Light Rivalry.—The Underground Question.—Telephone Matters.—A New Telegraph Company.—Difficulty in Obtaining Rights of Way.—The Western Union Seeking New Quarters.—A Glimpse of Early Days.—District Telegraph Systems.

THE electric lighting business continues to occupy the attention of the public in a large degree, although the bitterness engendered by the controversy between the American Electric and Illuminating Company and its rival has in a measure subsided. A week or two ago, stories were rife that the Rhode Island Electric Light Co. had made overtures to the new concern, with a view to consolidation. The presence in the city of W. A. Hovey on the day that the story was circulated, gave color to the rumor, but up to this time there has been no confirmation of the report.

The Narragansett Lighting Co. made a fine exhibition January 12th, of their incandescent lights, in the Arcade and the Butler Exchange. The brilliancy and character of the illumination received flattering encomiums. In this rivalry between the two companies, whereby the public is bound to be the gainer, there is arrayed on one side the immense capital and long business experience of ex-Governor Lippitt, President of the Rhode Island company, and on the other the keenness and undoubted energy and ability of Edward H. Goff, of Boston. No one can deny the shrewd generalship by which Mr. Goff made his sortie into the hostile camp and came out victorious. The movement had been carefully handled for some time by the local manager, R. F. Straine, and it reflects no little credit on the business capacity of both gentlemen that they were enabled to gain the right to plant their poles in face of such determined and vigorous opposition. Under the direction of Superintendent Bradford, the work of erecting poles is being rapidly pushed forward.

The city authorities have not yet decided to compel the electric lighting companies to place their wires underground, but it is believed by many that such action is not far distant. In Fall River the Edison wires are so treated, and the city authorities have prohibited the erection of any poles in the public streets in the central portion of the city. The electric light is doing well in Woonsocket, under the able management of Superintendent F. S. Pond.

The telephone is on the boom. It is true that the stock is now quoted as low as $220 a share, but every one will admit that that is a good figure for a stock the par value of which is only $50. For some reason best known to themselves, the directors voted to pass the October dividend. This had a mild quieting effect upon certain stockholders, causing the price to gradually fall off, when a dividend was declared in November.

The stock of the People's Telegraph and Telephone Company, whose salvation is said to rest on the successful issue of the suit in behalf of the Drawbaugh patent, is in the "doldrums," being quoted at $5 a share, while a month ago it was hard to find a holder who would be willing to let his possessions go for less than $10. "Hope deferred maketh the heart sick," and it is this long waiting for the successful termination of a vexatious litigation that has knocked the props out from under the Drawbaugh stock. I am told that the Drawbaugh people did not intend to build, but that when the suit was decided in their favor they would settle with the Bell Company for the modest sum of $5,000,000.

Telegraphic circles in the East are now welcoming the advent of a new-comer in the field, *i. e.*, the Multiplex Company. Robert Brown and W. J. Mowatt have the contract for building the line between Providence and Boston. The poles are to be 35 feet in height, to be placed 35 to the mile, and to carry a two-pin arm, on which is to be strung two number 6 iron wires. They have chosen for the route that occupied by the Bankers' and Merchants' line. On the morning of the 7th instant their gang begun to dig at the Attleboro line, choosing, of course, the best places on the road. It so happens that the Bankers' and Merchants' are building a new line to Boston, and their poles were already on the road; consequently, when the rival company started in, the former company was obliged to protect its right of way, and speedily got ahead of the Multiplex people. Year after year it is becoming more and more difficult to get the right of way through towns and cities. In Connecticut the Bankers' and Merchants' line made its way across private property. This enterprising company is now building a splendid 16 wire line from New York to Boston, and is also reaching out to Fall River. Its service is first class, and it bids fair to become, as indeed it is now, a most formidable opposition to the Western Union.

The Western Union Company has been looking at a new location for its office in Westminster Street, where the rent is $2,600 a year against the $2,800 now paid, the object being, I am told, to have the operating and receiving rooms on one floor. The new location is a very good one, but not to be compared to that occupied at the present time, which is connected with the office of the Providence *Journal*, which takes the news of the Associated Press.

Speaking of the *Journal*, I am reminded that one of the proprietors, Senator Anthony, was an early friend of the telegraph, being one of the owners of the Rhode Island Magnetic Telegraph Co., in 1848, whose lines extended from Providence to Worcester and New Bedford. On this line many of the best known telegraphers in the country served their apprenticeship, among whom were J. W. Lane, William Arnoux, Horatio N. Williams, and others. The line was finally absorbed by the old New England Union Company.

Providence is to really have a lively company for the furnishing of stock quotations. The Financial Telegram Company of New England, using the Field "ticker," intends to shortly begin running their wires, and with the improved facilities at hand, expect to give a service that will effectually dwarf that of the Western Union. The preliminary business has been most skilfully handled by R. F. Straine, one of the directors, and the company will begin business as soon as the wires can be strung. On all sides I hear nothing but good words for the Field instrument.

E. W. Wilson of New York, the President of the Providence District Messenger Company, was in town three days looking after the interests of the concern. His company is taking in about fifteen dollars a day, which of course barely covers the expense of running it. It is Mr. Wilson's wish to obtain the delivery of one or more telegraph companies, but as yet he has been unsuccessful.

In the midst of all these systems for District Service, of which there are now four in the city, I hear of another soon to be started, that will use the box invented by Stephen D. Field, and which will have a respond connected with it. When the Mutual Union Telegraph Company started business in Providence, they had in circuit about 25 boxes, with the respond connection, and they were very satisfactory. No matter how placid may be a man's disposition, he will speedily become ruffled if a district boy fails to answer a call in the minutest and most infinitesimal part of a second, and the fact that he is not certain of the call being received at the main office does not tend to mollify his feelings. In this respect a district box, which will notify the customer that his call has been registered, and that a messenger is on his way with lightning speed, will prove a blessing to humanity.

PROVIDENCE, R. I., January 14, 1884.

WASHINGTON.

Slow Progress of Government Telegraph Schemes.—A Tilt at the Patent Laws.—Investigation Into the Transfer of Telegraph Franchises.—The Brush-Swan Electric Light Co.—Continued Favorable Experiments with Underground Cables.—Extent of the Government Local Telegraph System.—Introduction of the Police Telephone System.

BUT little progress has been made by Congress in the matter of the postal telegraph. On Monday last Senator Hill called up the bill for the purpose of delivering a speech in its support, after which the bill took its usual course, and was referred to the Committee on Post Offices and Post Roads, where it is likely to remain for some time. When reached by the committee the friends and opponents of the measure will be afforded an opportunity to be heard. A searching inquiry into the modes of doing business by the Western Union and other telegraph companies, will doubtless be incidental to the consideration of the postal scheme.

The speech of Senator Hill was elaborate and carefully prepared, giving the history of the British system, and a summary of what had been done in this country in the matter of the telegraph in the United States, with many valuable and interesting statistics. Recognizing the Western Union as the greatest obstacle to the Government telegraph system, he paid special attention to that corporation in a manner not altogether complimentary.

In the House yesterday, while a bill in relation to patents was under consideration, Mr. Anderson, of Kansas, took the ground that the present ability of the Western Union Telegraph Company to throttle its rivals was the result of the power it gained under the privileges originally derived from the ownership of the Morse patents.

To the casual observer it would appear as though Congress was in earnest, and that the postal telegraph system was only a question of time; but when it is known that every member, who thinks it worth asking for, is supplied with books of stamps which will carry his telegraphic correspondence all over the country, and that the favors of the Western Union increase in exact ratio to his influence or opposition to them, the prospect of the adoption of such a measure becomes more obscure.

Gen. Bingham has secured the adoption by the House of his resolution calling upon the Secretary of the Interior for information in relation to the transfer of their telegraph franchises by land grant railroads, and the Auditor of Railroad Accounts is now engaged in preparing a reply.

A. A. Hayes has secured the necessary subscription of $200,000 to the stock of the Brush-Swan Electric Light Co. of Washington. The stock is widely diffused, the number of holders being sixty-one. Owing to a provision in the laws of West Virginia, under which the company propose to organize, a certain time is required to elapse between the full subscription for the stock and the organization of the company. That time expires to-day, and the company will be organized to-morrow. Meanwhile Mr. Hayes, who will be made President of the company, has been going on with the work in his individual capacity. The machinery for the original plant has been ordered, and orders for the introduction of the lights have come in unsolicited, until it has become a question as to which the company when formed can first execute to the best advantage. The Interior Department, and possibly the Post-office Department, will probably be among the earlier installations.

Experiments with the underground cables of the Standard Company of Pittsburg by the General Government and District authorities continue favorable; there are no signs of leakage or other trouble. The cables seem admirably adapted for the short telephone lines, as the earth carries off the induction, even from an air line on which the induction is plainly noticed, before connecting with the underground extension. The District authori-

ties are so well pleased with them that they will only grant an air line privilege on condition of a deposit of money as a guarantee that the beneficiaries will put their whole system underground before next Fall.

A statement was made in your journal, for January, that the Government had 150 miles of telegraph in this District. This was intended probably to cover the Signal Service and Department wires only, as the Fire-alarm and Police Telegraph, with the School, Health Office and other wires, make an aggregate in themselves of nearly 400 miles—exclusive of the 150 miles referred to. These are already partially underground, and the Commissioners propose to bury the others during the present year.

The Gamewell Company are about to equip the Fifth, the most compact and at the same time the most disorderly of the police precincts, with their system of telephone street boxes, so that at various points on his beat an officer can communicate with the station as readily as if there in person. This precinct is equipped as an experiment, but it will almost certainly be ultimately paid for, and the system adopted for the other precincts, which are larger in area, and where the necessity for it, owing to the smallness of the force, is really greater, though the expense of introduction would also be greater.

The claim of the American Bell Telephone Company against the Government for payment of a royalty on all telephones manufactured by the United States Signal Service, in use by the Government, as infringements on the Bell patents, is to be settled by a contract whereby the Government pays the Bell Telephone Company the royalties claimed.

WASHINGTON, D. C., Jan. 18, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents. Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York City.*

MATHEMATICS IN SCIENTIFIC WORKS.

[2.]—I appreciate your remarks about "books" exhibiting the extent and profundity of the author's knowledge "of the higher mathematics."

It is an easy matter for an expert mathematician to elaborate a page or two of mathematical formulæ, from an unscientific proposition, and finish with the trite remark that "figures cannot lie." It is a far more difficult task to spend weeks or months in experimental research, and put the result in clear, concise language. I think the following from Mattieu Williams quite appropos: "There is a method of manufacturing hypotheses which has become rather prevalent of late, especially among mathematicians, who take observed phenomena, and then arbitrarily, and purely from the raw material of their own imagination, construct explanatory atoms, media, and actions, which are shaved and pared; scraped and patched; lengthened and shortened; thickened and narrowed, till they are made to fit the phenomena with mathematical accuracy.

"These laborious creations are then put forth as philosophical truths, and afterwards the accuracy of the fitting to the phenomena is quoted as evidence of the positive reality of the ethers, atoms, undulations, gyrations, collisions, or whatever else the mathematicians may have thus skillfully created and fitted." A.

CHICAGO, Jan. 10, 1884.

QUESTIONS AND ANSWERS.

[2.]—**Electrical Reference and Text Books.**—L. B. J., Jr., of Philadelphia, says: Several young men interested in the study of electrical science, as applied to the electric light, electric motor and telephone, find difficulty in ascertaining which are the most comprehensive text and reference books. A list of the most practical will be of value to them and possibly to others. Ans.—The following list of books will probably serve your purpose, at least to commence with. For general elementary instruction, Tyndall's *Light and Electricity*, $1.25; Thompson's *Electricity and Magnetism*, $1.25; Jenkin's *Electricity and Magnetism*, $1.50. For electric lighting, dynamos and motors, Thompson's *Dynamo-Electric Machinery*, 50 cts.; *Incandescent Electric Lights*, 50 cts.; Dredge's *Electric Illumination*, $7.50. The last-named is a large and finely illustrated volume, containing full descriptions of all the prominent electric generators and electric lighting systems, a historical review of the whole subject, and lists of patents relating thereto. For the telephone, we recommend also Dolbear's *Telephone*, 50 cts., and Lockwood's *Practical Information for Telephonists*, $1.00. These can be ordered from any bookseller, or the publishers of this journal will forward them, post paid, upon receipt of price.

[3.]—**Permanent Magnets.**—E. McN., Jonesport, Maine, asks: 1. What work will give me information on magnetism, methods of making magnets, and the most economical batteries to be used for the purpose? 2. Please give name of a party from whom I can get magnets made to special order. 3. From whom can I get material for making batteries? 4. Which will be the most economical method of obtaining a few magnets of high power for experimental purposes, to order them from manufacturers, or make a battery and manufacture them myself? Ans. 1. We know of no published work giving the necessary directions for manufacturing good permanent magnets; it is to some extent a trade secret. 2. Western Electric Company, 109 Court Street, Boston. 3. From any of the numerous dealers in electrical supplies advertising in our columns. 4. You will save time, trouble and expense, by ordering such magnets as you require from a manufacturer; it will be a very difficult matter to make good ones yourself.

[4.]—**Books on the Telephone and Telegraph.**—J. F. R., Chicago, asks: "What do you consider the best practical work on electricity which includes full details of the telephone, quadruplex and duplex apparatus, etc.?" Ans. Prescott's *Electricity and the Electric Telegraph*, $5.00, contains full information as to the quadruplex and duplex; some additional information is, however, given in the *Telephone, Electric Light and Other Inventions*, by the same author, price, $4.00, which also contains a great deal about the telephone; see also reply to No. 2 above.

[5.]—**Making Cheap Voltaic Battery.**—C. D. B., New York, asks: "Will alcohol serve in place of turpentine to break off the bottom of a bottle, or must the molecules of the liquid be close together?" (Voltaic Battery, Vol. III., No. 25.) Ans. Alcohol will probably not serve the purpose, as it tends to mingle with the water, instead of floating upon it.

[6.]—**Carbons for Electric Light.**—J. W. M., Jr., of Burlington, N. J., asks: "Please inform me how and of what material electric light carbons are made. I wish to make a few for experimental purposes." Ans. Gas retort carbon or graphite is ground fine or pulverized, and mixed with some binding material, such as syrup, tar, or asphaltum, forming a plastic mass, which is forced by hydraulic pressure through a mould or die, in the form of a continuous rod, which is cut into pieces of the desired length. These are then baked for several hours in an oven, being kept at a red heat. Carbons may be bought so cheaply that it is hardly worth while to try to make them yourself.

[7.]—**Lightning Rods.**—T. H. S., of Chicago, sends a circular of a lightning rod agency, and says: "If the statements therein contained are true, it upsets all the present notions concerning lightning rods, and advocates a new departure. What are the opinions of the best electricians on this subject?" Ans. The "new departure" you refer to has been condemned by almost every intelligent and competent electrician in the country. It is based on an absurd hypothesis, and is utterly useless in practice. The best work on the subject is Spang's *Lightning Protection*, $1.50, which contains a full discussion of the case under consideration.

NO COMPROMISE OF THE DRAWBAUGH SUIT.

PARKER C. Chandler, president of the Drawbaugh Telephone Company, has issued a statement formally denying reports that the Drawbaugh people had recently "made overtures to the American Bell Telephone Company for a compromise or sale." He says:

This statement is false from beginning to end. The American Bell Telephone Company and the owners of the Drawbaugh invention have not discussed the question of settlement of the suit between them for three most excellent reasons:

1st. The Drawbaugh side has irrevocably contracted to fight the suit through to a final and speedy conclusion, and there is and can be no power delegated or authorized to stop the legal proceedings.

2d. The settlement of the suit would be of no use to the Bell Company, as several litigants have already set up Drawbaugh's claims to the priority of the invention, and if we did not have the merits of this claim adjudicated on, some one else would.

3d. The company have not the means to make a settlement on the basis of valuation which the Drawbaugh owners place on their claims.

Renewed interest will be devoted to the Drawbaugh suit now that it is being vigorously pushed by new parties. Information regarding its prospects may be obtained at No. 2 Wall Street, New York.

ELECTRICAL NEWS AND NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

Electric Lamps and Regulators.

AT the adjourned meeting of the New York Electrical Society, January 16, Dr. N. S. Keith entertained an attentive audience with an interesting lecture, the subject of which he stated might be properly termed "The Evolution of the Arc Light." He traced its growth from the original discovery of Sir Humphrey Davy, in 1810, down to the present time, illustrating by drawings the fundamental principles of each invention which marked an actual advance in the art. By using a voltaic pile of many thousand couples Sir Humphrey was said to have produced a 9-inch arc from points of charcoal. This was a remarkable result at the time; but with some of the large dynamos of the present day, arcs of 4 feet in length had been produced, although it is doubtful if they could be sustained for any length of time. After experimenting with various materials for many years, it was finally discovered that the most satisfactory carbons were obtained from the coke which accumulates in gas retorts. The first lamp was a simple device for securing the carbons in a fixed position attached to an upright standard, the wires being led directly to each clamp, which was insulated from the upright. It was not until after 1842, when the Grove, and still later the Bunsen galvanic batteries had been introduced, that serious attention was devoted to electric light experiments.

In 1845 Thomas Wright, of England, patented the first arc lamp in which carbon discs were used as electrodes, the arc being established between the nearest points of their respective peripheries. The discs were slowly rotated by clockwork. Subsequently various experimenters devoted their efforts to the invention of an automatic feeding device. In 1852 a lamp was patented in which the lower carbon was pushed upward by a float resting in fluid, it being so adjusted that as the carbon was consumed and its weight diminished, it would rise up. This plan was defective, the upper carbon being consumed more rapidly than the lower, until the arc was finally so lengthened that the light was extinguished.

In 1855 a lamp was produced by Slater and Watson, which seems to have been the first in which the existence of Ohm's law was recognized. This lamp has received considerable attention from our modern inventors, as it embodied the use of a carbon-supporting clamp, which is thought by some investigators to have anticipated those now used. This lamp would form its own arc, and its feed was regulated by magnetism. Henry Chapman, in 1855, introduced a cord and pulley, the motion being controlled by a brake, actuated by magnetism. In 1857 Serrin patented what has since successfully held its place as a standard laboratory lamp, although the mechanism has been considerably improved. This was a focussing lamp, and was the first used by the makers of dynamo machines. Some of them are still used by the English and French governments.

In 1877 J. T. Way invented a lamp in which a fine stream of mercury was rendered incandescent and volatilized by the electric current. The light was surrounded by a glass chimney, to prevent the escape of noxious vapors; but did not protect the inventor, who subsequently died from the effects of salivation. Owing to the expensive methods of producing electricity, experiments in electric lighting received little attention from the public until the introduction of the Jablochkoff candle in 1872. The temporary success of this new departure was principally due to the effective results of the Gramme dynamo machine, which may well be called the foundation of the electric lighting system of the present day. The lamp of Lacassagne and Thiers, 1856, was of special interest as embodying the differential principle of independent regulation applied to each lamp, now so generally used when a number of lamps are arranged in series.

Having pointed out the different stages of development of the arc lamp, the lecturer then turned his attention to some of the best known devices of the present day. He regretted that more attention had not been paid to the æsthetic features of our modern lamps, as he considered it a matter of considerable importance that they should be of a neat and graceful pattern, as well as perfect in operation. Samples of the Brush, Weston, Hochhausen and Wood's lamp, which latter is owned by the Fuller Electrical Company, were then submitted for examination by the audience, after the close of the lecture.

A vote of thanks was tendered to Dr. Keith by the Society, for his courtesy, and at 10 o'clock the meeting adjourned.

THE DAMAGED BOSTON EXCHANGE QUICKLY REPAIRED.

ON the morning of January 12, the formidable work was undertaken of restoring the connections with about 2,000 telephone wires which were destroyed by fire on the previous day. The damage to the switches by water, and the cross connections caused by particles of wet charcoal, and lead which had been melted, added to the manifold difficulties of the task. It was first necessary to remove all the damaged wires between the operating room and the roof. To replace this, Manager Downs ordered 4,000 feet of 50 wire cable and 40 miles covered wire, which was forwarded by Eugene F. Phillips, of Providence, by special messenger on the noon express train. All the available forces of the Boston and surburban exchanges were placed at work, night and day, warm meals being furnished them on the spot. The Brush Electric Light Company furnished 2 arc lamps, so that the repairs were continued without difficulty during the night. All of the electric light companies tendered the assistance of their men if required. The express calls, connecting with 500 customers, were first re-established on Monday Jan. 14, and the entire exchange was ready for operation on Wednesday. The celerity with which the work was done reflects great credit upon all engaged in it, who toiled with enthusiasm until the last joint was covered.

IMPROVED WIRE FOR ELECTRIC LINES.

WIDE attention has been devoted during late years to the production of a wire for aerial lines which should combine in the highest possible degree the important qualifications of strength, lightness, durability and conductivity, as well as of comparative economy. The invention of the well-known compound wire was a step in this direction, but the earlier forms manufactured developed certain defects which, for a time at least, prevented its very general adoption. A hard drawn copper wire has now been placed upon the market, under the trade name of the "Acme bronze wire," which seems to be thoroughly well adapted for the construction of telegraph or telephone aerial lines. The following results of careful tests by a well-known expert, have been kindly furnished us by the Ansonia Brass and Copper Company:

WESTERN UNION TELEGRAPH CO., NEW YORK, Dec. 18, 1883.

A. A. COWLES, Secretary—

DEAR SIR: The following are the results of my test of the "Acme" wire sent me yesterday:

Weight per mile	110.9 lbs.
Resistance, Tp. 75° F.	993.5 "
Weight per mile-ohm	99 per ct.
Conductivity (compared with pure soft copper)	290 to 305 lbs.
Breaking strain	2 to 4 per ct.
Elongation	20.5 to 37.5
Twists in six inches	

Truly yours, (Signed,) GEO. A. HAMILTON.

This wire is said to surpass in tensile strength iron wire of the same cross-section, of the quality now generally stipulated for telegraphic purposes. The price per pound is of course much higher, but on account of its manifest superiority in every particular, especially as to conducting power and durability, it would seem to be really the cheapest wire that can be used.

THE WESTINGHOUSE SAFETY APPARATUS FOR CROSSINGS.

THE crossing of the Philadelphia and Reading and Lehigh Valley railroads, two miles west of Bound Brook, N. J., has been fitted with interlocking signals and derailing switches upon the Westinghouse electro-hydro-pneumatic system, the movements of the switches and signals being effected by compressed air controlled by electricity from the signal cabin. This arrangement allows a train having the right of way to pass the crossing at full speed, during which passage it automatically locks open the derailing switches on the intersecting track, thereby preventing all possibility of collision. The apparatus was erected by the Union Switch and Signal Company of Pittsburg, and went into operation January 6, 1884. This is the first apparatus of the kind ever erected, and has excited much interest among railway men.

THE TELEPHONE CASES.

IT is now stated that it is probable that the same issue which is involved in the suit now pending between the Bell and Drawbaugh companies—that is, the priority of invention of Bell or Drawbaugh—may be passed upon in the suit of the Bell Company vs. the Overland Company, which will be heard at Philadelphia on January 21. In this cause the Overland Company has set up three defenses: First, the prior invention of Drawbaugh; second, the prior invention of Reis; third, the claims of Baxter, whose patents are owned by the Overland Company. The Bell Company has met the Reis and Baxter defenses, but has not yet answered the Drawbaugh defense.—*Boston Advertiser, Jan.* 12.

DOES PROTECTION PROTECT?

A very elaborate lightning-rod, made of woven copper ribbon, with which the spire of Chichester Cathedral, England, was supposed to be protected, was struck by lightning during a thunderstorm Nov. 25th. About 150 feet of it was fused and destroyed, beginning at a point 40 feet from the top of the spire. At the parapet the charge appears to have taken a more desirable route via a leaden gutter and down a stack pipe, which it split into pieces. Possibly this was the "Patent indestructible solid copper tape lightning conductor."

THE ELECTRIC LIGHT IN BOSTON.

In his annual message the Mayor of Boston said: "The number of electric lamps has been largely increased during the past year. The total number now in use is 981, of which 265 were erected in 1883. An electric lamp costs $237.25 per annum; a gas lamp $34. Each electric lamp displaces, on an average, 3½ ordinary street lamps. The demand for the electric light is constantly increasing, and, if it is to be satisfied, the cost of lighting streets, which now amounts to about $500,000 per annum, must be greatly increased, if not actually doubled. The electric light must be regarded as a luxury, and not a necessity. In some localities, notably the public squares or vicinity of railroad stations, it is a desirable thing to have; but I question whether a proper regard for the interests of the city will warrant its general use for street lighting."

TELEPHONIC LITIGATION.

THE motion for a preliminary injunction, brought by the American Bell Telephone Company against the Overland Telephone Company, came up for argument before Judge McKennan, in the United States Circuit Court, at Philadelphia, on January 23. It was argued on behalf of the Bell Company, by E. N. Dickerson of New York, and J. J. Storrow of Boston, and for the Overland Company by Henry Baldwin of Philadelphia, and A. J. Keasbey, United States District Attorney of New Jersey. The Overland Company alleges priority of the invention by Philipp Reis, of Germany, and J. W. McDonough, of Chicago, and also presents part of the proof taken in another case to substantiate the claims of Daniel Drawbaugh, of Pennsylvania.

A WORK INDICATOR.

A USEFUL instrument, which will doubtless become a necessity in certain lines of manufacturing, is being introduced by Blodgett Bros., of Boston. An electrical system is established throughout a factory, which, through the agency of an indicator placed in the office, shows at a glance whether the different looms or machines in the building are in operation.

THE TELEGRAPH.

Domestic.

The conservative farmers of New Jersey are doing all they can to prevent the erection of the lines of the Postal Company, unless their demands for compensation are complied with. The wires will go through in spite of them.

The Rapid Transit Telegraph Company, capital $500,000, recently incorporated at St. Paul, Minn., will connect that city with Chicago, touching Milwaukee, Stillwater and Minneapolis.

The Standard Multiplex Telegraph Company has been incorporated, with a capital of $2,500,000. It proposes to build lines throughout the United States, and put into practical use Mr. Delany's multiplex system.

With the exception of Portland and Bangor, all the Eastern and Mutual Union offices in Maine have been closed.

It is reported that the Baltimore and Ohio telegraph system will be extended throughout the North-west and South-west, and the New England States.

The Lowell District Telegraph Company, the Manchester District Telegraph Company, and the Lawrence District Telegraph Company, were incorporated on January 9, with a capital of $60,000 each.

The Metropolitan Burglar Alarm Company has been organized in New York. Its stock is mainly distributed among those who will be the future patrons of the company, the jewelry interest being largely represented. It is under the management of C. H. Sewall, late Superintendent of the American District Telegraph Company.

Foreign.

A severe gale throughout Great Britain, December 11th, created great havoc among the wires of the Post-office Department.

The French Postmaster General proposes to establish a class of "urgent" telegrams, for which a higher charge will be exacted. Such a system was introduced in Sweden, January 1.

The revenue of the British Government from the telegraph service during the past year was £1,750,000, an increase of £60,000 over 1882.

The post-office and telegraph services in Russia are to be amalgamated upon a plan similar to the German system. A considerable reduction in expenses is anticipated.

The German telegraph engineers have been making very satisfactory tests, with a view to replacing galvanic batteries with dynamo-electric machines.

THE TELEPHONE.

Domestic.

The Mayor of Lowell recommends the establishment of 40 stations in different parts of the city, placed in telephonic communication with the Police Department.

The new telephone wire between New York and Boston, built of No. 12 hard-drawn copper, is nearly ready for use.

Foreign.

All the Government offices and ministries at Alexandria, Egypt, have been placed in telephonic communication, and connection will soon be established with Cairo, 150 miles distant.

It is said that in proportion to its population, Italy makes more use of the telephone than any other country in the world.

The longest telephone line in Germany is from the Berlin Stock Exchange, to Magdeburg, 80 miles. Telephonic communication with Leipsic and Hanover will soon be established.

During the late gales which created great havoc near the Clyde, it was found that nearly all the wires broken were the old ones of iron. The new light-weight wires stood the strain much better.

ELECTRIC LIGHT AND POWER.

Domestic.

Application was made December 14, at the State Department of Pennsylvania, for a charter to the Finney Electric Light Co. of Pittsburg. Capital stock, $25,000.

The Brush-Swan Electric Light Co. of Washington, D. C., was organized Jan. 19. The executive officers will be elected Feb. 2. It is understood that A. A. Hayes will be chosen President, and Mr. Payson, late Assistant Secretary of State, Treasurer.

The Davenport, Iowa, Gas Light Co. has solved the problem of competition with the electric light, by adopting the arc and incandescent systems of the United States Electric Lighting Co. which it is running successfully.

The contract for street illumination in Houston, Texas, has been awarded to the Houston Electric Light and Power Co. using the United States system.

A bill in equity has been filed in Boston by Francis P. Adams and others, against the American Electric Light Co., and Fred'k Grant of New York and others, praying for an account as to the disposition of its stock, and especially as to the transfer of a large quantity to Eugene M. Hersey.

The New Orleans City Council have authorized the Mayor to contract with the Brush Electric Light Co. for lighting Canal Street, from the Custom House to Claiborne Street, for one year at $3,000, not including the public squares.

A movement is on foot at Norwalk, O., to light the town with electricity.

Practical steps have been taken to introduce the electric light into Chelsea, East Boston, and Revere and Crescent beaches at an early day.

The Worcester Electric Lighting Co. has been organized, with a capital of $100,000. T. M. Rogers is President, and C. B. Whiting, Treasurer. It has voted to purchase the 200 light Thomson-Houston plant.

Mayor Donovan of Lowell, Mass., thinks the general introduction of electric lighting will incur a greater expense than would be warranted.

Foreign.

The Lancashire Maxim-Weston Co. (limited) is completing its contract with the Liverpool corporation, and will soon light up the leading thoroughfares. The same company has nearly completed a large central station in Manchester, and will soon have 100 arc and from 1,000 to 2,000 incandescent lamps in operation.

The operations of the Eastern Electric Light and Power Co. in India, have been brought nearly to a standstill by the requirement of the government that their wires should be placed underground. The prospective business does not warrant the expense.

An extensive exhibition of the electrical transmission of power is being organized at the City of Steyr, in Austria. The water power of the river Steyr will be utilized by this agency for various industrial and household purposes.

A telpherage plant is nearly completed at Hitchin, Eng., to make a thorough practical test of the efficiency of this novel system of transportation.

The British Government officials closely observed the operation of the different electric lighting systems at the Fisheries Exhibition, and it is understood gave the preference to the Ferranti.

The Streets Committee of London were to meet on the 25th of January to receive tenders for illuminating certain streets of the city by electricity. The contracting parties will be allowed the privilege of connecting private houses along their routes.

An arc lamp plant has been installed in the shipyard of Swan & Hunter, at Wallsend-on-Tyne.

An electric light plant has been established at Brixton Station, London, using the Clark, Clark & Bowman arc lamp, which gives great satisfaction. Incandescent lamps are also supplied, and a small motor which runs a groceryman's coffee mill.

The endless diversity of uses to which electricity may be put received another illustration recently at the Court Opera at Vienna, where, by the simple expedient of suspending tiny incandescent lamps by fine swinging wires, the effect was produced of swarms of fireflies flitting about a tropical forest. By switches the current is turned off and on at the pleasure of the operator, and the effect, as the artificial fireflies flash and dance in mid-air, is said to have been electrical in other than a literal sense.

SUBTERRANEAN LINES.

Domestic.

A bill has been introduced in the New York State Senate, providing that in all cities of 500,000 or more inhabitants, telegraph wires and cables of all descriptions shall be placed underground before November, 1885.

The Providence Board of Trade passed a resolution January 1st, requesting the city government to compel all electric wires of every description to be placed underground.

A resolution adopted on January 16th, by the New York Board of Fire Commissioners, states that it is the intention of the board to place the wires of the Fire-alarm Telegraph under ground in certain streets. If the Commissioner of Public Works will consent to taking up the pavement, the wires will be buried in Broadway, from South Ferry to 59th Street, and from 42d Street and Broadway, to 12th Avenue, and from 34th Street and Broadway to the East River.

Foreign.

The National Telephone Company has laid down at Birmingham, 500 yards of 2 parallel lines of 3-inch pipe to carry about 64 wires underground in the centre of the town. The cost of the conduit is £500 per mile. If the arrangement proves entirely satisfactory, the overhead wires in most important centres will gradually be transferred to similar pipes.

SUBMARINE CABLES.

It was expected that the Faraday would sail from England, the last week in January, for Dover Bay, whence she will lay the first 500 miles of the Commercial Cable Company's new cable toward Europe. She will then return to Dover Bay and lay the section between Nova Scotia and Cape Ann, Mass. The Faraday is expected to leave England again at the end of May or beginning of June, carrying the remainder of the cable, which will thus complete the first line of communication of the Commercial Cable Company between England and America.

The Mexican concession said to have been obtained in the interests of the Western Union Telegraph Company, for a cable connecting Mexico, the United States and Central America, has been declared forfeited, for non-fulfilment of the terms, no work having been done within the prescribed time.

The probable organization of the American-British and Continental Cable Company is announced, which is to begin operations at the maximum rate of one shilling per word, with an assurance of a reduction as soon as the second cable is laid.

The interruption of telegraphic communication between China and Europe is often due to the mischief of Celestial fishermen or pirates, according to the *Japan Weekly Mail*. These thieves cut the cables to sell the copper and steel wires, and from the mode of their proceedings it is evident that there is a well-planned and skilful organization to execute the robbery, to break the wire into suitable lengths, and to establish regular markets for the sale.

MISCELLANEOUS.

Domestic.

Mayor Reed, of Worcester, promises the people that no more poles for electric wires shall be placed in the streets without due authority. He recommends the reconstruction of the fire-alarm telegraph, and the introduction of the non-interference box.

At the annual meeting of the National Board of Trade, called at Washington, January 23d, the "Postal Telegraph" and "Telephone" are two of the twenty-five subjects to be brought up for discussion.

A bill introduced in the New York State Assembly by Mr. Moore, proposes to tax telegraph and telephone companies 3 per cent. upon their gross earnings.

Ripening and purifying wines and strong liquors is done by the Electric Liquor Company of California, by means of an electric current. By this process the liquor is freed from all its poisonous essential oils, and the work of from three to six years is done in a few hours. Light clarets are treated in three to six hours: brandy requires sixty.

Foreign.

On the occasion of the opening of the Turin Electrical Exhibition, the Italian Government will present a prize of 10,000 francs to the inventor of the most practical process for the generation and transmission of electric power in the form of motive force and light. All nations may participate in the competition.

Electrical arrangements were quite generally used in the recent launching of H. M. S. *Imperieuse*, at Portsmouth, England, on December 18. By pushing a button, water was admitted to the dock floating the vessel; a second button christened the vessel, by shattering a bottle of wine; whilst a third released the hawser, which allowed her to be hauled out of the dock.

MANUFACTURING AND TRADE NOTES.

Domestic.

The wages of the employees of Roebling's Trenton Wire Mills have been reduced an average of 6 per cent.

Pearce & Jones have just completed for the City of Yonkers, an outfit of their patrol and signaling system, which is a very efficient adjunct to a limited police force. The apparatus is exceedingly simple and efficient.

The Jarvis Engineering Co., of Boston, has recently received a contract for fitting up a new station for 100 Thomson-Houston arc lights.

The Armington & Sims Engine Co., of Providence, have recently furnished 3 50 h. p. engines for the Jenney Electric Light and Power Co., Peoria, Ill.; 2 each for the steamer City of Worcester and the Edison Ill. Co., of Newburg, N. Y., and 1 each for Honolulu, H. I., the Brush E. L. Co., Norfolk, Va.; the State Capital Building, Lansing, Mich.; the Electric Light Co., Fall River, Mass., and Markle and Hall, Detroit, Mich. An order for 2 more of their engines has been received for the Edison Pearl Street Station, New York.

The Union Switch and Signal Co., of Pittsburg, has received the highest premiums offered for signal appliances by the National Exposition of Railroad Appliances, in Chicago, for 1883, being 2 gold and 3 silver medals, as follows: Gold medal for best system interlocking yard switches; gold medal for best electric signaling device for block or other signals; silver medal for best signal for railroad crossings; silver medal for best depot signal, and silver medal for best semaphore.

Foreign.

The North Woolwich Telegraph Works Co. having decided to close up business, Secretary G. Fraser has been appointed liquidator.

By order of the High Court of Justice, the works of the Electric Carbon Storage and Apparatus Manufacturing Co. of Scotland, was to have been disposed of at public sale on Dec. 20th.

English wire manufacturers are much exercised over the successful competition of the German wire drawers, and some mills have been obliged to stop. The railway companies are censured for giving too much encouragement in their rates to this awkward development of free trade.

ELECTIONS AND APPOINTMENTS.

At a meeting of the stockholders and directors of the B. and O. Telegraph Co., at Baltimore, January 7th, David H. Bates was elected President and General Manager.

The following Board of Officers has been elected by the directors of the Postal Telegraph and Cable Co.: John W. Mackay, President; George S. Coe, Vice-President; Henry Cummins, 2d Vice-President and General Manager; H. L. Horton, Treasurer; George R. Williamson, Secretary and Auditor; Wm. H. Fairbank, Superintendent of Construction.

The Drawbaugh Telephone and Telegraph Co. has been organized in New York with the following Board of Officers: Parker C. Chandler, President; John R. Bartlett, Vice-President; Lester M. Clark, Secretary.

At the first annual meeting of the New York Electric Lines Co., held in New York, January 16th, Henry A. Gildersleeve, Sidney F. Melbourne, George L. Weed, George S. Hart, Charles Riley, Edward Barr, Silas B. Dutcher, and Herbert C. Whitney, were elected Directors.

At a meeting of the directors of the Commercial Telegram Co., on January 16, the following officers were elected: A. W. Dimock, President; G. S. Mott, 1st Vice-President; John B. Scott, 2d Vice-President; L. E. Shinn, General Manager; J. G. Case, Treasurer; George W. Casper, Secretary. Messrs. Dimock, Mott and Case hold similar offices with the Bankers' and Merchants' Telegraph Company.

George T. Williams, for many years District Superintendent of the Western Union Telegraph Company, located at Cincinnati, O., has been appointed General Manager of the National Telegraph Company, the lines of which extend from New York to Chicago, via the West Shore and "Nickel Plate" Railroads.

The annual meeting of the Gold and Stock Life Insurance Association was held at the Western Union Building January 14. The reports of the Secretary and Treasurer exhibited a satisfactory condition of its affairs. The following board of officers was elected: President, Daniel E. Pike; Vice-President, James E. Hamilton; Treasurer, Carl Winkel; Secretary, Edward T. Fisher. Additional members of the Executive Committee: M. Breslin, C. G. Howard, W. H. Collins, G. E. Scott, A. G. Waring.

PERSONAL MENTION.

Vice-President Joseph P. Davis, of the Metropolitan Telegraph and Telephone Company, while holding the office of City Engineer of Boston, began the work on the sewerage system of that city which has just been completed at an expense of $5,554,272.89. It is said to equal any similar work in the world.

Edward S. Sears, late railroad and electrical news editor of the Boston *Daily Advertiser*, has resigned that position, and accepted the appointment of Assistant General Manager of the American Electric and Illuminating Company.

Parker C. Chandler, of Boston, was in Washington on January 15th, looking after the patent cases of the Drawbaugh Telephone Company, at the Interior Department, and urging a speedy decision as to the priority of the Drawbaugh and Blake telephone patents.

O. H. Booth, one of the oldest telegraph superintendents of the West, died at his home in Mansfield, O., December 31.

FINANCIAL.

NEW YORK, Jan. 21, 1884.

The gathering strength of the opposition companies is doubtless having its effect on Western Union stock, although its weakness is attributed to a lack of confidence on the part of investors in any security which is under the control of Jay Gould. It is reported that he recently bought 30,000 shares to sustain the market. Telephone stocks are likely to remain unsettled until pending suits are decided, which are expected to settle the question of the stability of the Bell patent. The Electric, Manufacturing, and Miscellaneous Stock Exchange is rapidly gaining in importance, having disposed of 270 out of its 300 memberships, and added largely to its list of securities. Our quotations of shares in electrical companies are from this Exchange, with the exception of active stocks, which are listed at the New York Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	176 00	178 00	Molecular	3 00	9 00
Am. Speaking	—	175 00	New England	47 50	—
Bay State	90 00	97 00	N. Y. & N. J.	75 00	—
Boston & N'th'n	90 00	100 00	N. Y. & Penn.	75 00	85 00
Central Am.	115 00	—	Nat. Bell (new)	65 00	90 00
Currier-Tele. Bell	1 00	—	Overland	5 00	—
Columbia & Pan.	19 87	20 00	Peoples	10 00	—
Continental	2 00	15 00	Peoples (N. E.)	1 60	1 55
Dolbear	5 00	10 00	Shaw	10 00	17 00
Erie	37 00	40 00	Solenoid	—	125 00
Granite State	—	85 00	Suburban	100 05	110 00
Globe	1 00	—	Southern Bell	95 00	125 00
Hudson Riv.	60 00	85 00	Southern N. E.	—	175 00
Inter-Cont.	10	15	Tropical	1 40	1 56
Mexican	2 85	—	W. I. Tel. & Telph	1 90	2 00
Mexican Central	1 00	2 00			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	—	65 00	Postal Tel., Ex. stock	44 00	—
Mexican	240 00	245 00	Postal Tel. (new Co.)	4 00	4 50
Postal Tel. (stock)	4 00	4 00	Mutual Union	15 50	16 00
do Bonds with stock	—	—	Western Union	72 37½	73 50

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	4 00	8 00	Edison European	2 00	15 00
Brush	50 00	65 00	Excelsior	—	35 00
Brush Ill.	48 00	65 00	Fuller Elec.	10 00	28 00
Daft	—	80 00	Swan	—	90 00
Edison	160 00	175 00	U. S. Ill.	90 00	95 00
Edison Ill.	—	65 50	do. Electric Light	—	114 00
Edison Isolated	100 00	135 00			

The U. S. Electric Lighting Co. has declared a dividend of 5 per cent., payable Feb. 1.

The Erie Telephone Co.'s net earnings for the quarter ending Dec. 31, were $70,000, being an increase of $3,500 net over the previous three months. After declaring a dividend of 1 per cent., a surplus of $32,000 remains, which, with the previous surplus, amounts to $52,000.

The New York Mutual Telegraph Company has applied to the Stock Exchange to list its capital stock of $2,500,000. This is the old Mutual stock reduced to one quarter of the original amount.

The Cumberland Telephone and Telegraph Co. has declared a quarterly dividend of 1¾ per cent.

The Great Southern Telephone and Telegraph Co. has declared a quarterly dividend of 1½ per cent.

The Brush Electric Light Co., of New England, has declared a dividend of 5 per cent.

The Western Union Telegraph Co. has compromised the claim of the State of Pennsylvania for back taxes, amounting to $147,000, by agreeing to pay $50,000.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope, Edgecomb & Butler, *Solicitors of Patents for Electrical Inventions, 32 Park Place, New York city.*

LEGAL NOTES.

In the U. S. Circuit Court at Philadelphia, Jan. 25, McKennan, J., refused for the present injunction asked for by Am. Bell Telephone Co. against Overland Telephone Co.

A Berlin despatch of Jan. 24 states that the litigation in Germany between Edison and Swan, involving the fundamental patents on incandescent electric lamps, has been decided in favor of Edison. It does not appear, however, that any legal action has yet been taken in the United States by the owners of the Edison patents against the Swan lamp. The Congressional Committee on Patents has reported a bill, under the provisions of which all United States patents will run for 17 years from their date, notwithstanding the fact that a foreign prior patent on the same invention may expire at an earlier date. It is understood that attempts are being made by certain large interests to make this bill retroactive in its provisions; but it is difficult to see how this can legally be done, and it is not very likely that the bill will pass in that shape.

Supreme Court of the United States.—In the case of *Clements* vs. *Odorless Excavating Company*, which was an action brought on a reissued patent, appealed from the Circuit Court, Maryland District, the court held that defendant's apparatus did not infringe either of the two claims of the original patent. Material enlargements of the scope of the invention having been embraced in the reissue apparently with the intent to cover an apparatus like defendant's, the court held the case to be within the principles laid down in *Miller* vs. *Brass Co.* (104 U. S., 350), and that no excuse was given for the delay in applying for the reissue, nor was any accident, inadvertence or mistake shown. The new claims of the reissued patent were therefore held invalid, reversing the decree of the Circuit Court. The date of the original patent was June 6, 1871, and of the reissue, February 29, 1876.

United States Circuit Courts.—*Roberts* vs. *Watley* was a suit for infringement brought in the Northern District of New York for the process of torpedoing oil-wells. Complainant called defendant as his own witness, and after latter had testified that he was engaged in that business, and that he owned patents for the processes used by him, was asked to give the names of the persons for whom he had done work. By advice of counsel he refused to answer. Motion was made to punish him for contempt of court. Coxe, J., held that as he refused to answer under advice of counsel and apparently in good faith, he should not be punished for contempt, and that both validity of the patent and infringement being denied, complainant cannot, as part of his preliminary proof, make defendant disclose names of confidential customers to whom he had furnished articles alleged to be covered by the patent, although he may be required to give the name of one such person. *United States* vs. *Gunning*, Bill filed in Southern District of New York, to vacate letters patent for an invention granted to defendants, upon ground of fraud and false suggestion, alleging that applicant induced the grant by stating in his application that he believed himself the inventor, and did not know or believe it had been in public use or on sale in the United States for more than two years prior to his application, whereas both these statements were false to his knowledge. Defendant demurred, and contended that the United States cannot maintain suit in equity to vacate letters patent for an invention, even although the grant was obtained by fraud, also that in the absence of express statutory authority therefor, no such suit can be maintained. Wallace, J., overruled demurrer, and held that no distinction exists between letters patent for invention and for land as regards rights and remedies for vacating them when obtained by fraud; and that the appropriate remedy in behalf of the United States when a patent for an invention has been obtained by fraud is by a bill in equity.

United States Patent Office.—*Ex parte Finch*. Applicant filed two applications for patents, in one of which a specific device is shown and described but not claimed, while in the other the device is shown, described and claimed, the accompanying drawings being identical. A disclaimer was inserted in the first application referring generally to matters shown therein, but claimed in another application. Commissioner Marble held that this was not sufficient to meet the requirements of Rule 42 of the office, and called upon applicant to specify the particular application by date of filing and serial number. Applicant thereupon appealed to the Secretary of the Interior, who now confirms the decision of the Commissioner, holding that the rule contemplates such a specific reference as will clearly identify the particular application referred to, and this would seem to be best accomplished by stating the date of filing and serial number of the application. *Ex parte Gunson* and *Schumann*. The question arising on this appeal to the Commissioner is as to the sufficiency of the oath accompanying the application. Applicants are residents of Germany, and took and subscribed the oath to their application before a judge of the Royal Prussian Court. Butterworth, Commissioner, held that such oath was not sufficient, and that section 4892, R. S., does not authorize an applicant resident of a foreign country to make oath to his application before any officer other than those designated in said section.

CLASSIFIED LIST OF UNITED STATES PATENTS.

From December 25, 1883, to January 15, 1884 (inclusive).

NOTE—Those dated previous to Dec. 25 were inadvertently omitted from the list in January issue.

Conductors, Insulators, Supports and Systems:—*System of Electrical Generation and Distribution*, M. G. Farmer, Dec. 25, 290,873. *System of Electrical Distribution*, C. S. Bradley, Jan. 1, 291,141. *Underground System*, S. D. Field, Jan. 1, 291,317. *Telegraph Pole*, B. A. Davis, Dec. 25, 290,753. *Attaching Cross-arms*, C. H. Wagner, Jan. 1, 291,435. *Case for Conductors*, H. Edmunds, Jr., Jan. 1, 291,170; T. J. Mayall, Jan. 1, 291,371. *Insulator*, F. L. Pope, Dec. 25, 290,924. *Submarine Conductor*, J. B. Hyde, Dec. 25, 290,881. *Conductor*, P. B. Delany, Dec. 25, 290,753; H. F. Campbell, Dec. 25, 290,853, 290,971. *Underground Conductor*, J. Greives and J. H. Bleco, Jan. 8, 291,715. *Electric Cable*, R. S. Waring, Dec. 18, 290,375; H. F. Campbell, Dec. 25, 290,854. *Conduit for Electric Wires*, N. Randall, Jan. 1, 291,399. *Sectional Compound Conduit*, J. W. Horner, 291,478. *Conduit*, E. T. Starr, Jan. 8, 291,793. *Mechanism for*, H. Howson, Jan. 8, 291,840; D. H. Dorsett, J. E. Morris and B. Williams, Jan. 15, 291,966. *Insulating Compound*, J. B. Hyde, Dec. 11, 290,057, 290,058; J. Greives, Jan. 8, 291,716, 291,717, 291,718. *Apparatus for Covering Conductors*, H. D. Stanley, Jan. 1, 291,239. *Telegraph and Telephone Wire*, G. Gray, Dec. 25, 290,769. *Wire Joint*, C. McIntire, Jan. 1, 291,211. *Conductor for Fire Hose*, C. M. Bowman, Dec. 25, 290,844. *Press for Molding Glass Insulators*, E. J. Murphy, Jan. 1, 291,072.

Alarms and Signals:—*Fire Alarm*, A. T. Brown, Jan. 1, 291,288. *Alarm for Boilers*, H. W. Page and H. Carley, Dec. 11, 290,101. *Annunciators*, A. E. Leitch, Jan. 1, 291,063. *Indicator and Alarm*, W. H. Baker, Jan. 8, 291,483, 291,484.

Storage Batteries:—*Automatic Regulator for*, J. S. Beeman, W. Taylor and F. King, Jan. 1, 291,465. *Plate for*, W. Taylor and F. King, Dec. 18, 290,611. *Electrode for*, E. T. Starr, Dec. 25, 290,943. *Secondary Battery*, E. J. Molera and J. C. Cebrian, Jan. 8, 291,526, Jan. 15, 292,034; E. R. Knowles, Jan. 8, 291,850; C. A. Smith, Jan. 15, 292,142.

Telegraphs:—*Escapement and Unison Mechanism for Printing Telegraph*, S. D. Field, Jan. 8, 291,705. *Quadruplex*, G. Smith, Jan. 1, 291,236. *Duplex*, S. D. Field, Jan. 1, 291,318. *Static Neutralizer*, C. Selden, Jan. 1, 291,096, 291,097.

Commutators:—*Electric Cut-out*, W. H. Thomas, Jan. 15, 291,958; A. L. Bogart, Dec. 25, 290,732.

Ignition:—*Firing Ordnance by Electricity*, A. Bouilly, Dec. 11, 289,965.

Galvanic Batteries:—G. G. L. Velonl, Dec. 18, 290,654; J. L. Tobin, Jan. 1, 291,241; H. J. Brewer, Jan. 15, 291,871. *Electrode for Electric Batteries*, E. T. Starr, Dec. 25, 290,941, 290,942. *Zinc for Batteries*, H. J. Brewer, Jan. 1, 291,286.

Metallurgy:—*Magnetic Apron Cylinder for Ore-separating Machines*, E. B. Hastings, Dec. 11, 290,182. *Process and Apparatus for Obtaining Gold and Silver from their Ores*, M. Body, Jan. 8, 291,670. *Ore Separating Machine*, G. W. L. Carter, Jan. 15, 292,096. *Manufacturing Articles by Deposition on Forms*, W. Wallace, Dec. 25, 290,949.

Lamps:—C. J. Van Depoele, Jan. 8, 291,553, 291,651, 291,653; T. H. Blamires, Jan. 15, 291,867; C. H. Hayes, Jan. 15, 292,113. *Safety Cut-out*, C. J. Van Depoele, Jan. 8, 291,649; *Do. for Series*, 291,652. *Carbon*, W. C. Beckwith, Dec. 25, 290,836. *Bracket*, H. Edmunds, Jr., Jan. 1, 291,171. *Electric Light Lantern*, W. G. Levison, Dec. 4, 289,825. *Circuit Closer*, C. J. Van Depoele, Jan. 8, 291,648. *Insulating Connection for Fixtures*, C. H. Hinds, Jan. 8, 291,731. *Incandescent*, W. Holzer, Dec. 11, 289,837, 289,838. *Support for Filaments*, J. S. Beeman, Jan. 1, 291,464.

Dynamo Machines and Motors:—*Motor*, L. W. Stockwell, Jan. 8, 291,636. *Dynamo*, D. A. Schuyler and A. G. Waterhouse, Jan. 15, 291,944; C. E. Ball, Jan. 15, 291,973; J. Westrom, Jan. 15, 292,079; E. R. Knowles and F. E. Idell, Jan. 15, 292,121. *Exciting Circuit for*, C. Lever, Jan. 1, 291,209. *Regulator for*, C. J. Van Depoele, Jan. 8, 291,554; F. Bain, Jan. 8, 291,595. *Apparatus for Regulating Transmission of Power*, E. Weston, Jan. 1, 291,445. *Current Regulator for Motors*, Jan. 8, 291,650.

Telephone Systems and Apparatus:—*Repeating Circuit*, T. D. Lockwood, Dec. 25, 290,898. *Transmitter*, D. Drawbaugh, Dec. 25, 290,980, Jan. 1, 291,311, 291,312, 291,472; E. Berliner, Jan. 15, 291,866. *Break Key Attachment for Magneto Generators*, J. S. Ross, Dec. 25, 290,709. *Protector for Instruments*, A. A. Connolly, Jan. 1, 291,290. *Mechanical Telephone*, C. Selden, Jan. 1, 291,094. *Telephone*, D. Drawbaugh, Dec. 25, 290,978, 290,979; J. H. Cheever, Jan. 8, 291,684; L. W. Sutton, Jr., Jan. 8, 291,802. *Circuit and Apparatus*, T. D. Lockwood, Jan. 15, 291,915. *Cut-out for Telephone*, A. Williams and J. M. Gannon, Jan. 8, 291,825. *Exchange System*, F. B. Herzog, Jan. 15, 292,115. *Combined Telephone and Burglar Alarm System*, B. F. Dillon, Jan. 1, 291,310. *Switchboard*, H. W. Breckenridge, Dec. 25, 290,845. *Switching Apparatus*, J. V. M. Bartelous, Dec. 25, 290,730. *Sound Muffler for Telephone*, H. Maine, Jan. 15, 292,023.

Time-pieces:—*Circuit Breaker for*, G. B. Webb, Dec. 11, 289,944. *Setting Mechanism*, J. F. Kettell, Dec. 25, 290,894.

Miscellaneous:—*Anti Magnetic Shield for Watches*, C. K. Giles, Dec. 4, 289,642. *Electric Gas Generator*, C. Ball, Jan. 1, 291,403. *Electrical Sheet Stop for Printing Presses*, A. Campbell, Jan. 8, 292,575.

Measurement:—*Meter for Electric Circuits*, P. G. Russell, Jan. 1, 291,405.

Railway Appliances:—*Electric Car Brake*, R. Kample, Dec. 25, 290,689. *Train Signal Apparatus*, C. Selden, Jan. 1, 291,095. *Block Signal*, J. K. Knight, Jan. 1, 291,309. *Railway Signal*, W. Vogel, Jan. 8, 291,556; W. W. Gary, Jan. 8, 291,590; W. Hubben, Jan. 8, 291,721. *Hydraulic and Electric Interlocking Apparatus*, O. Gassett, Jan. 8; Reissue, 10,434, 10,435.

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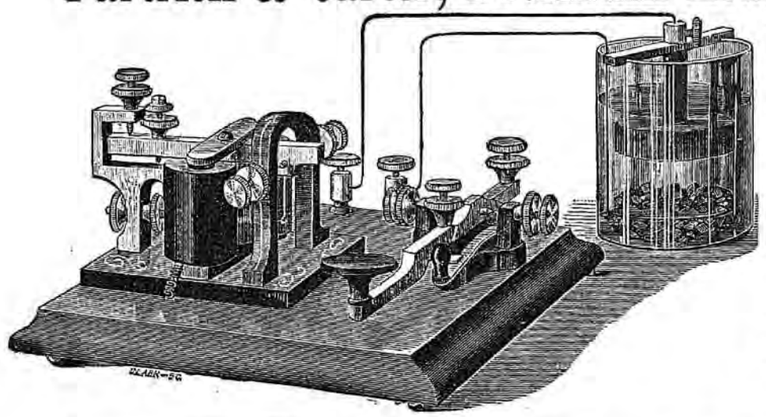

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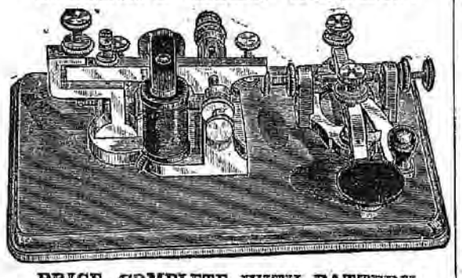

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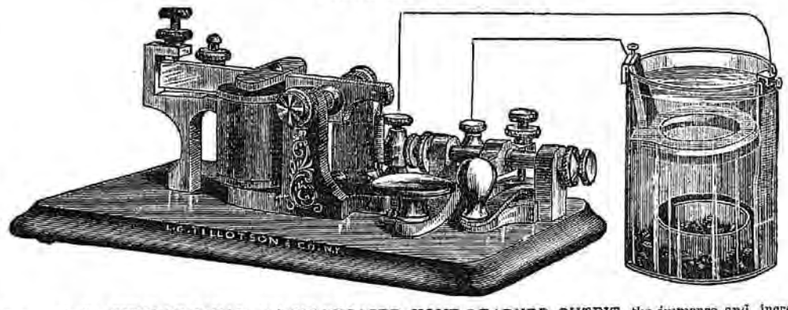

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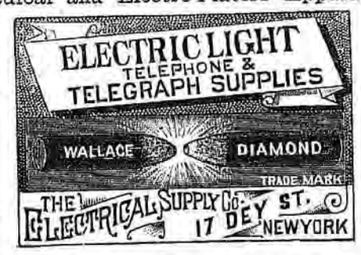

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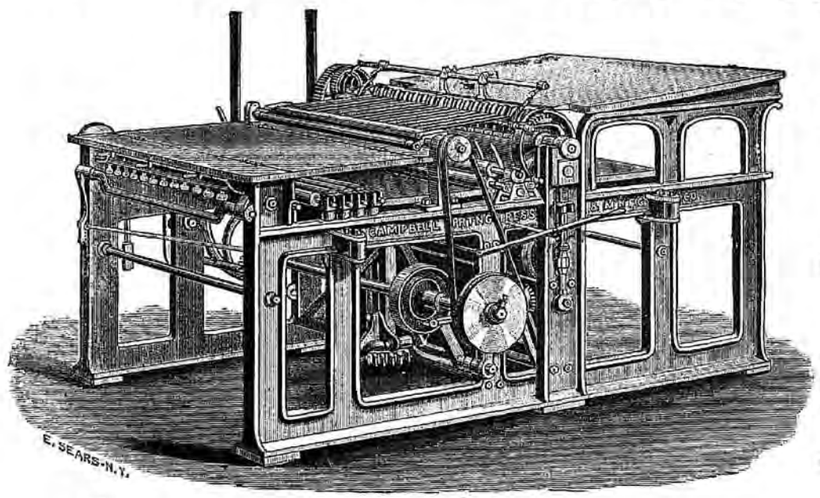

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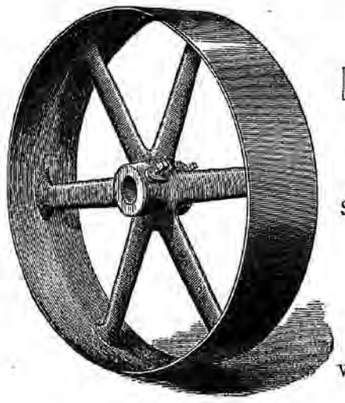

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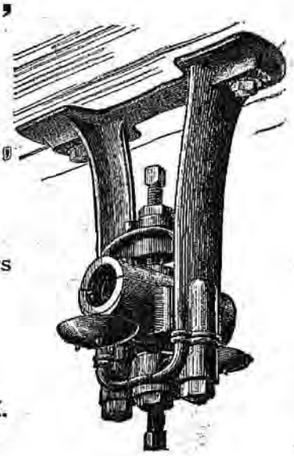

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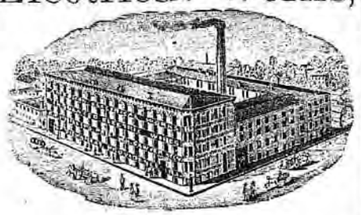

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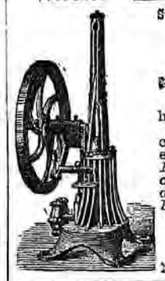

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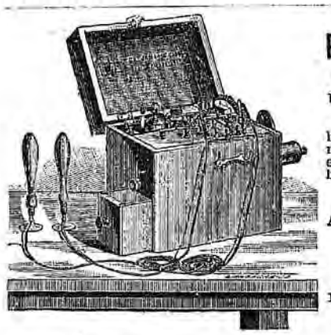

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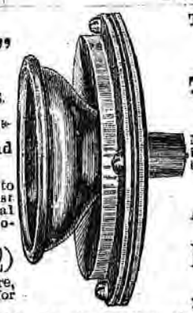

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Conducted by F. L. POPE. R. W. POPE, Associate Editor.

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NEW YORK, MARCH, 1884.

THE TELEGRAPHIC SITUATION.

THE prospective development of rival telegraph systems has never within our remembrance awakened such general interest throughout the country as at the present time. The activity displayed by the different telegraphic organizations in securing new alliances, and extending their present facilities, promises a keen competition for the patronage of the public, which it is to be hoped will, for the time being at least, result in an improved service, as well as the unavoidable reduction in rates. If we can judge anything of the future by the experience of the past, the contest will ultimately result in the usual consolidation, accompanied by a general reduction in the number and pay of the working force and the closing of numerous duplicate offices. The rival interests are in the present instance far more nearly equal in strength than is usually the case, and there is an appearance of earnestness and vigor in their methods which seems to indicate that the competing companies are not based altogether upon speculative efforts, or the prospect of contractors' profits to be derived from line construction. The Western Union Telegraph Company is under the necessity of paying dividends upon its large capital to its stockholders which, at the customary rate, amount to no less than $4,800,000 per annum. In order to accomplish this result the strictest economical measures have prevailed, and in many cases have been carried to such an extreme that necessary repairs have been neglected, and, what is far worse, the loyalty of vast numbers of its employees has been diminished to such a degree that it is probable that their best efforts are not in all cases directed to the enhancement of the interests of the company. The evil effects of such a policy do not immediately appear in the statistics, but they are none the less actual and formidable. The prestige gained by many of the new companies which have sprung up in the past has been the direct and manifest result of the deep personal interest taken by the humblest workers in the service, and their careful attention to their specific duties. An old established company, however, continues to maintain its foothold, by the very inertia of its long existence, by the supposed superiority of its service as a whole, and above all by the very important circumstance of its connection with all telegraphic points large and small, so that it is not necessary for a customer to ascertain before sending his telegram to the office, whether the company has a station at the particular point he desires to reach. If there is a difference in rates, the desire to effect a saving will in many instances influence to some extent the distribution of patronage; but the fact nevertheless, remains, that after a new system of lines has been built and equipped, a vast amount of business must be diverted from the old channels in order to place the new ones on a paying basis.

The Baltimore and Ohio Telegraph Company has entered into the present contest with one advantage never before possessed by any similar organization. Instead of depending upon the precarious financial resources of speculative stockholders, it has the very desirable privilege of drawing upon a comfortable surplus which has been accumulated by the Baltimore and Ohio Railroad Company. So long as the stockholders of the latter company are satisfied with this arrangement, there is certainly no reason why the public should complain, but it would seem to be a somewhat singular disposition to make of funds accumulated in this manner, and presumably for a different purpose. Whatever else may be said, however, the money will at least be used in building telegraphic structures which will be worth what they cost, and hungry line contractors will not find much encouragement in hovering about the Baltimore and Ohio treasury. In manning its lines for business, a decided improvement in the *personnel* of the service has been made under the administration of President Bates, and if anything is to be gained by the policy of acquiring skilled labor, the future of this company will present a very marked improvement upon its past record.

The Bankers' and Merchants' Telegraph Company is also making gigantic strides with the avowed purpose of becoming the leading opposition line, and the enviable record which it has already gained for conscientious attention to business, will make it a most formidable competitor in securing the good will of the business public. A statement of its President has been laid before the Senate Committee assuring that body that it has come to stay; and such is its apparent intention. Although competition of this kind has never failed to receive the approval of the public, as well as the endorsement of the press, it is nevertheless to be regretted that so much energy has hitherto been wasted in the building up of short-lived companies, while, on the other hand, the fluctuating demand for the services of operators and other telegraphic employees has unquestionably been detrimental to their best interests. In the end, the public generally must in some manner make up the losses occasioned by a war of rates. The lapse of time will alone show how long the

future building and subsequent amalgamation of telegraph lines in this country will continue. It seems to be the opinion of most persons who have given particular attention to the question, that the ultimate result will be the establishment of a Government monopoly, in accordance with the experience of other countries. The powerful opposition of wealthy corporations may for a time avert this change of public policy, but their managers will in all probability eventually find that they can drive a better bargain with the Government than with private parties, and a wonderful change of heart will then be manifested by them. But it is not wise to speculate too minutely concerning the distant future. According to present appearances, the immediate future will offer abundant food for conjecture and prophecy.

THE ELECTRIC LIGHT TESTS AT CINCINNATI.

It will be remembered that the commissioners of the industrial exposition which was held in Cincinnati in September and October, 1883, issued a special preliminary circular calling particular attention to the scientific tests and measurements of the comparative efficiency of electrical lighting apparatus and systems which they proposed to make. This circular, which was widely distributed in advance of the exposition, stated that no expense had been spared by the commissioners in securing the services of a jury composed of the best scientific experts in the country, and the promise was also made that in deciding on the best systems of arc and incandescent lighting, the jury would take into account the following factors, viz.: dynamos, lamps, conductors, fixtures, safety devices, regulating apparatus, manner of erection, including cost of operation, number of lamps per horse-power, economy, efficiency, etc., etc.

The jury appointed by the commissioners consisted of Prof. T. C. Mendenhall, Chairman; H. T. Eddy, Thomas French, Jr., and Walter Laidlaw. The measurements and tests of the jury were made before the close of the exposition, and it was considered somewhat remarkable at the time, that the representatives of the different exhibitors were not permitted to be present during all of the measurements. The jury, as the result of their investigations, recommended that the two principal prizes for the best arc and the best incandescent systems, be awarded respectively to the Thomson-Houston Electric Company and the Edison Electric Lighting Company. An award was given to the United States Electric Lighting Company for the best arc dynamo. These recommendations were unaccompanied with any figures or data whatever, an omission which was at the time the subject of much comment in electrical circles.

It will also be remembered that the representatives of the United States Company, being dissatisfied, not only with the results, but with the methods employed, and the general manner in which the tests were conducted, at once filed a protest with the commissioners. These officials, however, apparently paid no attention whatever to the protest, whereupon the United States Company carried the matter into court, and promptly applied for and obtained an injunction restraining the commissioners from delivering the awards in accordance with the recommendations of the jury, and at the same time commenced an action for damages against the commissioners on the ground that they had failed to carry out their implied agreement in accordance with the promises contained in their circular.

This action on the part of the United States Company, was, so far as we are aware, entirely without precedent, and has excited much unfavorable comment, being regarded by many as nothing more than a piece of unusually sharp business practice; and in consequence of this controversy, it is said that the commissioners of the exposition subsequently held at Louisville, declined to admit parties to the electric lighting competition unless they would agree in advance not to take legal action in case they were dissatisfied with the awards. It is presumed that the United States Company declined to accede to these conditions, as we do not learn that they were represented at that exposition.

The legal proceedings at Cincinnati are still in abeyance, the hearing not having been reached at the time of writing; so that the ultimate result is still a matter of conjecture. But in *Science* of February 15, 1884, an anonymous article appears, which nevertheless is apparently of an official character, giving at considerable length the methods and results of the tests made by the Cincinnati jury. We have examined this report with some care, and we are constrained to say that the methods and figures therein given afford the most ample justification for the summary action which was taken by the United States Company. The report apologizes in some measure, it is true, for the shortcomings of the tests, on the ground of lack of time, although the author nevertheless expresses great confidence in the justice of the awards. But this does not alter the fact that the results, as published, are neither consistent with each other, nor with the laws of electricity. They bear on their face the most indisputable evidence of their utterly untrustworthy character. The discretion of the author of the report, whoever he may be, in declining to make himself responsible for its findings by appending his signature, is certainly commendable.

In consequence of the late day at which this paper has reached us, and the lack of available space to discuss the same properly in our present issue, we have been reluctantly compelled to defer the matter until next month, when we propose to give at least a full abstract of this remarkable document, together with an analysis of the methods pursued by the jury in making the tests, and of the extraordinary results which were reached by them; results whose gross inaccuracies are apparent upon the most casual inspection to one familiar with the law of operation of dynamo-electric machines and electric lighting plants, and more especially to one acquainted with the structure and principle of operation of the particular machines and systems upon which the tests were made.

It is sufficient for the present to say, that no check whatever was employed upon the results of the methods of test adopted, and hence the most serious errors appear to have been made and to have remained wholly unsuspected, although the absolute scientific impossibility of some of the conclusions claimed to have been reached, would seem to have been, at least, sufficient to excite suspicion in the mind of an expert of even tolerable ability.

No consideration whatever appears to have been given to the question of safety devices, regulating apparatus, and other practical auxiliaries upon which the economy and efficiency of any system largely depends. We are the more surprised at this, as the Cincinnati exposition has hitherto enjoyed a reputation, which we believe, on the whole, to have been well deserved, of impartiality and thoroughness in the matter of awards of this character.

TELEPHONE EXCHANGE CONSTRUCTION.

So many objections have been raised on account of the annoyances, dangers and interruptions arising from the general use of overhead electric wires, that it would seem to be the part of wisdom to adopt every practicable means of avoiding the necessity of their erection. In the denser portions of our great cities, the placing of additional wires has now become so difficult that the use of aerial cables has frequently been resorted to as the only means of escape from the dilemma.

The degree of success which has attended the adoption of these cables in exceptional cases of this kind, has already convinced some of the best practical telephone experts that the use of cables may with manifest advantage be still farther extended, and the opinion is advanced by persons well qualified to judge that they will eventually prove not only satisfactory in their practical operation, but economical as well, on account of their greater durability. It is the general expectation that all electric wires, at least in cities, will ultimately be placed underground; hence the experimental use of aerial cables will in a measure serve to determine the conditions of construction best adapted for subterranean purposes, though of course all the necessary qualifications might not be found in them. Enough has already been accomplished in this direction to carry the subject fairly beyond the experimental stage, and the resulting facts and figures may, without doubt, be readily obtained by any manager who seriously considers the adoption of cables in preference to separated line wires in telephone exchange work. We shall be pleased to receive from our readers facts derived from their own experience which may throw light upon this subject.

TELEGRAPHIC RIGHTS OF WAY.

The increasing difficulty in obtaining rights of way over railways, highways and private property, has become a very serious obstacle to the erection of new telegraph lines. The mutilation and destruction of shade trees, the disagreeable sounds which emanate from the wires, the incessant demands of workmen to obtain access to them for repairs, and other attendant annoyances, all tend to prejudice the general public against granting any privileges to telegraphic corporations to which they are not entitled by strict construction of law. In many states no telegraph company can legally obtain privileges for line building, even along the public highways, unless the consent of the abutting property-owners is first obtained. In some instances undue advantage is taken by such property-owners of the supposed necessities of the companies, and exorbitant sums are demanded and paid for privileges which would scarcely be entitled to be considered at all, under an appraisal by any fair-minded arbitrator. It has for some time been apparent that telegraph companies must eventually be granted the privilege of condemning land, as is now done in the case of highways and railroads, in order to protect them against these unjust extortions, which are year after year becoming more formidable.

The Supreme Judicial Court of Massachusetts has recently rendered a decision which has a very important bearing upon this question. A bill was brought to enjoin the selectmen of Brookline from granting to the American Rapid Telegraph Company a permit under the statute to construct a line of telegraph on certain highways in Brookline, on the ground that the statute was unconstitutional. The court held that the use of a portion of the highway for the structures of companies formed under the laws of the State for the "transmission of intelligence by electricity," and subject to the supervision of the local authorities, is a public use, similar to that for which the highway was originally taken, and that accordingly the owner of the fee is entitled to no further compensation.

This decision is a just one, and will remove what has often been found a serious obstacle in the way of telegraphic construction, especially in the more thickly settled portions of Massachusetts. Stringent legal protection ought at the same time to be given to the property-owners against the depredations of the vandals employed by the telegraph builders, who often mutilate and destroy valuable ornamental trees, not merely upon the highways, but even within private enclosures. If the telegraph company were made to pay roundly for such trespasses of their employees, means would speedily be found to put an end to them.

THE ECONOMY OF INCANDESCENT LIGHTING.

The practical results of electric lighting are now bringing forth some more substantial statistics regarding the cost than were accessible in the earlier stages of its development.

It seems to be fairly settled that in England, at least, it cannot compete in price with gas, although it is now generally admitted to be so far superior in many respects as an illuminator, that it fairly earns the higher rate at which it must be furnished. The price of 16-candle gas in London —75 cents per 1,000 feet—is so much lower than in this country, that the relative cost of electricity gives it an important advantage here, where the price to the consumer varies from $1.75 to $3.50 per 1,000 feet, the actual cost being in some places as low as 95 cents.

The cost of the electric light is also somewhat greater here than in England, which is due to the higher prices paid for steam coal, as well as for the labor and material which enter into the construction and operation of a plant.

Perhaps the most advantageous field for incandescent lighting, and the one which is now being rapidly developed, is that of steamer illumination, for which there has heretofore been no really satisfactory light. The steaming capacity of marine boilers is so great, that the comparatively small amount of additional power required for the generators is hardly perceptible, while the mechanical skill necessary to keep the machinery in good working order is always available.

ARTICLES.

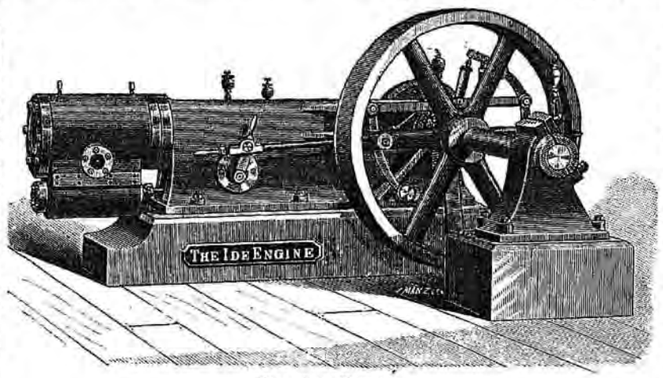
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

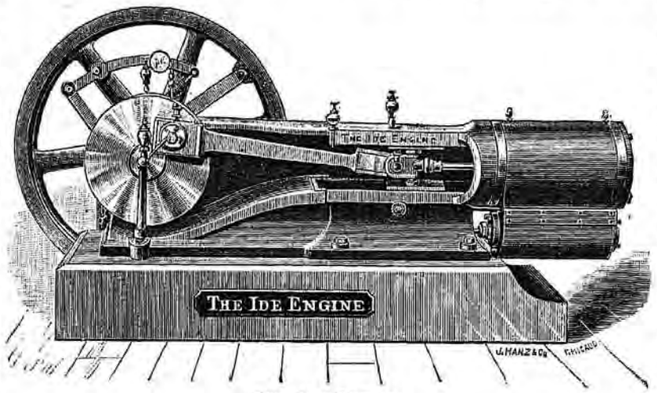
V.—SPECIAL FORMS—(*Continued*).

THE IDE ENGINE.

THE engines which have been described are by no means the only engines which are deserving of mention, and of careful study, as illustrating the peculiarities of the best modern practice in the field which it has been the object of the writer to explore. A number of other engines, of one or another of the classes which have been described and illustrated in the preceding articles, have nearly or quite equal claims for consideration. Of these engines, only typical or representative examples have been sought, and have been selected from the machines with which the writer is most familiar. One more engine may be here described—not as possessing the singular novelties of design which distinguish some of those already examined, but as affording a good illustration of the principles and practice which have come to be recognized as distinctive of the latest phase of that progress, which has recently been so rapid, in the direction of improved methods of construction, as well as of design, and in the application of the modern materials of construction. The engine is one with which the writer cannot claim that personal familiarity which has led, in some cases, to the selection of those which have been previously considered; but a description, such as is to be here given, will show that it may fairly be taken as a representative of the best practice, in matters of detail, which it is the special object of the writer now to exhibit.



THE IDE ENGINE.



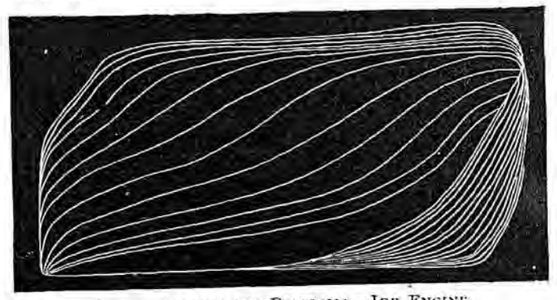
THE IDE ENGINE.

The Ide Engine is of the same class with all the engines described in the preceding section—a high-speed engine, intended to be driven up to high power and to occupy small compass; to regulate with all the accuracy desired in electric lighting, and in the spinning of fine cotton; to have good wearing qualities, and to be economical in its use of steam and of fuel. The above illustrations exhibit its general form, and the more important details of the machine. Examining it in some detail, it will be observed that the frame, although of novel design, is of the same general form with those which have been already described in this class, possessing that solidity and rigidity that have been seen to be an essential feature of all successful high-speed engines. The main pillow-blocks are formed in the frame; and the cylinder is secured at the opposite end, overhanging as in cases already familiar to the reader. The crank-pin is set in a disc, which permits counterbalancing, and gives great strength. The connecting-rod is tapered from the crank-pin to the crosshead-end, in the manner now common to all fast-running engines. The outlines of all visible parts indicate strength and stiffness, and are very neat in design.

The valve-gear and governing mechanism are shown best by the view of the opposite side of the engine, given in the next engraving. The piston-valve is adopted, and is placed directly under the steam-cylinder. This arrangement permits most complete drainage of the cylinder, and thus lessens the danger of accident, should the entrance of water with the steam occur to any serious extent. The placing of the valve at the side is not an unusual feature of this class of engine; but the arrangement here adopted is, in this respect, still more advantageous. This arrangement also affords a means of getting an equalization of the travel of the valve relatively to that of the piston, which is an advantage. Still another advantage is that this position of the valve-chest gives dry steam from the steam-chest, by causing it to act as a trap, as well as drains the cylinder of water that may have condensed within it. The connection with the steam pipe is made above the line of connection between the steam-chest and the cylinder, and it is thus rendered possible to remove the former, and get at the valve without disturbing the steam pipe.

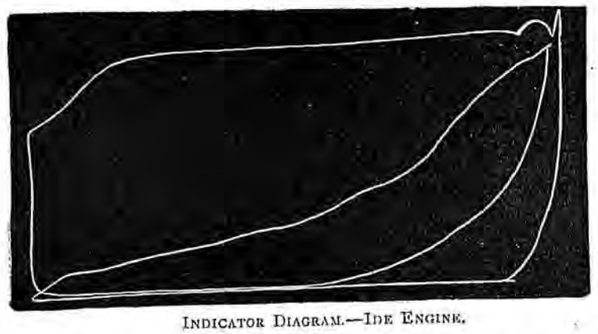
The regulation is effected by a governor of the class adopted in all engines of this kind, and the regulation and the action of the valve are similar in character and in precision to those seen in those already described. The range of power and the distribution of steam at various points of cut-off are shown very beautifully in the indicator diagram here given, which was obtained by suddenly throwing off the load; each revolution gives a distinct "card." Steam may follow from the beginning nearly to the end of stroke, with good exhaust and an excellent range of compression. The speed of engine was here 225. The card was taken by loading the engine to its maximum power by a Prony brake, and then taking the diagrams while the governor was adjusting the steam supply, the brake being at the moment released. The smallest card is therefore a "friction card." The smoothness of action

of the regulating mechanism is shown by the uniformity with which the power falls off and the cards diminish in area.



SERIES OF INDICATOR DIAGRAMS—IDE ENGINE.

The next diagram shows the range of work which such engines are capable of doing, and illustrates very finely the change in the distribution of steam which takes place in this accommodation of the power of the engine to its load. It is seen that the compression, as well as the expansion, gradually changes in amount as the power varies, both acting to reduce the area of the diagram with diminishing power, or to increase it as the required power



INDICATOR DIAGRAM.—IDE ENGINE.

becomes greater. A very interesting effect of this change is to give increased economy in the use of steam by checking cylinder condensation, the greatest known source of waste of heat, just when that loss becomes most serious in both absolute and relative amount. In some cases, the economy obtained, with considerable expansion, by the introduction of large compression, has amounted to above 10 per cent. Where superheating is adopted, this gain is less; but in the usual case, using saturated steam, the use of the valve-motion, of which an example is here illustrated, brings with it a very important advantage; and nearly all builders of such engines are now agreed in testifying to its value. The lines of indicator diagrams obtained by the writer from this engine are unexcelled by any that he has ever seen from engines of this class.

One very important feature of recent progress in the construction of the steam engine is well illustrated in the Ide Engine, and affords a special reason for studying it—this is the extensive use of steel in its running parts. Within a few years it has become possible to obtain from the makers of Bessemer and "Open Hearth," as well as of crucible steel, a quality of metal which earlier could not have been obtained at all. This is a steel which is distinguished, chemically, by its low percentage of carbon and its relatively high proportion of manganese, and physically, by its wonderful combination of ductility and strength. As the proportion of carbon decreases in steel it loses strength; but it gains ductility and malleability in a far higher ratio, and thus it happens that the softer qualities are much better fitted for use in machinery than are the very best of wrought irons produced by the ordinary process of puddling. The former are strong, tough, amply hard for all such uses, and perfectly homogeneous; the latter are less tenacious, often not as ductile, and are never homogeneous; but are full of "cinder streaks," and have a fibrous structure that is objectionable, and is never seen in steels. These steels are all made by casting molten metal into ingot moulds, and thus securing comparative freedom from cinder and defective structure.

The soft steels are displacing iron in every direction; and the probabilities seem to be that in the course of time, in the coming "Age of Steel," iron, puddled as is now usual, will be entirely displaced by these, properly so-called, "Ingot Irons." The Ide Engine, and many of the engines now coming into market from the shops of the best builders, illustrate this change of material. It has its piston-rod, its connecting-rod, its valve-stems and links, and its smaller journals, all of steel. Large castings are not usually made in steel in this country, but all small parts are coming to be made in that remarkable metal.

ENGINES OF THE NEW YORK SAFETY STEAM-POWER CO.

In the course of the somewhat extended series of descriptions of standard forms of engine which is now soon to be closed, it will have been observed that the tendency has been toward the reduction in number of parts, and increasing simplicity of mechanism as the speed of engine is increased. The earlier types of engine having detachable cut-off apparatus as a part of the valve-motion were engines of moderate speed of piston and of comparatively long stroke, and, therefore, of even more moderate speed of rotation. The latter forms of standard engine are of simpler construction, and of higher speed of piston, and of much higher speed of rotation. This difference is not only due to the necessity of reducing the number of parts and securing greater positiveness of action in the valve-gear, but it is also due to the more general recognition of the fact that economy of steam and fuel consumption is but one of the economies to be studied in the use of steam as a motive power, and that the cost of securing great economy of steam and fuel may be such as to more than compensate the saving effected by such expenditure. This is especially true of small powers, and common experience has shown that it is seldom advisable to construct complicated valve-gears for such engines, as the cost rarely comes within the commercially economical limit. This principle has probably been carried too far; and the writer has no doubt that engines of the higher grade may be often found commercially economical for even very small powers. The field for the simpler class of small engine, nevertheless, is enormously extensive; and the number annually built is very great.

But little attention, comparatively, has been paid to the design and construction of small steam engines until very recently. The engineer has been too often inclined to look upon this as too small a matter to demand the thought and the time that he has freely given to larger and more attractive work. It is now different, and some excellent forms of small engines are to be found in the market. It is the intention of the writer here to describe a single example of this class of machine, not as the only good engine of the class, but as a type of this class.

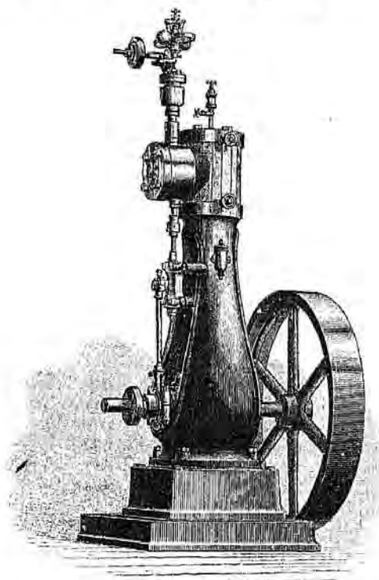
The British builders of portable and agricultural engines were the first to develop the art of steam engine design and construction in this department. A dozen years ago, they were building engines of as little as 20, or even 10, H. P., which demanded but 3 pounds, and even less, of coal per H. P. per hour. As early as 1867, they reached the figure 4.13 pounds;* in 1870, it became 3.73; and, in 1872, the Reading Iron Works built an engine of 20 H. P. which,

* Mechanical Engineering at Vienna; Reports on the Vienna Exhibition: R. H. Thurston, Washington, 1878.

on trial at Cardiff, required but 2½ pounds of picked coal per hour and per H. P. This engine had a cut-off valve on the back of the main valve.* Single valve engines have never done as well; but some of them have nearly approached these figures. A consumption of 5 pounds of coal per hour and per H. P. is a good figure, and is rarely attained in such small engines. The best of them may be expected to use from 5 to 7 pounds and to consume, therefore, from 40 to 80 pounds of steam, averaging, perhaps, about 50, on the basis of the indicated power.

Among the earliest of American engineers to turn attention to this department of mechanical engineering, were Messrs. Babcock & Wilcox, who have become well known as the inventors of a successful form of "sectional" steam boiler. The style of engine which was designed and introduced by them, and built by the New York Safety Steam Power Co., has now become as generally accepted as standard among builders of small engines as has the Corliss engine among constructors of drop cut-off engines. It has been copied in all parts of Europe, as well as in the United States. They may be taken as representative of the best methods of construction in this country, and as exhibiting the elegance in proportions and that excellence of material and workmanship which are now becoming recognized as desirable in steam engines of even the smallest size. In fact, as has been seen, the opportunity here offered for improvement, and for economizing steam and fuel consumption, is much greater than with large engines; and these excellencies are, therefore, the more desirable.

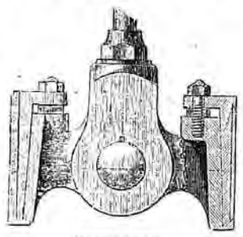
The engraving exhibits the form of the engine here to be described. It is a "vertical engine" mounted upon a bascplate of neat and strong form, and with the steam cylinder bolted by the lower head to a very strong and very graceful frame. The main journals are carried in bearings constructed in the frame, and consequently free from liability to loss of perfect alignment, or to unequal wear. The valve is either a plain, locomotive-slide or, preferably, a piston valve. The latter is fitted in a detachable seat, which can be easily removed for renewal of seat and valve, should accident or wear ever make it necessary.



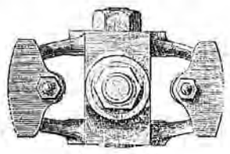
N. Y. Safety Steam Power Co.'s Engine.—5 H. P.

* Ibid, page 100.

The vertical position of the engine prevents wear within the cylinder becoming serious or unsymmetrical. The pistons are hollow, and are packed with rings set with sufficient spring to keep them up to a bearing. The crosshead, which is shown in the following engraving, has its gibs turned to fit the guides in the frame, which latter are part of the casting of the frame and are bored out in line with the cylinder, and cannot possibly get out of line.

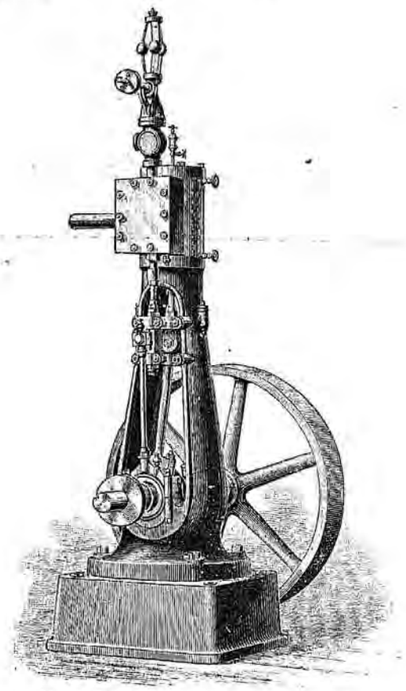


Crosshead.



Crosshead.

The engine above illustrated is of small size—4 or 5 H. P.,—and has been especially designed for electric lighting purposes. The governor is that known as the "Waters Governor"; it regulates by adjusting the supply of steam passing to the engine through a throttle valve—a method which seems to have been here more successful than is usual in engines having to perform so exacting a kind of work. The speed of this engine is usually about 250 revolutions per minute.

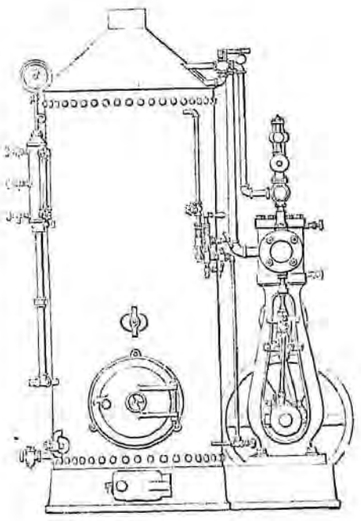


10 H. P. Vertical Engine.—N. Y. S. S. P. Co.

Larger engines of this style are often constructed ranging up to 100 H. P. The heavy engines, when of 15 to 100 H. P., are given an independent crank-shaft pillow-block and a counterbalanced disc-crank. In these engines, of all sizes, the modern innovation of the use of steel for running parts is very generally

introduced. The rods, pins, and minor parts are of this metal; the bearings are usually of bronze lined with Babbitt metal, and are given large area. Crank-shafts are either of steel or of hammered iron. As is customary with all well constructed engines, these engines are set up and operated in the shop long enough to exhibit all defects and to afford opportunity to make all adjustments before sending them out, and are thus made safe against those annoying delays which otherwise attend the introduction of such machines. The parts are made to gauge, and therefore interchangeable; and it is thus made easy to replace them when worn or injured, at minimum expense and with little delay. The valves, even, when worn, are taken out, sent to the shop, and the spare valve and seat, already fitted, takes the place of the parts removed.

Where engines are of large size, they usually have the engine room and boiler room distinct; with these small engines, however, it is found often to be desirable to place engine and boiler side by side, and even upon a common base, as is illustrated by the last of this series of engravings. This forms what is known, frequently, as the "semi-portable" engine, to distinguish it from the "portable," which last named style is mounted on wheels.



Semi-Portable Engine.

MECHANICAL EXPLANATION OF ELECTRICAL UNITS.

BY F. B. CROCKER AND C. G. CURTIS.

(Continued.)

In taking up the discussion of the electrical units, and in applying to them the idea of static and dynamic effects, as we have already done in the case of the mechanical units, we must very carefully guard against the danger of confounding these terms with "static" and "dynamic," as frequently employed to designate the two *kinds* of electricity. In this latter sense, "static" and "dynamic" are synonymous with "frictional" and "voltaic." These terms (static and dynamic) are used merely because the former kind of electricity generally exists as a charge, and the latter as a current; but the use of these terms has no relation to any questions of force or work. Both kinds of electricity being capable of producing static effects, *i. e.*, exerting force or pressure (attraction) without doing work or consuming energy; and both also having the capacity to produce dynamic effects, *i. e.*, perform work or be transformed into other forms of energy. Therefore, we might have, and, in fact, do have, however strange it may sound, both static units (pressure) and dynamic units (work) of static electricity, and the same also of dynamic electricity. But we shall confine ourselves in what follows to the consideration of the latter series of units only, since frictional or static electricity is of no practical use or importance.

The electrical units—volt, ohm, ampère, etc., are based upon the C. G. S. system of absolute units, that is, they are measured and defined in terms of the fundamental units Centimetre, Gramme, and Second.

The manner in which the electrical units were determined upon, and the various methods and forms of apparatus employed, constitute a very interesting branch of electrical science, and time spent in studying this subject would by no means be wasted. But in electrical engineering—in practically utilizing electricity as an agent for the transmission of energy, for example, it is not so important for us to know the exact manner in which the units were determined as it is to know what they *mean*. When we employ the various weights and measures—pounds, tons, feet, quarts, etc.—it is not at all necessary that we should know how they originated; and interesting though it might be to trace this origin, probably not one person in a hundred has ever thought of it. Now, if our knowledge of the new electrical units is as good as our knowledge of the old weights and measures, it will certainly be sufficient. Therefore, let us strive to acquire the same knowledge of the new units as we already have of the old, and we shall then be able to use the former as easily as we now use the latter. Let us take the table of the five principal electrical units as it is usually given:

NATURE.	SYMBOL.	NAME OF UNIT.
Strength of current	S	Ampère.
Electromotive force or Potential	E	Volt.
Resistance	R	Ohm.
Quantity	Q	Coulomb.
Capacity	C	Farad.

But what do these words mean? How can we have a *quantity* of something which is absolutely intangible? The answer is that electricity has always been treated and spoken of as if it were a *fluid*, and the terms quantity, strength of current, capacity, etc., are used figuratively. We must always remember this, and be careful that we are not misled by it. For example, we might suppose, since electricity is a form of energy, that quantity of electricity would mean quantity of energy in the form of electricity—so many foot-pounds or kilogrammetres. But no, quantity of electricity (*i. e.* coulombs), as we shall see further on, is not quantity of energy.

We dwell upon these things because many persons are very apt to think that they know all about electrical units when they know that coulomb is the unit of quantity, ampère the unit of strength of current, etc., and to make a great many mistakes in consequence. In fact there is a deplorable tendency to use electrical units and electrical terms in a very free and loose manner, whereas nothing requires more care and definite knowledge. We do not wish to be understood as saying that it is *wrong* to use the terms "current," "quantity," etc.; they are certainly very convenient and often greatly facilitate explanations; but it is best always to bear in mind that they are merely figures of speech, and that there is a great deal more to the electrical units than is expressed by these words.

In order that our meaning may be perfectly clear, let us begin at first principles, and then we shall be sure to know

precisely what we are talking about. If we take a voltaic cell or other source of electricity, and connect its two poles by a wire, we shall then have a closed circuit, and an electrical effect will be produced through this circuit—in technical language, a current will flow. This electrical effect may be made to manifest itself in several ways, the simplest of which is to suspend near the wire a magnetized needle, which will be deflected when the circuit is closed, and remain deflected until the circuit is opened again. This electrical effect is measured as strength of current, that is to say, when we have a greater effect of this kind, we call it a greater strength of current.

If now we introduce another voltaic cell into the circuit with the first one, it will be found, upon closing the circuit, that the force tending to deflect the needle is twice as great as before,[1] and therefore the strength of current which is measured by this deflecting force is twice as great. Now it is obvious that two cells have twice the electrical power, or technically, twice the electromotive force of one, hence we conclude that strength of current is directly proportional to electromotive force. Still keeping both cells in the circuit, if we double the length of the conducting wire, it is plain that the resistance offered to the passage of the current will be doubled, and we shall then find, upon completing the circuit, that the deflection of the needle is reduced to the same amount as it was in the first experiment—from this we infer that current strength is *inversely* proportional to resistance.[2]

Had we measured the strength of current by any other method instead of by the deflection of the magnetic needle, we should have obtained similar results. If, for example, we had interposed in the circuit, water or other liquid capable of being decomposed by the current, we should have found that two voltaic cells decomposed twice the weight of liquid in a given time that one did; and also that the weight decomposed was half as much with twice the length of wire in circuit. And these results, like those of the previous experiment, tend to prove that strength of current is directly proportional to electromotive force, and inversely proportional to resistance. This relation is usually expressed:

$$S = \frac{E}{R}$$

$$\left(\text{In using the formula we put S in ampères} = \frac{\text{E in volts}}{\text{R in ohms}}\right)$$

and is called Ohm's law.

We are told that Ohm arrived at this law as a result of profound mathematical investigations, and we are expected to regard it as an extraordinary achievement of science. We sincerely hope that our heresy will be forgiven us; but, for our part, we fail to see that this law is anything more than common sense—a truism, in fact, which must necessarily hold good universally, viz., that an effect is directly proportional to that which tends to produce it, and inversely proportional to that which tends to oppose it. However, whether we look upon it as a wonderful discovery or an obvious truth, it is certainly true that Ohm's law is used in solving almost every problem relating to electricity, and the trinity of terms—S, E, and R—which constitute it, and the units corresponding to them, are among the most important of which we have to treat.

We have seen above, that that which deflects a needle, decomposes electrolytes, etc., is called strength of current; in fact strength of current is measured by these effects. Now the *mechanical* effects of strength of current are the same as the static effects which we spoke of when discussing the mechanical units. The pull exerted by an electromagnet upon its keeper, the tendency to rotation of the armature of a dynamo electric machine, the force with which an iron rod is drawn into a hollow coil of wire traversed by a current, the attraction for each other of two parallel wires through which currents are passing, etc., are all of the same nature as the deflection of the magnetized needle, and all are also true static effects or pressures; which static effects when multiplied by the distances through which they are exerted (*i. e.* the distance the keeper, armature, or rod is moved) will give the work done. It follows, therefore, that strength of current itself is not work, because it has to be multiplied by something in order to obtain the work. It is merely *one factor* of work or energy, and it alone does not determine the work, any more than we should know how much money a man had if he told us that he had it in silver dollars. We must know the *number* as well as the denomination of coins in order to determine the amount of money he possesses. Considering it in this simple mechanical way, it is very easy to understand what strength of current means; and from this mechanical point of view electrical questions may often be treated more easily than in any other way. Instead, however, of multiplying, as we have done above, the strength of current, or what is the same thing, the static effect which it produces, by the distance, and so obtaining the work, thus making a purely mechanical question out of it, it is customary to multiply the strength of current by the electromotive force. Now, if we consider a dynamo-electric machine, for example, we find that the electromotive force which it produces corresponds to the *speed* of rotation of its armature; therefore, when we multiply strength of current by electromotive force, it really amounts to multiplying static effect by velocity. But we have already seen in the discussion of the mechanical units, that the product of the static effect and velocity is rate of work or h. p. Hence we conclude that the product of current strength and electromotive force gives us the electrical h. p. This is a well-known fact.

The unit of electromotive force being the volt, and that of strength of current being the ampère, the product of the two is called *volt-ampère*, and this is the electrical unit of *rate of work*. This unit is also called a *Watt*, though it is difficult to see why it is appropriate to name an electrical unit after James Watt.

(To be continued.)

1. The *tangent* of the angle of deflection will be twice as great as before, but not the angle itself.
2. We assume, for the sake of simplicity, that the internal resistance of the cells themselves is so small compared to the resistance of the wire, that we may neglect it.

A CHEAP GALVANOMETER AND THERMOPILE.

BY. C. L. PENNY.

State Normal School, Shippensburg, Pa.

The Galvanometer and Thermopile are often indispensable in electrical investigations, although the cost of these instruments is so great as to deprive many amateurs of their use. It is believed, therefore, that a description of a simple way to construct both these instruments, which is quite inexpensive, and at the same time effective enough for most purposes, will be found serviceable to many.

First, for the Galvanometer—Make a box or reel out of pine board, 1-8 in. thick, which should be 4 in. long, 3 in. wide, and 1-4 in. deep inside, open upon the longer sides. Upon each of these longer sides glue a piece 1 1-2 in. wide and 5 in. long, so that it shall form a flange projecting 1-2 in. all around the reel. Cut out the middle portion of these side pieces so that the needle swinging horizontally inside of the reel will not come in contact with it. Through the middle of the top cut a slit 1-8 in. wide, from end to end of the reel, for the insertion of the needle. At each end of the reel, in line with the slit, glue a strip 3-16 in. wide, projecting perpendicularly 1-2 in. above the top, to prevent the wire from falling into the slit and closing it.

Upon the wooden reel thus made, wind about 100 turns of No. 21 cotton-covered copper wire; this will require about 1-4 lb. or 90 feet, and should not cost more than 25 cents. Between the successive layers, thin writing paper should be placed to perfect the insulation. The two ends of the wire may be introduced through two holes bored in the flanges.

The reel now needs a base. Cut from a suitable plank a piece 5 in. square, fix to the under side three brass leveling screws, one in line with the slit, and two at right angles thereto. The screws may easily be made by any smith, or they may be bought of an instrument maker. Upon the centre of the base glue the reel, taking care that the sides are parallel to those of the base. The ends of the wire may now be secured to binding screws placed upon the base. Upon the top of the reel glue a thin board, parallel to the base, and of the same shape and size, cutting through its middle a slit corresponding to the slit in the reel, for the insertion of the needle. Cover this top with a sheet of paper or card-board, and mark upon the paper a circle 3 inches in diameter, from the middle point of the slit as a centre, and graduate the arc into degrees. For a protecting cover, procure a glass jar about 3 1-2 in. in diameter, either open at both ends or having a hole in the top, and secure it in a position concentric with the arc, by means of cleats. The instrument is now ready for the needle.

To secure delicacy with weak currents, the needle should be compound and astatic. Straighten a piece of the mainspring of a watch without heating it. Cut off two pieces, each 3 1-4 in. long, and magnetize them separately. With waxed silk thread bind the centre of the needle, at right angles, near one end of a thin copper wire 1 1-2 in. long, and having a small hook formed at the upper end, the lower needle being at the other end of the wire axis, the upper needle 1 inch above the lower needle, and with their poles opposite to each other. By successive magnetizing, make the two needles of as nearly equal strength as possible, so that the combined system will point indifferently in any direction. Then suspending the compound needle by a thread of unspun silk, or by one of the finest attainable strands of sewing silk, drop the lower needle through the slit which has been formed in the reel, allow the upper needle to swing horizontally just above the dial, place the glass cover in position, and suspend the needle from the top as a point of support. It will be found difficult to make the needle *absolutely astatic*, and if it is not so then the axis of the coil must be placed in a direction coinciding with that which the needle on the untwisted thread tends to assume when at rest. It will even then manifest considerable delicacy. If the needles are approximately balanced, the instrument will be amply sufficient, in point of delicacy, for all class-room demonstrations. If a silver dime and a small piece of zinc be connected with the coil and placed on opposite sides of the tongue, the needle will show a wide deflection, over 30 degrees. A drop of acidulated water no larger than a pin-head touching the two metals will deflect the needle 90 degrees.

For the thermopile, the cheapest metals giving good results are iron and copper. Let any good tinner cut 75 strips each of common tinned iron and of thin sheet copper, 3 inches long and 3½ inches wide; let them be soldered in alternate succession and at opposite ends, the end of one strip being caused to project about 1-16 inch beyond its fellow, to admit of soldering. Three layers of 25 pairs each will be found sufficient for most purposes. After the layers are made they may be connected by soldering a piece of metal to the tinned strips of each layer in such a manner that copper is always adjacent to iron. Terminal wires about a foot long may be soldered to the first and last pieces. The pile is now easily insulated by inserting a slip of writing paper between every two adjacent pieces of metal, from the open end as far as the soldering will allow the paper to go, one piece of paper being used for the three layers. When insulated and securely wrapped around the outside with cotton cord, the pile will constitute a prism about 2 inches square at the face and 3 inches high. A tin or zinc case of nearly the same size, open at both ends and fitted with two caps or covers, may be mounted by a standard on a suitable wooden base. The tinned wires may be attached to 2 binding screws in the base.

Rude as the completed instrument is in appearance, its sensitiveness in action is surprising. Even in a warm room the breath blown against the end will give a deflection of over 30°. The heat of the hand or of the sun, falling upon the exposed metal, has an instantly noticeable effect. The advantage over the most delicate differential thermometer is that the effects of the temperature may be simultaneously witnessed by a large audience, if the needle be marked with a piece of bright paper. Such a galvanometer need not cost over $1.50, and the thermopile, including the services of the tinner, not over $2.00. The instrument maker's price for the former is from $15 to $30, and for the latter from $40 to $50. The cheapness and practical efficiency of the instruments will amply repay any one who needs them, for the moderate amount of labor and money expended in their construction.

AN ANALYSIS OF JOULE'S LAW.

BY C. L. BUCKINGHAM.

It was discovered by Dr. J. P. Joule, that the amount of heat or work developed in any part of an electric circuit by the passage of an electric current varies, *first*, directly as the resistance, and *second*, as the square of the strength of current. This is known as Joule's law, and is mathematically expressed as follows:

$$H = C^2 R T \times 0.24,$$

in which R is the resistance in ohms, C the current strength in ampères, T the time in seconds, and H the heat in gramme-degrees.[1]

Many electrical students find themselves wholly unable to understand why it is, that in a conductor of 1 ohm, for example, 2 ampères of current will develop 4 times as much heat or work in a given time as 1 ampère. The fact that doubling the current strength will much more than double the heat actually developed, is well enough known, yet so far as I am aware, no explanation of the *reason* of this fact has heretofore been presented in the text-books in a form to be readily understood, especially by those who are unfamiliar with analytical methods. It is hoped that the following explanation will serve to render this question, which has hitherto seemed somewhat abstruse, quite easy of comprehension, even to those of very moderate attainments in electrical science.

Let it be assumed that a current of 1 ampère is flowing through a resistance of 1 ohm; then, during 1 second, 1 unit of heat or work will be developed. Again let it be assumed that, instead of 1 ampère of current, 2 ampères are flowing through the 1 ohm. In this instance 4 units of heat per second will be developed instead of 2.

Now in the last case, in which 2 ampères of current are assumed, let us replace the single conductor having a resistance of 1 ohm, by 2 equal branches each of 2 ohms resistance, arranged in multiple arc. The joint resistance of 2 multiple arc branches of 2 ohms each is readily seen to be 1 ohm. Thus, with a given E. M. F. it is obvious that the actual strength of current throughout the circuit will remain unchanged, whether a part of the circuit be formed by a single conductor having a resistance of 1 ohm, or by 2 multiple arc branches having a resistance of 2 ohms each. The heat developed in the single conductor whose resistance is 1 ohm must necessarily be the same as that developed in both of the equal branches, of 2 ohms each. Nevertheless, while the heat developed in the 2 branches is equal to that developed in the single conductor, the particular proportion of the whole quantity of current (a unit current) which flows over each of the multiple arc branches, renders the determination of the work done in each a mere matter of inspection.

1. A *gramme-degree* is the quantity of heat required to raise the temperature of 1 gramme of water from 0° to 1° Centigrade.—[Ed.]

It is apparent also, that if the joint resistance of the two branches remains equal to the resistance of the single conductor, that is to say, 1 ohm, the current of 2 ampères will divide itself equally between the two branches, and hence there will be a current of 1 ampère flowing through each branch. A current of 1 ampère will develop 1 unit of heat in each unit of resistance; and there will, consequently, during a unit of time, be as many units of heat developed in each branch as there are units of resistance in that branch.

Therefore, to determine the number of units of heat developed in the two multiple arc branches, it is only necessary to compute the sum of their resistances, and the sum of the units of resistance of the two branches will equal the number of units of heat or work developed therein.

The work developed in the two multiple arc branches is equal to that developed in the single conductor, yet upon the single conductor there are twice as many units of work developed as there are ampères employed, thus demonstrating that 2 ampères of current develop 4 units of work and not 2, in a conductor of 1 ohm, or in other words, as many units as there are units of resistance in the two multiple arc branches.

If another example be taken of a conductor having a resistance of 1 ohm which is traversed by a current of 3 ampères, instead of 2, a multiple arc system of 3 equal branches must be assumed. If the three equal branches have a joint resistance of 1 ohm, the resistance of each branch must be 3 ohms, thus it will be apparent upon mere inspection that, with 3 ampères 9 units of heat or work instead of 3 will be developed.

Or to present the problem in a generalized form: Suppose n ampères of current be taken under the same or unit condition of resistance, n equal multiple arc branches, each of n ohms resistance, must be assumed. Here n units of work are developed in each branch and there are n branches, thus, while n represents the number of ampères employed, n^2 will represent the number of heat units developed thereby in a unit of resistance.

The preceding remarks should not be misinterpreted under an apprehension that the amount of heat developed is not proportional to the square of the current under all circumstances. If a unit of current be employed, for the purposes of numerical computation, the square may be neglected, inasmuch as the first power and square of unity are the same.

ELECTRICITY IN SCHOOLS.

BY PROFESSOR GEORGE H. MARTIN, A. M.

Agent of the State Board of Education of Massachusetts.

THE pupils in the public schools should acquire some knowledge of electricity. We say this notwithstanding the cry that the schools are trying to teach too many things and in consequence are teaching nothing well. It may be true that in some schools nothing is taught well, but if so, it is not because too many subjects are taught. The fact is, in most of the schools of the country the course of study is lamentably inadequate to the practical needs of life. In four-fifths of the schools the work is no broader than it was fifty years ago. But domestic and social and business and public life have been broadening by every new discovery in nature, and by every new adaptation of her forces to the wants of man. If the schools are to fulfill their mission—to prepare the children for life, there must be more flexibility, more power of adaptation, that they may change with the changing life of the people.

When electricity was known only as a plaything, serving no more useful purpose than to astonish or amuse the gaping students in a college class-room, it deserved no place in the public schools. But now it has ceased to be a curiosity and has become a servant; its use is not a luxury but a necessity; it touches the life of the poorest man at a hundred points, helping to determine his wages, the quality and cost of his supplies, his personal safety and his intelligence. Because electricity has become so potent a factor in the everyday life of us all we say some knowledge of it should be gained in the schools. We do not say this because it is our hobby. We say the same of steam and water and air, of heat and gravitation. People ought to know something of the world in which they live and of the forces at work in it, and if education means anything it means fitting them to get this knowledge.

Not long ago we were conducted through one of the largest manufactories of steam pumps in the country. As we were returning to the office at the close of the inspection, our guide, a polite young draughtsman, said: "Some folks think it's the pressure of the air that makes the water come into the pump, but it ain't so. It's the way we use the steam."

But right here some one says: "Would you teach telegraphy in the public schools? Would you make all the children electricians? This is not what the schools are for." True. Let us see what they are for. They have three ends—*knowledge, method of study* and *culture*, which is control of the faculties so as to determine their products. The second and third of these ends are more important than the first, because the knowledge gained in the schools must necessarily be small in amount, but if the pupils go out with a good method of study and with faculties under control all knowledge is within their reach. But knowledge and method and culture are of two kinds—general and special. For instance, the knowledge that iron is malleable may be called general; the knowledge of the color which shows the proper welding heat is special. That control of the eye which enables its owner to observe quickly and accurately the qualities of the object he wishes to know is a general culture, and is to be distinguished from that special acuteness which enables the shepherd to distinguish the individuals of his flock. The proper function of the schools is general knowledge, and culture, not special; principles, not practices; sciences, not arts.

At this point the advocates of manual training in the public schools make a fatal mistake. The culture they aim at is special—to plane, to hammer, to file. These are useful accomplishments, but not more so than ten thousand others. These people assume that the crying want of the times is more men trained to use their hands. The assumption is false. It was true in the middle ages, and the guilds were organized to meet the want. The want of this age is more men trained to use their brains. Heads win now, not hands. The difference between an unskilled and a skilled hand-worker in any business is immeasurably small compared with the difference between the best hand-worker and the brain-worker in that same business. And this difference is increased by every machine that is invented. This age demands *directive* skill and energy, not muscular—not men who can shovel more gravel, but men who can understand and manage a steam shovel. Your manual labor school may send out boys who can plane a board well if the board and the plane are furnished. This will do for European countries, but it has been the glory of our public schools that they have so trained the mind that their graduates could invent a plane or find a substitute for the board.

No, we would not have the schools teach telegraphy, but we would have them teach the nature and principles and laws of electricity, and we think they can do it. It cannot be done by compelling the pupils to commit to memory a book on electricity. That is the bane of the so-called science teaching now done in the schools. It substitutes words for things, information about electricity for electricity itself. A writer has said that it is not the work of the teacher to give us science, but directions for making ourselves scientific. If we ask what it is to be scientific, President Porter answers—to observe exactly, to define precisely, to classify correctly, to explain rationally.

This shows us what the schools should do, and the order of doing. First they must teach to observe exactly. This necessitates bringing before the pupil for his observation and thought, experiments shewing the simple phenomena of electricity, static and dynamic. The more simple the means used the more will the pupil be encouraged to experiment for himself, and when he begins to do this, and not till then, he begins to become scientific. The work of the teacher is not to tell, but to direct. Nothing should be done for the child which he can do for himself. Following the example of Tyndall and Faraday, the teacher may lead the pupil along step by step until he has discovered for himself all the important principles of the science. This stage of the work belongs in the lower schools, and can be done better there than anywhere else. The other parts of the work—defining, classifying and explaining, belong to more advanced grades, and can be done there if the elementary work has been well done. Much of the scientific work now attempted in the higher schools fails to give satisfactory results because no foundations have been laid in the study of facts.

In addition to the study of facts and principles their practical application should be shown. Home made models of the telegraph and the telephone, the fire alarm and the annunciator might be shown, and the children stimulated to construct such for themselves, and besides this they should be directed to observe all these applications in actual operation.

We have written at length on this matter because we wish to see a closer connection between the schools and practical life. We should be glad to contribute in any way to this end, and if any of our readers who are practical electricians can suggest simple experiments or devices for illustrating the subject, we will see that they are published for the benefit of teachers.

ON A NEW METHOD OF DETERMINING THE CONSTANT OF A GALVANOMETER.

BY W. L. HOOPER.

Physical Laboratory of Tufts College, January, 1884.

THE term galvanometer constant is used to designate that factor with which a trigonometrical function, usually the tangent, of the angle of deflection of the needle is combined to obtain the current strength producing that deflection.

It is itself composed of two factors:—the horizontal component (H) of the earth's magnetism, and a factor (K) depending upon the form and dimensions of the coils and their position relative to the needle. In all properly constructed instruments, K is a constant quantity; but H will of course vary with changes in terrestrial magnetism. Hence, strictly speaking, the term galvanometer constant should only include K, but in practice it is convenient and usual to combine the two, which will be done in this paper.

The constant of a galvanometer is usually determined in one of the following ways:—

(*a*) If the galvanometer has large circular coils, and a needle symmetrically placed with reference to these coils, K may be calculated from the known dimensions of the instrument, and H independently determined.

(*b*) KH may also be found by passing a constant current through the instrument for a definite length of time, measuring the total quantity of this current by the decomposition of a solution of sulphate of copper or other electrolyte. This method is exceedingly troublesome, and usually not very accurate.

(*c*) The current from a battery of known electromotive force may be passed through a known resistance, and from these data the current producing a given deflection may be calculated. This presupposes a knowledge of the resistance of the battery, which is seldom twice alike and usually quite unsatisfactory to measure. Then, too, the electromotive force of the battery is liable to decrease with decrease of resistance, through polarization of the plates.

The following method is believed to be as precise and reliable as any of the above, takes but little time, and requires only such apparatus as is in constant use in any well-appointed physical laboratory or electrical test room.

The resistance of the galvanometer is first carefully measured. It is then connected up with a battery, and resistance inserted to reduce the deflection to any desired amount. While the current is passing, the difference of potential between the binding screws of the instrument is measured by a quadrant electrometer, or by charging a condenser from the binding screws and immediately discharging it through a Thompson galvanometer. The value of the deflection thus obtained is found by comparison with a Clark's standard cell.

Calling D the deflection with Clark's cell, and d the deflection with galvanometer, the difference of potential (P) between the ends of the galvanometer coil will then be expressed by

$$P = \frac{1.457\ d}{D} \qquad (1)$$

The current (C) through any conductor is numerically equal to the ratio of the difference of potential between its ends and its resistance (R).

$$C = \frac{P}{R} \qquad (2)$$

But with a tangent galvanometer C equals the product of the tangent of the angle of deflection (θ) and the constant of the instrument (KH).

Hence,
$$KH \tan.\ \theta = \frac{P}{R} \qquad (3)$$

Substituting P for its value $\frac{1.457\ d}{D}$ and transposing,

$$KH = \frac{1.457\ d}{D\ R \tan.\ \theta}. \qquad (4)$$

EXAMPLE.

The resistance of galvanometer was 97.71 ohms. The deflection produced by Clark's cell was 349.8.

Deflection produced by Galvanometer.	Reading of the Needle.	Constant KH.
55.66	33° 54′	.003531
74.	41° 16′	.003595
87.12	46° 15′	.003563
106.85	51° 57′	.003564
	Mean value	.003563
	Probable error	.000009

The above example shows four consecutive determinations of KH, with their mean value, and the probable error of the result. Each of the "deflections produced by the galvanometer" and "readings of the needle" are the mean of three observations.

The advantages of this method over the second one described, lie in the ease and celerity with which the observations are made; over the last in the fact that we are quite independent of the battery employed, almost any kind of a cell answering the purpose. The method is not, however, suitable for galvanometers of very small resistance, for in such instruments the difference of potential becomes too small to be measured with precision.

A slight modification of the above method is well adapted to the determination of the internal resistance of a battery. The electromotive force of the battery is measured by comparison with a Clark's cell. The poles are then connected with a certain resistance, best approximately equal to that of the battery itself, and the difference of potential between these poles observed as before. The ratio of the difference of potential between the poles to the electromotive force of the battery will then equal the ratio of the external to the whole resistance of the

circuit. The whole resistance, minus the external, will be the resistance of the battery.

EXAMPLE.

The electromotive force of the battery was 1.05 volts.

Difference of potential between the poles.		External resistance.		Resistance of battery.	
0.42	volts	4	ohms	6.	ohms
0.48	"	5	"	5.94	"
0.53	"	6	"	5.89	"
0.60	"	8	"	6.	"
0.66	"	10	"	5.90	"
		Mean value		5.946	
		Probable error		.016	

The observations in the above example were taken some time ago, with no thought of being used in the determination of the resistance of the battery.

ABSTRACTS AND EXTRACTS.

THE CRUTO INCANDESCENT LAMP.

Herr Goetz has made a series of experiments showing some of the peculiarities of the Cruto lamp. The carbon filament is deposited upon a very slender core of platinum. It was originally supposed that this core was melted and dissipated by the application of a current of sufficient strength, and that there remained in the completed lamp simply a very fine hollow cylinder of pure carbon. It now appears, however, that the platinum core is not dissipated, but that it unites with the carbon, forming a compound filament. Herr Goetz did not go beyond a luminosity of 17 candle power, which he attained by the expenditure of 32 volt-ampères. Tests with some specimens of the lamps indicated an *increase* of resistance, with an increase of electro-motive force. No information has been reported as to their length of life, which is a most important qualification.

THE BENEFITS OF SCIENCE.

In a recent address on Science, Sir Charles Dilke asked "What shall it profit a man if he gain the whole world, but lose his own soul?" He would ask whether in inventing the telephone and other things of the present day we were not, to a certain extent, losing our souls. We fear Sir Charles has been misquoted. Had he stated, as he perhaps did, that users of the telephone were losing their souls, his words would have met with an appreciative response in the mind of many an unhappy "subscriber," frantic with interminable iteration of "What?" "Who did you say?" "How many?" "Where?" "Spell it," and the like, varying the performance by occasionally standing on the other foot.

AN ELECTRICAL CONGRESS.

The conference of leading electrical scientists which is being arranged for in connection with the International Electrical Exhibition at Philadelphia, in September, will be an important event in scientific circles. The movement is supported by Prof. Rowland, of the Johns Hopkins University; Prof. Trowbridge, of Harvard; Prof. Snyder, of the Central High School Observatory, Philadelphia; and Prof. Alex. Graham Bell, of Washington.

AN EARTH CURRENT REGISTER.

An apparatus for registering earth currents has been made by a Berlin physician, which consists of a very delicate galvanometer enclosed in a case with a clockwork arrangement for giving a photographic plate a steady downward motion. A fine ray of light is focused from the galvanometer mirror on the photographic plate, which moves at the rate of about 3 in. per hour, and the mark traced by the point of light shows the observer the variation of the galvanometer from minute to minute.

MAGNETS IN FLOUR MILLS.

In a collar box on the desk of a down-town dealer in machinery for flour mills, were twenty-seven bits of wire of various lengths and forms.

"How is that for a grist?" he remarked.

"Have you a machine to grind such things as that?"

"Not exactly; but millers run just such grists through their mills every day in the year. Several years ago, the genius of the reaping machine man invented an attachment by which the grain was bound into sheaves as it was cut. The binding was done with wire. As a consequence, when the wheat was threshed a good deal of that binding wire went through the thresher and dropped out in bits into the wheat. Millers, particularly in the North-west, found so much in the grain that profits were seriously cut by the injury done to the millstones. Two or three associations of millers in different States resolved to buy no wheat that had been bound with wire. That wouldn't work, of course; and it was not long before a milling company put magnets in the spouts through which the grain was received from the farmer. The miller found that he accumulated not only a lot of binding wire, but odds and ends of metal that he had never dreamed of. This lot in the box came from a grist of fifty bushels. But the magnets had their drawbacks. They didn't catch all the iron, and they had to be cleaned by hand. Then an inventor devised a machine which consists of a hopper, into which the grain runs, and from which it is fed in an even sheet over a plate of sheet-iron. The plate serves as an armature for a gang of horseshoe magnets beneath it, and becoming magnetized itself, it holds all the metal that reaches it with the grain. Once a minute an automatic wiper clears the metallic substances from the sheet of iron. The machines are of various sizes and makes, ranging in capacity from 25 to 300 bushels an hour, and in price from $45 to $125."—*N. Y. Sun.*

LITERATURE.

REVIEWS.

The Practical Telegrapher: A Manual of Practical Telegraphy and Telegraphic Construction. By Lieut. James A. Swift, *Signal Corps U. S. Army.* New York: W. J. Johnston.

This work is professedly intended as a manual of instruction for persons engaged in the construction, equipment, operation and testing of telegraph and telephone lines, the preface stating that an experience of 20 years in the telegraphic service has convinced the author that a work of this kind is much needed by beginners. So far as that portion of the work is concerned which relates to the construction of telegraph lines and the materials used therein, the laying of cables for river crossings and the like, the author has performed his task in a very creditable manner. An especially valuable feature in this portion of the work is a complete list of all materials and tools required in construction. Considerable information of value is given in regard to the iron poles used by the U. S. Signal Service. Specific directions are given as to the number of men that may be advantageously employed in a construction gang, and as to their proper distribution in connection with the work, as well as directions for the construction of the house-top lines which have now become an important feature of out-door telegraphic work.

The chapter devoted to the laying and repairing of submarine cables is an excellent one. It contains minute and clear directions for the making of joints in the insulated wires and the splicing of the exterior armor of the cable, together with a complete list of all materials and implements that may possibly be needed in the work. This will be found extremely convenient for persons who have to do such work, as nothing can be imagined which is more annoying than to undertake the repairing of a cable in some remote and almost inaccessible locality, and then to find that some apparently trifling, but nevertheless indispensable article has been overlooked or forgotten. The chapter on the mechanical tests of iron wire gives the methods adapted by the Western Union Telegraph Company and other large consumers, which have never before been published in detail, and will no doubt be found of value to many into whose hands the book may fall.

We regret to say, however, that aside from the portions of the work of which we have already spoken, we can find but little to commend. If the author's experience of 20 years in the telegraphic service has served to give him any clear idea of the fundamental principles of electrical science—such, for example, as the mutual relation between electromotive force, resistance and current-strength, or of their practical application to the art of telegraphy, he has most signally failed to produce any evidence of it in the portions of the work which purport to explain the operation of telegraphic apparatus and systems. We are reminded in this connection of the story of a college student who commenced a thesis with the following statement, which we fancy few attentive readers of Lieutenant Swift's book will be inclined to dispute: "It is frequently extremely difficult and in many cases absolutely impossible to communicate intelligibly to others ideas whereof we ourselves are not possessed." This may seem a somewhat harsh criticism, but reference to the book itself will show that it can hardly be said to be an unjust one. Many of the statements and explanations given are absolutely erroneous, others are incomplete, and still others are expressed in such involved and ambiguous language as either to wholly mislead the student or to leave his mind in a state of hopeless confusion. As an example of the last named fault, take the following attempted explanation of the chemical action in the Daniell battery:

> It is well known that zinc has a greater chemical attraction for sulphuric acid than copper, as may be demonstrated by suspending a piece of zinc in a solution containing sulphate of copper, when we will see the copper deposited and the zinc taking its place in the solution. And so, in the case of the battery, the zinc is constantly dissolving and the copper depositing. In the first case the chemical action produces heat as the zinc dissolves. We can easily show this fact by placing a thermometer in the solution. When the zinc dissolves in a battery, however, very little heat is produced in the battery but an electric current is generated which passes through the battery and along the wires, everywhere generating heat, which, if collected, would equal the heat produced in the first case. The zinc plate is constantly dissolving, forming sulphate of zinc; and the sulphate of copper is constantly decomposing and depositing copper. The amount of zinc dissolved and copper deposited is in direct proportion to the quantity of electricity which is allowed to flow from the battery. The electric current thus generated traverses short or long distances through the conducting capacity of metallic wires to which the battery may be attached.

It is difficult to conjecture what idea is intended to be conveyed by the above statement. If it is designed as an explanation of the physical law that the total heat generated in an electric circuit bears a definite relation to the chemical action in the battery, and that its distribution depends upon the resistances of different portions of the circuit within and without the battery, the author has utterly failed to convey any suggestion of it to the ordinary mind.

We select at random a few additional extracts, which show either a very defective knowledge on the part of the author, or inexcusable carelessness in the method of presentation:

> The main line relay consists of two bars of soft iron, bent in the shape of a U or connected by a yoke, wound with fine insulated copper wire and covered with hard rubber in spool shape *a*, a soft-iron armature *b*, an adjustable screw *c*, two binding-posts *d d'* (at the end) for the main line wire, and two *f f'* (on the side) for the local wires, all of which are secured to a wooden base, under which the different parts are connected. The soft-iron bars are called cores, and the fine insulated wires with which they are wound helices. The operation of the relay is as follows: The armature *b* moves freely when acted upon by an electro-magnet. When so moved it also causes the local battery attached to the sounder to work with it, one pole of the local battery being connected with the brass frame *h*, of the relay, and the other pole with the armature *b*. The current from the main line battery, passing through the coils of the relay, attracts its armature;—etc., etc.

We fancy that it would puzzle a beginner to make "head or tail" of the above description of the relay, especially as no preceding explanation whatever is given either of the electro-magnet or of the principles of electro-magnetism. The last sentence quoted is especially misleading, as the student would necessarily infer that the armature was moved by the direct dynamic action of the current. On page 72 again we find the following:

> The principle of the repeater consists in an arrangement of connections by which the opening and closing of the circuit on one instrument opens and closes the circuit on another line. It is similar to the operation of the relay and local circuit.

It may be possible for the learner, by referring back to the description of the relay and local circuit which we have previously quoted, to understand the principle of the repeater from the above explanation, but we very much doubt it. It would have been easy to have stated, that the repeater differs from the relay by reason of its capacity to re-transmit telegraphic signals in both directions instead of one direction only, which would have made the definition intelligible. The author's utter lack of knowledge of the principles of the galvanometer is nothing less than phenomenal, as the following extracts will show.

> The degree of deflection indicates the strength of the current. *In any case, however, the deflection does not proceed far after the needle has been urged out of its north or south position sufficiently to form a right angle with the wire of the coil.*
>
> Thus, if a current of a certain strength causes the needle to be deflected 10°, and another current deflects it at 20°, *the last current will not be twice the strength of the former*, although it produces twice the deflection.
>
> To measure the internal resistance of batteries, connect together the galvanometer rheostat and battery to be tested. Adjust the rheostat until a convenient deflection—say 50°—is obtained, and call such resistance *r*. Then increase the resistance until the *deflection* is reduced one-half, calling this new resistance *R*. The resistance *x* of the battery will then be $x = R - 2r$.

The student who follows the latter rule literally will arrive at surprising results; but if he reduces the *tangent* of the deflection instead of the deflection itself one-half, his results will doubtless be more nearly in accord with received theories. In the description of the principle of the differential galvanometer, we notice a statement that the opposing currents "neutralize each other," which of course is not the case.

The only information which is vouchsafed in relation to the now extremely important subject of duplex telegraphy, is a brief description of the old Siemens and Halske duplex, which was published in Pope's "Modern Practice" some 15 years ago, which is here copied verbatim, including a most absurd blunder which appears to have been overlooked by Pope, and which his copyist has neither discovered or corrected.

Apparently the author has not yet heard of the new system of nomenclature for the electrical units which was adopted by the International Congress of Electricians in 1881, as no mention is made of them. Among other units which are named by him is one which is new to us, and we think will be to most of our readers, namely, the "German-Nickel" unit.

The mechanical execution of the book is hardly up to the modern standard. By common consent, a scientific book which is worth publishing at all, is deserving of clear type, good paper, and neat illustrations. In the present case, economy has evidently been closely studied, somewhat to the disadvantage of the general effect, some of the engravings, notably those on pp. 74 and 109, being unusually bad. On the whole, we cannot regard this work as a very valuable contribution to the stock of electrical literature, except in the particulars which were mentioned in the early portion of this article.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Engineering, Jan. 11, 1884.—Hochhausen system of electric illumination. Primary batteries for electric lighting. *J. E. H. Gordon* on the h. p. expended in electric light wires. Jan. 18.—Railway exhibits at the Vienna electrical exhibition. Jan. 25.—Railway exhibits at the Vienna exhibition. *Clark & Bowman's* electric lamp. Feb. 1.—Railway exhibits at the Vienna exhibition.

Electrical Review (London), Jan. 12, 1884.—*Houghton's* system of telegraph working. Jan. 19.—*Sir W. Thomson* on the Measurement of electric currents and potentials. *E. L. Voïce* on a motor induction machine. Jan. 26.—*A. Jamieson* on testing lightning conductors. Feb. 2.—*W. Moon* on the best proportions of an electro-magnet. *Sir W. Thomson* on measurements of electric currents and potentials. *J. A. Kendall* on a new method of generating electricity.

Electrician (London), Jan. 26, 1884.—*D. G. Fitzgerald* on zinc primary batteries for electric lighting. *Prof. D. E. Hughes* on the physical condition of iron and steel.

English Mechanic, Jan. 18, 1884.—*J. T. Sprague* on electro-magnets. Jan. 25.—Electric launches. Electric lighting at the Trinity light-house, near Dover.

Science, Jan. 18, 1884.—The wants of the signal service. Electric time signals. Feb. 1.—The international electrical exhibition at Philadelphia in 1884. Feb. 8.—*Tissandier's* electric balloon. Feb. 15.—Test of electric light systems at the Cincinnati exposition. *Tissandier's* electric balloon.

RECENT PUBLICATIONS.

Connett, H., and Fraser, A. C. Patents on Inventions, a quarterly law review, containing information and advice for inventors, patentees, and manufacturers. Vol. I. New York, *Burke, Fraser & Connett*, 1884. 12+214 p., illustr. 12°.

Camille-Grollet. L'electricité. Les applications pratiques. Paris, 1883. 16°.

Grollet, C. L'electricité. Les applications pratiques. Paris, 1883. 352 p., illustr. 18°.

Jacquez, E. Dictionnaire d'electricité et de magnetisme etymologique, historique, theorique, technique. Avec la synonymie française, allemande et anglaise. Paris, 1883. 8°.

Japing, E. Die elektrolyse, galvanoplastik und reinmetallgewinnung. Wien, *Hartleben*, 1883. (Elektro-tech. bibl., vii.) 260 p., illustr. 8°.

May, G. A bibliography of electricity and magnetism, 1860 to 1883. With special reference to electrotechnics. With index by O. Salle. London, 1884. 12+203 p. 8°.

Plante, G. Recherches sur l'électricité. Paris, *impr. Mouillot*, 1883. 332 p., illustr. 8°.

Romain, A. Nouveau manuel complet de la telegraphie electrique (Roret). Paris, 1882. 16°.

Schwartze, T. Die motoren der elektrischen maschinen mit bezug auf theorie, construction und betrieb. Wien, *Hartleben*, 1884. (Elektro tech. bibl. xxi.) 312 p., illustr. 8°.

Tresca, H. Conference sur la transmission du travail mechanique par les courants electriques, faite a la Societe d'encouragement pour l'industrie nationale. Paris, *impr. Tremblay*, 1883. 28 p., 7 fig. 4°.

Turnlitz, O. Die Elektromagnetische theorie des lichtes. Leipzig, *Teubner*, 1883. 8+155 p. 8°.

Vivarez, H. Des progres recents realises dans la construction des lignes telegraphiques et telephoniques. Paris, *impr. Chaix*, 1883. 71 p., 4 pl. 8°.

Wiedemann, G. Die lehre von der elektricitat. Vol. I. Braunschweig, *Viewig*, 1882. 12+705 p. 8°.

CORRESPONDENCE.

NEW YORK AND VICINITY.

Sale of the Manhattan District Telegraph Co.—An Injunction Against the Transfer of the National Telegraph Lines.—Leased Wires.—War Against the "Bucket Shops."—The Gold and Stock Life Insurance Association.—No Haste about Burying Electric Light Wires.—The Edison Illuminating Co.—Electric Lighting in Brooklyn.

THE increasing magnitude of the opposition telegraph companies continues to form the most interesting feature in electrical circles. The acquisition of the Manhattan District Telegraph Co. by the Baltimore and Ohio, was a matter of considerable curiosity, as the controlling interest in that concern was held by the American District Telegraph Co., which, in its turn, is well known to be practically owned by the Western Union Telegraph Co. These facts were thought to indicate that the Baltimore and Ohio movement was not a genuine opposition. It appears, however, that the sale of the stock was a purely business transaction, and was of no significance as an indication of the two principal companies working in harmony. It was well understood, that failing to secure this property, a new district company would be started in the Baltimore and Ohio interest, consequently the opportunity was availed of by the American District Telegraph Co. to dispose of a system which it did not actually require, and which was being operated at a loss. A service of this description has now become a necessary auxiliary to a commercial telegraph company in large cities.

An injunction order has been obtained by the Western Union Telegraph Co., to restrain the transfer of the lines of the National Telegraph Co. to the Baltimore and Ohio. A careful examination into the title was made by the latter company previous to the purchase, and it is not thought that the injunction can be sustained. It forms a very important route, and if the transfer can even be delayed for a time, the legal interference will certainly be an annoyance. Rights of way are becoming more and more difficult to obtain, as the contracts between the different railroad companies are found to be carefully drawn, to prevent the nurturing of opposition schemes. The theory of Mr. Garrett is, that by building its lines for cash, serving the public well, and transacting business at a reasonable rate, greater earnings might be made than in any other way.

One of the new elements in the prospective financial success of a company is the leasing of wires to private parties. Six of the Baltimore and Ohio wires have been leased between New York and Chicago, at an average rental of $10,000 each per annum, being 4 per cent. on the capital it was proposed to expend for the entire line. The remarkable increase in the leasing of telegraph wires, goes far to prove that the securing of the very best service is considered a most important matter by parties who do a large amount of telegraphing.

Another attempt is being made by the Stock Exchange to prevent "Bucket Shops" from obtaining stock quotations from the instruments of the Gold and Stock Telegraph Co. The threat is made, that unless the telegraph company breaks up this service its reporters will be excluded from the Exchange, thus throwing the business into the hands of its young rival, the Commercial Telegram Co. It is also suggested that the business of reporting sales be undertaken by the Stock Exchange itself, and the quotations furnished to any company which may subscribe for them. The Exchange officials feel that they have the control of a very important bureau of information, and for several years there have been a number of members in favor of making the most of their advantage, some even going to the extent of advising the establishment of a telegraphic quotation system.

Among the beneficent institutions established by telegraph employees, the Gold and Stock Life Insurance Association is one that has been conducted in a modest way, and whatever may be said of its future, it has certainly accomplished good results during the past 5 years of its existence. It was the outgrowth of a desire to obtain more insurance than is granted by the Telegraphers' Mutual Benefit Association, and in order to establish it upon a basis of about 125 members, a novel plan of assessment was adopted, by which each member pays a monthly fee of 50 cents, and in case of death his beneficiary receives 24 semi-monthly payments of $25 each, thus spreading its benefits over a period of one year. It has already paid out $3,000 for losses, its expenses during the same time being but $58.52. Its membership is limited to 200, and as employees of other companies are admitted, if in good health, an opportunity is offered for a few more who desire to obtain additional insurance.

Notwithstanding the fact that the municipal ordinance has become a law, which will compel electric lighting wires to be placed underground within two years, the companies directly interested are taking no active steps to comply with it. They do not feel sufficient confidence in any plan yet brought forward which will warrant them in incurring the necessary expense. As the case stands to-day, they will not undertake it, and unless the action of the authorities is modified, or a practical plan suggested which will not absorb all the profits, it is by no means improbable that are lighting in New York city will be abandoned.

The report of the Edison Illuminating Co. furnishes some interesting statistics regarding the operation of its Pearl Street station from June 1 to November 1, 1883. The number of lamps burned was 8,000, and the earnings $36,563, the charge for service being at the rate of 1 1-5 cents per lamp per hour. This gives an average of 2 3-10 hours per day, while the plant is run continuously 24 hours. It appears, therefore, that only about one-tenth of its earning capacity is utilized. Nothing has been done as yet in the business of furnishing power from the central station, as no current can be spared at present, and the station lacks capacity for any further increase in the number of generators. No information is given as to the cost of running the station.

Electric lighting in Brooklyn is at a deadlock. No street franchises will be granted by the Board of Aldermen, and the Mayor declares he will veto any measure which is passed by the influence of money. Probably no city of its size in the country has exhibited as little progress in electrical illumination.

NEW YORK, Feb. 19, 1884.

PHILADELPHIA.

Arc Lights Working Through Underground Conduits.—The Postal Company's Wires to go Overhead.—Burning of Phillips' Cable Manufactory.—The International Electrical Exhibition.—The Rival Telegraph Companies.

ALTHOUGH the severe weather has put an embargo on subterranean telegraph operations, yet none of the interest has abated, and the various underground companies are laying extensive plans for an early and a vigorous opening of the Spring campaign. Since my last letter, the whole of Chestnut Street, from Ninth Street to Broad, has been lighted through the underground conduits. Over this route the lamps of the Light and Power Company have been substituted for the ordinary gas burners on the city lamp posts, and thus the street is nightly flooded with a soft, mellow light, while the conductors are completely out of sight.

The Postal Telegraph Company, which has boasted much lately of its anxiety to enter cities underground, has just obtained permission to build overhead wires across our streets. These, they say, will only be temporary—to admit of their getting to work at once. Their underground system here is intended to be somewhat different from those employed in other cities, thus giving a fair test to a number of systems. Their leaden pipes laid in an iron box, in Chicago, will then compete for supremacy with their paper tubes laid in asphaltum, in Washington; while in this city they intend to try the Phillips system—a lead-covered wire, with no other protection than that afforded by the leaden sheathing.

I might mention here, by the way, that Mr. Phillips, who was until recently superintendent of the city's police and fire alarm service, was engaged in manufacturing his new wire until the 6th inst., when his manufactory at Twelfth and Willow Streets was totally destroyed by fire. It was known as the Phillips Cable Manufacturing Company, and employed 20 men. The building contained a large quantity of valuable material, and a number of costly machines, besides 4 miles of 10-wire copper cable already finished for the United States Cable Company, and ready for shipment, all of which were destroyed. The total loss was a trifle under $30,000.

Preparations for the forthcoming International Electrical Exhibition are being vigorously carried on. The Franklin Institute has appointed a committee to confer with other scientific men as to the best method to be adopted for securing, next September, a conference of electricians in this city. The committee (of which Hon. John Welsh is chairman) which has in charge the arrangements for the reception of the British scientists who will be here, has appointed sub-committees on Invitation, Reception, Excursions, etc., and has commenced to hold regular monthly meetings. This project will doubtless join the Electric Light and the Underground in the "grand opening" next month.

Meanwhile the telegraph is furnishing all the excitement. Everybody is talking about the B. & O. Indeed, as far as Philadelphia is concerned, the B. & O. utters no uncertain sound, and its lively policy gives much plausibility to Mr. Bates' sweeping assertion that "within the present year their lines will cover the territory yielding three-quarters of the telegraph business of the country." Their selection of men is about as shrewd as the capture of the Nickel Plate route, and, when once secured, they are putting the recruits where they will do the most good for the B. & O. To-day, for instance, they opened an office at the Stock Exchange, and astonished the brokers by having it manned with the entire Western Union force as it stood at the same Exchange two weeks ago, including the Western Union manager. Under these circumstances, it is needless to say that the opening was an auspicious one, and that the ex-Western Union operators took

particular pleasure in subjecting the two sets of duplexes between here and New York to the wonderful process known in esoteric parlance as "making 'em hum." Another instance: At the Commercial Exchange the B. & O. opened not only with the former Western Union manager in charge, but also in the former Western Union office! Then they have here also the former W. U. superintendent, Mr. Zeublin, and Mr. William G. Jones, the manager of the Western Union main office from April, 1881, until the 26th ult. Mr. Jones has been appointed Assistant Superintendent of all lines and offices of the B. & O. in the States of Pennsylvania, New Jersey, and Delaware, with headquarters at Philadelphia. Mr. John D. Clarke, until a week ago Western Union Manager at Washington, D.C., is also here for the B. & O., but will soon go westward.

The Baltimore & Ohio has secured the old American Rapid office at Chestnut and Bank Streets for a main office; a selection not the most eligible, though possibly the most available just now. It is to be handsomely fitted up, with all the latest improvements, and the operating department will be under the direction of Mr. Daniel J. McLorraine, the Western Union traffic chief.

There is talk of the B. & O. securing a working contract with the Philadelphia, Reading and Pottsville Telegraph Company, which is now operated in connection with the Western Union. Such an arrangement would transfer to them nearly 2,000 miles of wire (including the Jersey Central), and covering the most important centres in the Pennsylvania anthracite coal regions.

Meanwhile, the old company goes on the even tenor of its way, as it did in the many crises through which it has already passed, and seemingly convinced that there are as good fishes in the sea as ever were caught. They have appointed Mr. S. S. Garwood manager at the main office—an excellent appointment—in place of Mr. Jones. The superintendency left vacant by Mr. Zeublin has been filled by the appointment of William B. Gill, for many years assistant superintendent, and Mr. Zeublin's immediate predecessor in the same office. Minor positions, caused by resignations to join the opposition, are quietly filled by promotion from the rank next subordinate.

PHILADELPHIA, Feb. 14, 1884.

CHICAGO.

The New and Complete Factory of the Western Electric Company.—Absorption of the Gilliland Company of Indianapolis.—A New Form of Portable Bridge Galvanometer.—Various Reports of Coming Telephone Opposition.—Mysterious Circulation of Drawbaugh Documents.—Enthusiastic Inventors.—A Good Record of Telephone Service. The Electric Light Competition.

THE Western Electric people, who have long anticipated and impatiently awaited relief from their crowded and uncomfortable quarters on the north side, have recently taken possession of their new building at the corner of Van Buren and Clinton Streets, on the west side. Having been constructed expressly for the purpose, it is not surprising that it should fit the business in every part; and while the structure has an air of belonging to the *noblesse* of architecture, it has not had one dollar of extravagant expense lavished upon it. Everything is substantial, solid, of the best. The building is four stories in height, above the basement, of an L shape, the whole comprising about 350 x 50 ft. A 350 h. p. engine, in one of the neatest engine rooms the writer ever saw, furnishes the power, in a very modest and unassuming manner, and reminds one of the mint engine at Philadelphia, so quietly it does its work.

The former shops of the Gilliland Company at Indianapolis, have been removed to this place, and merged in the present shop. One of the features of the new building is the cable floor in the basement, which covers 250 x 50 ft of space, and an insulating room 50 x 100 ft. Each floor of the building has fire-proof vaults, for the reception of patterns, valuable apparatus, combustibles, etc. The building is being fitted up with arc lights of their own, run by their own dynamo, the light being of the pure white variety, and abundantly intense for the use of the workmen on the most delicate articles.

A new arrangement of the Bridge Rheostat principle, for use in telephone line inspection and other measurements, is in course of construction, and seems to have every element of compactness and utility. A concise description may be permitted. The instrument is circular, 8 inches in diameter, and will be inclosed in a box. The top, which is the face, is provided with four pairs of binding screws, placed at the extremes of the vertical and perpendicular diameters of the face, and are attachments for the galvanometer, battery, unknown resistance, and for the introduction of additional resistance when necessary to increase the capacity of the rheostat. Inside—toward the centre of the face—are 4 series of 11 blocks over the resistance coils. These coils are 10 in number in each series. The eleventh block is connected to permit of plugging out the entire series. These blocks are arranged circularly, parallel to the periphery of the face. Inside these are 4 solid blocks, corresponding in curvature to those above, and arranged to be connected by a plug to any coil in its own series. Still nearer the centre, occupying only the upper half of the circle, are the bridge connecting plates. In the centre of the disc are 3 keys, normally open. The middle one of these closes the galvanometer circuit, those on either side of it throw either the positive or negative current to the coils, as desired. The bridge coils (or first and second sides of the bridge) are 6 in number, two of 10, 100, and 1,000 ohms each.

The 4 outside series of resistances are divided as follows: the first embraces 10 coils of 1 ohm each, the second 10 coils of 10 ohms, the third 10 of 100, and the fourth 10 of 1,000. In addition to the 10, as I said above, the plug, when inserted in the first of the 11 blocks, thus connecting it with the larger plate, cuts out the coils of that entire series. It is only necessary then to use one plug for each series. A designating mark shows the number of ohms in, whenever a hole is plugged. Say we put the first plug in block two, the second in the third block of the second series, and the fourth plug in its number four. Remembering that the first plug in the series is a cut-out, we have only to add the number of ohms where the plugs stand. In the first series we have 1, in the second 20, in the third nothing, and in the fourth 3,000, or 3,021 ohms total. As all the resistances are plugged *in*, instead of the reverse, there is much less danger from loosening plugs than where there is a greater number. A direct measurement may be made with this instrument of 11,110 ohms, while by varying the proportions of the two known sides of the bridge a very much higher resistance can be obtained, and the addition of supplementary coils is provided for as well.

This application is due to the ingenuity of E. P. Warner, one of the company's mechanical, as well as electrical experts.

The dear public here is largely exercised over the subject of telephone companies. For some reason, possibly a fancy that this sort of investment is a richly remunerative one (fabulous tales are told of the quarterly and extra dividends of the Chicago plant), perhaps a feeling that competition would improve the service—for some reason or other; at all events, every few days vague rumors are found floating in the air, foreshadowing some new enterprise which is about to break over the doomed heads of the hello-monopoly—its perfect annihilation sometimes, in a rapidly approaching future. The name of one of the oldest employees of the old Bell Co. of this city is nearly always connected—I know not why—with these will-o'-the-wisp propositions, which one day announce the Baxter system as the coming ogre, at another the Dolbear, and again some other. The latest "unquestionable shape" heralds the Drawbaugh. Those who might be supposed to be best posted are extremely reticent, claiming to know nothing—and others who are evidently interested, yet deep in the gloom of ignorance, look wise, and intimate by a solemn dumb show, a large amount of superior knowledge. The whole thing has a Col. Sellers eye-water flavor, but as a sensation probably serves its purpose. One of these systems, which has been regularly threatening to move on the enemy's works for the past year and a half, at least, I think, is still massing its forces and masking its batteries preparatory to the grand attack. Several copies of the testimony in the Drawbaugh case, privately printed for the use of stockholders only, have mysteriously escaped from their proper custodians, and are surreptitiously shown behind closed doors and in dark corners. Said a gentleman to me the other day: "One share of this stock, sir, was sold as high as $1,200." This gentleman has either three or four of these mysterious pamphlets, which have been sent him at various times. Our weather at this season is windy, and windy weather is always good gull weather; but the party in question has no wings.

The desire to invent something in an electrical way seems to have become epidemic, with a class of persons who are constantly running ashore for want of preliminary knowledge. They are often found in the ranks of students who expect to grasp the whole subject, and bolt it at one gulp. Such an one often enquires for "some book that will tell me all about it." I have lately ran across several of this group, who have ingenuity, but lack—well, something. One is struggling with the electric light question, from a new standpoint. He roundly berates the electricians as a set of educated fools, assuming that the only thing necessary in lighting is a mechanical arrangement for feeding the carbons together, and his result, as predicted by him, was to astonish the world, and place mechanics, as a class, far ahead of the poor unfortunates aforesaid. It is cruel, this asking electricians to be practical mechanicians as well; but it is certainly generous on his part not to assume both rôles, and leave the fools to entire extinction. The lamp, however, requires a little more mechanics before it will succeed, to judge from its performances up to date. Its success is still in the beyond.

Another illustration is that of a young telegrapher, who has invented, and had constructed, an instrument for taking the time reports—or sixes—of night operators. It is ingenious, and the work is very complete. It consists of a clock, to which is attached a type wheel, which once in 30 minutes makes a record of the time, on the register paper inclosed in the same case. Simultaneously with this action the paper starts, and a contact wheel, arranged with blank spaces on its outer rim, makes and breaks circuit in the proper combinations to call for reports. All

this is placed in the train dispatcher's office, where, if that gentleman is not too busy, he may be supposed to be quietly enjoying a pipe. In each office along the line a box is placed, something like an A. D. T. fire alarm, with a contact wheel. In his turn, the operator pulls the starter, and his office is reported automatically by the wheel.

I was curious to know why the operator did not do this work with his key. "Ah!" said the inventor, "that's the most valuable part of the whole thing. You see the operators sometimes want to sleep an hour or two, and they arrange to answer for one another. This box sends in the signal reversed—that is, spaces come in place of dots and marks, and the local is connected through the back points of the relay. That, you see, is what an operator can't do, and this box alone can do it." It was pretty evident to me that he never talked to the girl of his heart in some other office, by grasping the back end of the key lever, and reading by the back stroke.

Prof. Haskins, of the Wisconsin company, claims that Milwaukee has the model exchange of the world. As a proof of this assumption, I heard him a few days since, make the following statements: "When we put in the multiple switchboards, in October last—we have 5—our exchange subscribers numbered 916. On the 1st of February we had 1,092, and the only reason I can give you for the increase is the perfectly uniform work our exchange is doing. Every call is registered, because our system of rentals is based on the number of calls made—the number one year making the succeeding year's rate. Now, a call is made; the operator answers, connects the parties, makes the memorandum, and the whole time, from the first ring, is less than 6 seconds average. The operators all use the head telephones, and to tell you the truth, I can't keep house without 'em, for the girls will use no other. We have less operators than we formerly had and are doing better work. For three weeks at one time we had not one complaint of the service."

I have not given you his exact words, but the facts are all as stated by him.

I took a run among the electric light people the other day, and learned some curious facts. I have been unable to find one agent or inventor whose light, as well as dynamo, was not the best, most economical, and smooth-running in the world. Every one of them, except "mine," in each case, uses more than a h. p. to an arc light, but mine goes far below that h. p. I found no less than four parties who only knew of but one system of combining the two forms of lamp on the same circuit—and in each case it was "ours." Competition is very fierce in this line, and every company has its lights more or less scattered throughout the city, and quite plentifully, too. One of the companies has proposed to take the water power of a Michigan river, convert and transmit it, delivering 400 h. p. at a town in Ohio, 25 miles away.

The old proverb, "Every crow thinks her own young the whitest," has its parallel in the case of watch owners. Let anyone in a crowd ask his friend, or wonder what time it is, and every watch within ear-shot is drawn. Now that we have a standard of time there is less excuse for variations than formerly, and the poor electrician's calling comes in as the cause. Almost everyone's watch has suddenly been magnetized, and the amount of work the jewelers have had thrust upon them of late is something phenomenal. De-magnetization is so difficult, it costs heavily. So one of our prominent jewelers has applied for, and obtained a patent for a soft iron cover or cap, which encloses the works of a watch, and either does away with the magnetism already in or prevents it from getting in, somehow. In any event, he claims that it runs perfectly, lying or hanging against the pole of a large magnet, and that no other watch will. It is a little singular, however, that one maker of dynamos, who is constantly working nearer the lines of magnetic force than any visitor ever dares come, is carrying a very elegant and expensive watch, which has never shown any magnetic rheumatism whatever, in three years of this crucial service. His being full of electricity and electrical ideas, however, may, in some mysterious way, account for the neutralization.

CHICAGO, Feb. 12th, 1884.

WASHINGTON.

The Government Telegraph Agitation.—Political Influence Still Effective.—The New Electric Light Company.—An Exhibition of Tower Lighting to be Made.—Personal Changes.—The Western Union Black List Abolished.

SINCE my last letter, parties interested for and against a system of telegraph under Government control, have been busy before the Senate Committee on Post-offices and Post-roads. Presidents, superintendents, attorneys and others, have presented the case from every standpoint save one, *i. e.*, the political effect of such an absorption of the means of communication. This seems to have been almost overlooked; but it will not be lost sight of if a bill is discussed in the House—and probably not in the Senate. The testimony and statements made before the committee have been so extensively published by the daily papers that it seems hardly desirable to reproduce the reports.

Referring again to the political feature of the question, reminds me of an incident related by one of the operators at the Signal Office in this city. Some time since, while busily engaged on the routine business of the office, a high official of the War Department, disregarding the sign, "*No admittance*," entered the operating-room, and peremptorily ordered the operator to suspend the business of the bureau and get the latest election news from certain points. He was reminded that he was in the operating-room, and that orders came to them through regular channels. With this he was by no means satisfied, and left threatening the immediate discharge of the offending operator. In this case no harm was done, but the incident may serve to "point a moral."

The recent unexpected development of the Baltimore and Ohio Railroad Company's telegraph system has created much surprise, and the question is often asked, What does it mean? The capture of Bates, Zeublin, Clark, Jones, and others from the front ranks of the Western Union Co., has led to suspicions that Gen. Eckert might be behind the movement, as these men were his known favorites, and that, after all, the Western Union might have a hand in the matter. With this young monster, into which the B. & O. has so suddenly grown, the pretentious and rapidly growing Postal Telegraph Co., the energetic and fast spreading Bankers' and Merchants' lines, and the numerous new telegraph corporations springing up in every section, Congress will have to do business more rapidly than is its usual wont to keep pace with the growth of the system so as to know when and how to "catch on."

The Postal Bill of Mr. Anderson, of Kansas, slept quietly in the Post-office Committee of the House until yesterday, when Messrs. Anderson and Sumner made arguments in its favor. In my last I expressed doubts of any bill passing. I feel more strongly convinced now as to this result. "An army of Federal office-holders to control the elections," is the great bugbear of the present House. It was so potent the other day that it defeated an otherwise unobjectionable bill, a bill providing a special 10c. stamp, to secure the special delivery of a letter in letter-carrier cities, between the hours of general delivery and midnight. A few additional carriers (boys were proposed by the bill) were magnified into an army, and the bill was defeated, almost solely on this ground. With such apprehensions, the employment of many thousand operators, linemen, clerks and messengers, will meet with but little favor from the dominant party in the House.

I find by reference to the report of the U. S. Commissioner of Railroads, that up to June 14, 1883, no less than 60 telegraph companies have filed their acceptance of the provisions of the Act of July 24, 1866, "To aid in the construction of telegraph lines, and to secure to the Government the use of the same for postal, military and other purposes," and accepted the rates fixed by the Postmaster-General for the transmission of government business, which is 1 cent per word for each 500 miles or fraction thereof; 25 words, including address and signature, to be the minimum charge.

But little is being done just now in the matter of electric lighting. President Hayes, of the Brush-Swan, Arc and Storage Co. of Washington, is pushing forward the work on the original plant; but as they propose to use the latest and best machinery, much of it has to be made to order, and in some instances there is delay caused by earlier orders to be executed. At the earliest opportunity, Mr. Hayes proposes to take advantage of the high elevation of the Washington Monument (400 ft.) and the dome of the capitol, to give an exhibition of the tallest kind of tower lighting. Some 15 or 20 arc lights, of 2,000 candle-power each will be lighted at either of these two points, distant apart something over a mile. In connection with this exhibition some interesting experiments are to be tried in the matter of concentrating the light by means of reflectors.

Early in the season, the United States Electric Light Co. (local) took preliminary steps to light the approaches to the capitol. Owing to delay in completing the north and south stairways, in consequence of Winter setting in, they were only enabled to put their lights on the west front, where they have not proven a success, owing mainly to the imperfect manner in which they laid their underground wires.

The wires of the Standard Cable Co., laid in the Fall, have stood the test of Winter, including the remarkable February thaw. The District Commissioners are so well satisfied with the working of the cables under their control, that they will permit no more wires to be strung overhead, and have urged all interested to come into a general arrangement for getting rid entirely of air lines. All but the Western Union Co. have assented to making a thorough experiment of the underground system. As the wide streets of Washington afford such excellent facilities for cable laying, it becomes of something more than local interest, and it is to be hoped the Western Union will lend its co-operation and have the problem finally settled.

M. Marean, who left the Western Union office in this city in December, to act as manager of the Postal Co.'s office, returned to his first love on the 1st inst., having been made manager in place of Clark, gone over with Bates to the B. & O. Leonard Whitney, who was removed as manager soon after the strike, has been re-employed, and made a superintendent. The Western Union operators who struck in this city, have been notified that their names have been taken off the black list, where they were placed by Supt. Zeublin, and that their applications for employment will receive the same consideration as if the strike had never occurred.

WASHINGTON, Feb. 12th, 1884.

PROVIDENCE.

Continued Active Demand for Telephones.—The Inter-State Telephone Company Not Thriving.—Public Telephone Stations.—Decline in the Use of Arc Lights for Private Illumination.—Local Telegraph Competition.—Telegraph Facilities in Pawtucket.—A Town Without a Telephone.

THE prosperous Providence Telephone Company is actively engaged in extending its lines, and such is the demand for instruments that there has never, for at least two years, been a time when there were not sixty applications ahead. Notwithstanding the flurry in American Bell shares there was no palpable effect upon the price of the Providence stock, which still stands at $220 per share. Of course there is not the slightest ground for alarm among investors, even should the stock of the parent company decline to $10 a share. The local company has a ten year lease, enjoys a gross income of at least 60 per cent. on its capital stock, and being a close corporation with few stockholders is not liable to get into the hands of outsiders. Its lines through the city are models of telegraphic construction.

The Inter-State Telephone Company, whose ungainly 40 foot line, with cross-arms 6 feet apart, may be seen stretching across the fields to Boston, has not proved a paying investment. Originally started and backed by men like Marshall Jewell, Ex-Governor Rice, and others of equal note, with the expectation of getting control of telegraphic business between Providence and Boston, it was subjected to the adverse influences of induction, and was what might be called a fair weather line. Now, by means of a metallic circuit, it is working very fairly, although the revenue is slight. In fact, the telephone as a means of communication between merchants in distant cities loses its value on account of not making a record. I believe that three-quarters of the stock of the Inter-State is now in the hands of the Connecticut Telephone Company. Its poles are being utilized by the American Bell Company, who are stringing an experimental line from New York to Boston.

The revenue of the telephone for local uses at pay stations suffers on account of poor facilities. There are three or four scattered about in news-stands and drug stores, but none, as they should be, in a well-appointed office especially for the purpose and located on the main street. However, all these may come in time.

The town of Mansfield, Mass., twenty miles from Providence, enjoys the unique distinction of being the only place of any size which has not a telephone in its limits; and yet Mansfield is a flourishing place, and an important junction of the Boston and Providence and Old Colony Railroads.

The electric light war has in a manner subsided, and the Narragansett Lighting Company is busily at work setting poles. The question which comes before the public mind is, Will this thing pay? The new company has an extensive and costly plant, and all the most approved appliances for doing business. All this will require a goodly revenue to pay expenses, and this must be looked for in the dim future. When the electric light was first introduced in Providence, it was no uncommon thing to see them in hotels, in restaurants and in many stores. Gradually the number began to diminish, and now in places like the dining-room of the Narragansett Hotel the unsightly wires connected across may be seen hanging over the head of the guests, like the sword of Damocles. The Central Hotel has also discontinued the use of the light, while the Hotel Dorrance has put in a superb lot of incandescent lights, which were furnished by the Rhode Island Electric Light Company.

The Holmes Burglar Alarm, which is well handled by Mr. E. M. Carhart, is, I am pleased to say, doing a good business, which is increasing rapidly. I have heard many people speak of the value and convenience of the system.

I saw the delivery numbers of the Western Union the other day and was surprised to see how light they were. Possibly the activity evinced by the Bankers' and Merchants' Company may have had something to do with this falling off. The Bankers' and Merchants' people are putting up a splendid line, and their loop down Canal Street, consisting of a superb lot of poles ranging from 50 to 75 feet in height, on which are placed 5 eight pin arms, is something to make every other line in the city pale in comparison. The office is emblazoned with signs bearing "Bankers' and Merchants'" to be seen from every available point, and from what I learn the Company is earning a name in the East which it has obtained and held in New York. If quick service and careful attention to customers' wants will bring trade it is safe to say that the new Company will prosper.

For some years there has been great complaint of the poor Western Union service in Pawtucket. The office is kept open from 8 a. m. until 8 p. m. with two hours for dinner, and woebetide the wretch who arrived with his telegram at 15 seconds past 8. No amount of entreaty would avail in getting that window up and the customer was obliged to take the train for Providence.

With this state of things existing, when the Bankers' and Merchants' asked permission to extend their lines in Pawtucket, they met with no difficulty whatever. In fact I am told that the people afforded them every facility. I learn by the daily papers that in recognition of these courtesies the Telegraph Company will give the town such accommodations as one would suppose would be needed in a place of 20,000 inhabitants.

The Multiplex Company is gradually nearing Boston. The contractor, Mr. W. J. Mowatt, is a well-known figure on the road attending to the delinquent pole contractors who take the profits from telegraph builders. In South Attleboro, one abutter compelled him to move thirteen poles, and this in a place where every hole had to be blasted. Messrs. Delany and Calahan, the controlling directors of the Multiplex, were in town last week probably looking after the progress of the line. It is understood that a son of the contractor, Mr. Brown, will have charge of the Company's interests in Providence. It is not thought that any great dividends will result from the operation of the Multiplex or anything else that resembles an automatic system. It is true I am told that the Rapid did a good business with others, but the more business carried the less money was made.

A frequent figure on the street is that of Mr. E. W. Wilson, of New York, Vice-President of the Providence District Messenger Company. This concern is gradually increasing the number of its boxes without a corresponding increase in receipts. I know that Mr. C. H. Porter, the Superintendent, works hard, but it cannot be denied that the field for that kind of work in Providence is rather limited. Besides this, the business is cut up between four companies. The American Rapid uses an open circuit box which has long been the property of the company, but I hear that since the accession of the Bankers' and Merchants' to the management, they have gotten out a closed circuit box which will probably be generally adopted.

The Baltimore and Ohio Telegraph Company has not yet applied for right of way between Providence and Boston. Neither has the Postal Company, when they do they may wish that they had staked out their lines ten years ago.

Towns now require ironclad agreements. The Multiplex Company is in Rhode Island, and is now being puzzled how to get out. They avoid Pawtucket, and I hear will run a tremendously long loop to get into Providence.

PROVIDENCE, Feb. 13th, 1884.

BOSTON.

The New Aspirants for the Telephone Monopoly.—Fairy Stories of the Fabulous Wealth of the Bell Syndicate.—Long Distance Telephony.—The Development of Electrical Inventions.—Underground Affairs.

THE principle topic of electrical conversation for the past month, has been upon the future of the telephone, growing out of the action of the Pennsylvania judge in withholding his decision in the case of the American Bell vs. The Overland Telephone Company. The air has been full of the "downfall of the great monopoly," and the good results which are to follow, when the public have a dozen telephone companies to offer "a more reasonable service." Great clouds of dust are raised, misleading and pernicious statements are made; new companies, all in the interest of the "dear public," are being organized, and stock placed upon the market for the crop of lambs and speculators who have been driven from the regular stocks and stock-markets, because of the biting frosts there found, into what is so plausibly held out as the new telephone mine, where present purchasers can get in "on the lower floor" of prices. Fabulous stories are told of the wealth accumulated by Bell, and all those who were so far sighted (as all *now* see) as to buy the stock at such ridiculously low figures, when it was a drug in the community, and numerous accounts are detailed of parties who had the stock forced upon them, who were obliged to take it for debt, etc., etc. And how all these unfortunates have suddenly become rich, keep house in oriental splendor, drive tally-ho's, serve their guests with two quart tankards of ale, keep in their boot closet a hundred pairs of shoes of all styles imaginable, and so on *ad nauseum*.

If one would but close his eyes and let this stream of fact, fancy, imagination and exaggeration run through his mind, he would think the days of dreamland were actualities, that the philosopher's stone had been found, and that the extravagances of the East had been realized in this long lost Atlantis found. Now it is true that Bell has a certificate of stock of the American Bell Telephone Company for *one share*, also true that his wife holds

certificates for about 2,000 shares, which at the rate of $150 per share, the present market value, makes the respectable sum of $300,000 *not* counting Mr. Bell's *one* share. Our imaginative *news*paper men make Mr. Bell to be worth $3,000,000. This is a sample of what might be called *long distance* telephony. There have been fortunes made in telephone stock, but not such large amounts as have been credited. The effect of this kind of talk is bad upon the public mind, it influences it and leads to wrong conclusions. The fact that new telephone companies can be organized, and their stock floated successfully is largely due to the ignorance of the public of the real facts and conditions of the case. The nearer one lives to the business centre of the telephone, the less speculation there is in new companies, outside of those connected with the Bell Company.

The telephone line now in process of erection between New York and Boston, will pass through New Haven and Providence; the line to follow, if the first one proves a success, will run through New Haven, Hartford and Springfield. The officers of the telephone company look for great results from the new wires—results which will affect an important change in the system of telephonic communication throughout the world. It is stated that in the West long distance talking by telephone is carried on much easier than in the East. More miles can be successfully covered by a single stretch of wire. Experts have been unable to account for this, save in one way, and that is because the meteoric conditions of the earth in the eastern part of the country strongly affect the wires. Another strange thing is that on wires running due north and south conversation is conducted more easily and satisfactorily than on others.

In connection with the boom which the long distance telephone companies, in opposition to the Bell Company, are now receiving from themselves, Mr. Morris F. Tyler, President of the Connecticut Telephone Company in a recent communication to a New Haven paper, says, that the long distance telephoning claimed to have been done by the rivals of the Bell Telephone Company has been done in an experimental way on copper wires by the Postal Telegraph Company, and that upon the same wire precisely as good results have been obtained by the use of the Bell instruments. The Bell Company, he asserts, is not hampered by its contract with the Western Union Company, and the Bell Company is at perfect liberty to build lines from New York to San Francisco if they choose, and the advancement in telephonic art depends in no sense upon the success of either party in the present litigation.

With a view to the commercial development of electrical inventions by fostering advantageous co-operation between the skill of the inventor and the capital of the business man a company, to be known as the Electrical Developement and Manufacturing Company, has been formed. It will aim to furnish to inventors the necessary facilities and assistance to enable them to perfect their inventions, and to reap a fair reward for their ingenuity and skill in case practical results are accomplished. It invites electricians to submit their ideas to thorough scientific, commercial and legal investigation, and will then, if found desirable, carry them forward to completion upon terms which shall be mutually satisfactory. The company by its charter has the right to manufacture, purchase, own, use, apply, lease and sell all kinds of apparatus, machinery and processes connected with the development and application of electricity. Col. Charles F. Wood, well known in this community as for many years the Assistant General Superintendent of the Western Union Telegraph Company in New England, is President and General Manager of the Company, and has established a temporary office at 234 Devonshire Street. The permanent office, laboratory and factory is to be at 197 Congress Street.

After we become as accustomed to the electric light and electrical apparatus as we are to the existence of gas, such incidents as the following will be discounted, and looked upon, as the "misdirected energy" of all other forces now is. One afternoon recently, Mr. Underhill, the clerk of Chief Engineer Green of the fire department, was made a trifle uneasy by a peculiar odor in his office, and, upon investigating, he saw smoke issue from the switch-board of the telephone upon the side of the wall. Calling assistance from the fire-alarm room, he made an examination of the switch-board, but nothing strange was visible, although the smell still continued. Opening the case and running his hand along the annunciators, Mr. Underhill found a red-hot screw on one of the circuits. The withdrawal of one of the rubber pins, which disconnects the circuit, and the opening of the circuit caused a perfect electric light to flash from the opening and set fire to the switch-board. The circuit was immediately disconnected. It is supposed that an electric light wire somewhere on the circuit became crossed on the telephone wire, thereby overcharging the wire. Had the trouble occurred later, or had a less observant man been in the room, a fire of magnitude might have occurred.

Old Boston has not lost her head yet in the underground business. We have had parties before the city government for franchises, exclusive and otherwise, but we are slow about trespassing upon the rights of others. The Western Union have been granted leave to set poles on some of the principal avenues and streets.

It is interesting to notice how the use of electrical instruments is being worked into all the various details of life and business—as an indication: The Fire Commissioners have passed an order directing that hereafter, in order to enable the board to obtain early information regarding bell or still alarms, the engineer or officer in command at a fire shall, as soon as practicable, send to that office through telephone or otherwise, and if the office be closed, to the fire alarm office, information thereof stating where the same occurred, its nature, &c., and shall also send a written account the next morning, with the morning reports, etc., stating such facts as he deems necessary.

There are 15 special boxes in the city, which have been established without expense to the fire department, and without regard to their proximity to other boxes, and they are designed for the exclusive use of the occupants of those buildings at which they are to be found—the theatres, hospitals, City Hall, etc. A call from any one of these boxes is understood by the department to mean that great danger is pending, and an extra force required to respond to the summons.

The Police Commissioners have been authorized to place the police signal system in one police division, at an expense not to exceed $6,000.

BOSTON, Feb. 12th, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York City.*

MEASUREMENT OF ELECTRICAL QUANTITIES.

[3]—For many months past I have used in my own calculations a peculiar system of naming or indicating the practical values of different electric currents. As this system, although somewhat different from the one which the text-books set forth, has enabled me to fix in positive terms an exact description of any required current of electricity, and as I have found myself unable to use the accepted terms in an equally comprehensible way, I desire to ask your opinion of its practical merits as compared with present systems, and would be glad to have you point out the objections to the system which I am using, which I will now describe.

The *volt* I use as the unit of tension exclusively, valuing it as the tension of current produced by zinc and copper in saturated sulphate of copper solution, irrespective of the size or distance of plates.

The unit of *size of current*, irrespective of tension, I value as the size of a current produced by 1 pair of zinc and copper plates in sulphate of copper solution, when the internal resistance of the element is 1 ohm.

I assume that the *size* of a current from any source is inversely in proportion to the resistance of the generator or battery per volt of tension produced. Hence a Grove battery of 2 volts tension and ½ ohm resistance, would produce a current 8 times the size of a gravity battery of 2 volts tension and 4 ohms resistance. A dynamo having 1 ohm resistance and 50 volts tension would produce a current of the same quality, and 100 times greater size than that from a gravity battery having 50 volts tension and 100 ohms internal resistance, and so on. I can thus specify for future use or reference the exact current which I wish to describe, as accurately as a druggist can reproduce a prescription. For instance, having found that 2 very large gravity sulphate of copper cells gave me the exact result I desired in certain electroplating operations, and wishing to make a record of it, I find first the internal resistance of each cell to be 2 ohms. To stick a pin in this spot I accordingly describe, not the battery but the *current* necessary for the purpose, as a current of 2 volts tension and 5 units size, so that no matter what generator I may in future use for the same purpose, I have only to produce a current of 2 volts tension and 5 units size, or what is the same thing, a generator of no internal resistance giving a current of 2 volts tension.

I think, in conclusion, that it might not be the worst thing that could happen to electrical science, in its many practical applications, if every current that was ever found to have produced a given result, could be designated in terms which would be at once a description and a specific direction for its reproduction from any convenient source. MANUFACTURER.

NEW YORK, January, 1884.

[The units proposed by our correspondent do not differ in any essential particular, except value, from those adopted by the Paris Congress in 1881, which had for years before that been in practical use, and which are now generally accepted. The principal intrinsic objection to the units proposed is their uncertain value. The electromotive force—or "tension," as our correspondent prefers to term it—of a zinc-copper pair in saturated sulphate of copper solution varies, under different conditions of temperature, polarization, and other imperfectly understood circumstances, at least 10 per cent. The accepted volt on the other hand, has an absolute and invariable value, which is somewhat less than the average of a Daniell's cell, although for rough work it is customary to reckon the two as equivalent.

Our correspondent's proposed unit of "size of current" corresponds to the ampère, that is to say, it represents a current of 1 volt through 1 ohm.

All electricians are now accustomed to define and describe currents as being of so many volts E. M. F. (tension), and so many ampères (units of size or volume), and this, in the words of our correspondent, "is at once a description and a specific direction for its reproduction."

For example, the electroplating current referred to by him would be technically described as a current of 2 volts and 5 ampères. It is easy to calculate from known data the precise weight of copper that such a current would deposit per hour, as well as what fraction of a mechanical h. p. applied to a dynamo, or what superficial area of plates in a given battery solution would suffice to produce that current. But if the zinc-copper sulphate of copper element were employed as a unit as proposed, we might be 10 or 15 per cent. out in our calculations, which, in doing work on a large scale, would be wholly inadmissible.

The accepted system of units provides for every possible measurement, calculation or record that may be required: but the whole subject has been so befogged by ignorant and incompetent writers, that it has become very difficult for any ordinary person to understand it, unless he dismisses from his mind, once for all, everything which has ever been said in reference to quantity, quality, intensity, tension, and the like; words proper enough in themselves, but which have become so wedded to erroneous ideas of the action of electricity that they will ultimately have to be given up altogether. When the mind is once free from these preconceived ideas, the whole system becomes very easy of comprehension.—EDITOR.]

QUESTIONS AND ANSWERS.

[8.]—**Telephones for Experimental Purposes.**—F. H. D., Hoboken, N. J., asks: "Would it be possible to get a pair of hand-telephones for experimental purposes separate from the entire apparatus? **Ans.** Write to American Bell Telephone Company, 95 Milk Street, Boston, Mass. It is probable that some arrangement could be made.

[9.]—**The Dynamo, How Made and How Used.**—F. M. G., Chelsea, Mass., F. R. S., Cleveland, Ohio, and numerous other subscribers inquire whether the series of articles commenced in THE ELECTRICIAN under the above title are to be continued, and if not, whether the numbers of the *English Mechanic* containing them can be had? **Ans.** We are negotiating with the author for the right to republish this series in full, and hope to resume the publication at an early day. We do not know whether the numbers can be had.

[10.]—**Incandescent Lamps—Telephones—Voltaic Battery.**—A. M. B., Boston, inquires: 1. "Please tell me how much of a current in volts it will take to run an incandescent lamp of 8 candle power experimentally on short circuit? 2. Is the light from such a lamp equal to that of an ordinary gas jet? 3. Will an electric telephone work when the wire on the spools is thicker than No. 40, B. & S. gauge? 4. Will the substitution of charcoal in a Grenet battery increase the power: 5. What would be the power of the cheap voltaic battery described on p. 9 of current volume ELECTRICAL ENGINEER? **Ans.** 1. An incandescent lamp of 8 candle power requires from 30 to 35 watts of electrical energy, the watts being the product of the E. M. F. in volts multiplied into the strength of current in ampères. An Edison lamp as usually made would require about 110 volts, and a Maxim lamp about 70 volts. A lamp may be made to give a certain candle power with high E. M. F. and a comparatively small volume of current, or with a lower E. M. F. and a larger volume of current, depending upon the length and thickness of the carbon filament. 2. An 8 candle lamp gives about half the light of an ordinary gas jet, the latter being usually rated at 16 candles. 3. Yes. 4. No, it will decrease it. 5. The E. M. F. is the same as any Daniell battery—say, 1.08 volts, but the resistance is high, probably about 20 ohms per cell. For working through high resistances, its power would be nearly equal to that of a large battery; but for small resistances it would be very much less.

[11.]—**Battery for Electric Lighting.**—J. A. H., Parishville, N. Y., inquires: "If a battery can be made which will produce an electric light, and if so, how many and what kind of cells will be required?" **Ans.** A large number of very powerful cells are required to produce an electric light. From 50 to 100 Grove or Bunsen cells of at least one gallon capacity are necessary. Such a battery would cost about $200.

[12.]—**Griscom Motor—Carbon Batteries.**—G. L., Parkdale, Ontario, asks: 1. "What size wire is used on the field magnets and armature of Griscom's electro-motor, and how much of it? 2. How can I make carbon plates 6x6x⅜ inches for bi-chromate batteries, as they are difficult to procure here?" 3. Have you discontinued the papers on "The Dynamo, How Made and How Used?" **Ans.** 1. We do not know. Write to the manufacturers, the Electro-Dynamic Company, 224 Carter Street, Philadelphia. 2. You will do better to order your carbon plates of some of the manufacturers advertising in our columns, as such cannot be manufactured without the aid of special machinery. (See Q. 6, p. 42, in our February No.) 3. See answer to Q. 9, above.

[13.]—**Induction Coils.**—T. S. S., St. Louis, Mo., asks: 1. "Can you send detail drawings and description of induction coil suitable for parlor use? 2. Has the above ever appeared in THE ELECTRICIAN? **Ans.** 1. Dyer's *Induction Coil, How Made and How Used*, contains all the necessary information. The publishers of this journal will forward it on receipt of 50cts. 2. It has not.

ELECTRICAL NEWS AND NOTES.

ELECTRIC LIGHTING IN THE SOUTH-WEST.

ST. LOUIS has taken a very prominent position in the introduction of electricity as a means of lighting. Some three years since some of its citizens secured the exclusive agency of the Brush Electric Company, of Cleveland, for several States, viz., Missouri, Kansas, Texas, Arkansas, Louisiana, Mississippi, Tennessee, Kentucky, Southern Illinois, Georgia, Alabama and Florida. They organized a corporation under the laws of Missouri called the Brush Electric Association, and have effected sales of Brush electric lighting apparatus in every one of the States above named. The Brush Electric Association has, through its agents, organized lighting companies in New Orleans, Galveston, Little Rock, Topeka, Memphis, Louisville, Nashville, Macon, Ga., Savannah, Chattanooga, Columbus, all of which companies are now using Brush apparatus sold to them by the St. Louis corporation. In addition, large sales have been made of apparatus to hotels, stores and manufacturing concerns throughout the States named, and there are to-day on the western rivers some fifty steamers using the Brush light.

ANOTHER TELEPHONE CLAIMANT.

THERE was filed in Baltimore, Md., last month, a certificate of incorporation of the Globe Telephone Company, the incorporators being Robert Garrett, William Keyser, James Sloan, Jr., William L. Scott, Alan P. Smith, James McHenry of London, D. H. Bates, John H. B. Latrobe and Howard Munnikhuysen. The company obtains rights from the parent Globe Telephone Company of New York, which hold the claims of Antonio Meucci and the Shaw patents upon improvements in the existing telephone. Meucci is an Italian inventor, who worked with Garibaldi at candle making on Staten Island, and still lives in the house used by the great Italian as a factory. According to a score of affidavits by different witnesses, he has been experimenting with the transmission of sound by electricity since 1849. Many friends and neighbors testify to having seen and tested a successful apparatus of his. In 1871 he filed a caveat in the Patent Office covering the invention of a "sound telegraph" in which a vibrating diaphram and electric current were essential features. Meucci was too poor to obtain a patent, but paid the caveat fee of ten dollars for three successive years, borrowing the money for this purpose. Since the Bell patents became of value, a company has been formed to protect Meucci's rights. A patent upon the telephone made before 1870 by Meucci has been applied for, and the different sub-companies, such as the one in Baltimore, will begin at once to put up telephone systems in competition with the Bell Company. This will of course lead to an application for an injunction by Bell, and then the whole matter of Meucci's rights will be legally decided. The Shaw telephone patents have been purchased by the Globe Company, as they cover important im-

provements. Although the Globe Company claims for Meucci the invention of the essential principle of the telephone, it is admitted that his first instruments were crude affairs, and for this reason the Shaw patents were bought.

DEATH OF GENERAL O. H. PALMER.

AT the time the Western Union Telegraph Company first came into prominence as a corporation of national importance, General Oliver Hazard Palmer was one of its best known and trusted officers. His career was an eventful one, and by his own efforts he raised himself from humble life to positions of importance in both telegraphic and political circles. After participating in the civil war, he was elected Treasurer of the Western Union Telegraph Company in 1863, being then located in Rochester, N. Y. He subsequently moved to New York, and became a Vice-President of the Company, having entire charge of its affairs during President Orton's absence in Europe, remaining a Director in the Company until the last change in its management. He died in this city February 2d.

RESPONSIBILITY FOR ERRORS.

THE Supreme Court of Georgia, in the case of the Western Union Telegraph Company against Shotter, from Savannah, decided that a telegraph company is responsible for the gross negligence of its agents in transmitting messages, in damages to the party injured, and declares that it is immaterial what condition a telegraph company puts upon the printed heading of its message blanks, so far as its liability for negligence is concerned. It is bound to discharge its duty to the public with skill and diligence, and to be accurate in the discharge of such duty, even if it be necessary to repeat messages in order to insure accuracy.

THE TELEGRAPH.

Domestic.

The Postal Telegraph and Cable Co. is now operating about 2,000 miles of wire.

The Baltimore & Ohio Telegraph Co. has bought the Texas & St. Louis narrow-gauge telegraph lines from Cairo, Ill., to Central Texas, including material for the line from Cairo to St. Louis, and for lines to New Orleans via Galveston, all of which are expected to be in operation within 90 days.

Judge Baxter issued an order at Cleveland, O., February 19, restraining the Nickel Plate Railway Company from preventing the Baltimore & Ohio Telegraph Company from operating the lines of the National Telegraph Company until a hearing is had in Cincinnati on March 10th, of the motion for a perpetual injunction against the Nickel Plate road.

A district telegraph company, with four districts, has been started at Salt Lake City.

The Bankers' & Merchants' Telegraph Co. have organized a Law Department in charge of R. S. Guernsey.

The North-western Overland Telegraph & Telephone Company, Chicago, has been incorporated, capital, $3,000,000; incorporators, John M. Gartside, Allen T. Nie and Charles Tahl.

The control of the Chicago Board of Trade telegraph line from Chicago to St. Louis, has been bought by the Bankers' and Merchants' Telegraph Company. The Milwaukee line of the Chicago Board of Trade has not been purchased, but will hereafter be operated by the Bankers' and Merchants' Company. The lines have hitherto been used in connection with the Baltimore and Ohio Company. The Bankers' and Merchants' Company is building a 10-wire line westward from Cleveland, which it expects to complete to Chicago by March 1st.

An application has been filed at Harrisburg, Pa., for a charter for the Western Pennsylvania Telegraph and Telephone Company, with a capital of $100,000. The business is to be confined to the Western Counties of Pennsylvania, and portions of West Virginia, Ohio, New York and Maryland. The chief office will be located at Pittsburg.

The International and Eastern Telegraph Company, with a capital of $5,000,000, was incorporated in Albany, February 18. De Witt C. Wykes, J. G. Johnston and Arthur H. Walker are the trustees.

THE TELEPHONE.

Domestic.

Preston C. Nason, 71 Leonard Street, N. Y., has obtained a fifty-year exclusive telephone concession for the entire republic of Santo Domingo.

The City of Portland, Me., is endeavoring to obtain free telephones, as at least partial compensation for the pole rights granted to the companies doing business within its limits.

The Equitable Telephone Company was incorporated January 16th, with a capital of $3,000,000. It is based on the ownership of the Robertson telephone patents.

The Universal Telephone Company, capital $2,500,000, filed its certificate of incorporation January 30th.

ELECTRIC LIGHT AND POWER.

Domestic.

The Brush Electric Light Company, Buffalo, having secured a large contract for street lighting, are building a new station with a capacity of 600 lights. It will be equipped with 10 60-light dynamos, driven by 10 independent engines of 65 h. p. each. The contract for power was awarded to the Westinghouse Machine Company for their automatic engine, after a competitive test extending over about a month. The dynamos will be belted direct, and no counter-shafting will be used.

A company was organized at Erie, Pa., February 13, for lighting that city by electricity. The capital stock is $100,000, in shares of $100 each, which is all subscribed except 15 shares. W. L. Cleveland is President; J. F. Downing, Vice-President; Charles C. Shirk, Secretary and Treasurer. Contracts have been signed with the Brush Company of Cleveland, and the works will be in operation in 30 days.

The City of Logansport, Ind., is now lighted entirely by electricity under a five years' contract with the Jenney Electric Light Company.

Austin and El Paso, Texas, are now lighted by the Brush system, using the Westinghouse engines.

Seven petitions for electric light franchises have been laid before the Brooklyn Board of Aldermen, all of which have been referred to the Committee on lamps and gas.

The Thomas Electric Light and Power Company has been organized at Ottawa, Ill.

The U. S. Electric Lighting Company has sold its property at 59 Liberty Street, at a handsome advance upon the price paid for it a year ago.

The tower system of electric lighting, which has been adopted at Elgin, Ill., is giving great satisfaction in the suburbs and residence portion of the city. In the business centre, however, where the streets are lined with tall buildings, it is thought that better service is obtained where the lamps are placed at the ordinary height.

Davidson's Opera House, St. Paul, Minn., is lighted by 300 Maxim incandescent lights. The installation is a very complete and successful one, all the fixtures being handsome and artistic in design. The plant was erected by the St. Paul Electric Light and Power Company, a sub company of the United States Electric Lighting Company of New York city.

SUBTERRANEAN LINES.

Domestic.

An experimental line of 10 wires was laid down in Montreal last November by A. T. Woodward, of New York. A company has been formed to extend the system this spring, if it continues to work satisfactorily, as it has done up to this time.

There was an argument before the Committee on Miscellaneous Corporations at Albany, February 19th, on the underground telegraph bill. Burton N. Harrison appeared in behalf of a telephone and telegraph company against the bill. D. S. Robeson, of the Standard Underground Cable Company, described the successful working of underground wires in Washington and Pittsburg, and exhibited specimens of wire encased in lead. He asserted that the burial of wires underground was feasible.

SUBMARINE CABLES.

The new Merchants' Telegraph and Cable Company proposes to lay two light cables across the Atlantic, to be quite different in construction from those now used. They will cost $6,000,000, and are to be furnished within a year.

Mr. Muirhead has contracted with Mackay & Bennett for supplying his duplex system to the new cables which are to be laid by the Commercial Cable Company.

Articles of Association of the Merchants' Telegraph and Cable Co. were filed in New York, January 29th. Its capital is fixed at $13,000,000, with the privilege of increasing to $20,000,000 The corporators are Thomas L. James, Anderson Fowler, Matthew C. D. Borden, Edward A. Quintard, David Bingham, William A. Cole, Edwin R. Livermore, Henry W. O. Edye, Adolph D. Straus, John H. Herbert, John F. Plummer, Edward H. Tobey and Vernon H. Brown.

The steamer Faraday, which left Queenstown some time ago with a portion of the new Mackay cable on board, has returned to Portland. She has lost her port propeller, and is going to London for survey.

MISCELLANEOUS.

Domestic.

The following new companies have recently been incorporated: The Police Telephone and Signal Company of Chicago; capital, $100,000; incorporators, E. Bruce Chandler, Wm. C. Green and Chas. Hawkins.

The Blair Electric Company of Chicago; capital, $100,000, incorporators, Benj. S. Heath, Aaron P. M. Jeffers and Wm. Coffman.

It is a curious and important fact that pieces of wire cable of the Fairmount Suspension Bridge, recently taken down at Philadelphia, after being in use some forty years, were found to be fully equal in tenacity, elasticity and ductility to the best wire of that size now in the market.

The annual election of officers of the New York Electrical Society will take place at the next regular meeting, Wednesday, March 5.

Foreign.

The Glasgow *Medical Journal* describes an electro-magnet having a power to raise upon its point a weight equal to six ounces. It has been used successfully in cases where workmen in iron and steel have been severely wounded by flying chips, and the writer says that such instruments must henceforth become an essential part of the apparatus of ophthalmic surgeons.

A certain Herr Sauer has produced an electric battery which will work in the sunlight and not in the shade. The point is that the sunlight, whether by chemical effect or in some other way, is made to help work an electric battery. The object will be to get the sunlight to do as much of the work as possible, and to reduce the cost of the other elements employed to a minimum. Then, supposing that cheap and portable accumulators can be invented, instead of the cumbrous and expensive appliances now in use for storing electricity, force enough may be obtained out of the sunshine of a single Summer to drive all the mills and railway trains in the country for years.

MANUFACTURING AND TRADE NOTES.

Domestic.

The Western Electric Company transferred about 125 employees from Indianapolis to Chicago upon the removal of its factory from the former city. The works of the company are actively devoted to the manufacture of telephones and the various telephone attachments. When completed the Chicago factory will employ between 300 and 400 persons.

Cumming and Brinkerhoff, of New York, have been awarded "El Gran Premio" Medalla de Oro, at the Caracas, Venezuela Exposition of 1883, por su nuevo contacto telegrafico. This gold medal is accompanied by a special diploma of commendation signed by the President and ministers of the Republic.

Graham and Johnson, of Chicago, are making three tons of brass castings for electric brakes to be used on one of the street railways in that city.

The Union Electric Manufacturing Co. has closed its downtown office at 86 Liberty St., and all business will be transacted hereafter at the Factory, No. 9 Bond St.

The Cunningham Iron Works, Boston, have recently furnished two 100 h. p. boilers to the Merchants' Electric Light and Power Co., Boston.

The Standard Electrical works of Cincinnati have passed through the ordeal of Ohio floods, and are now prepared to execute orders promptly. They are receiving large orders for their new magneto bell, which is giving universal satisfaction.

Foreign.

The Western Electric Company has established an agency in London, at 59 Moorgate St. E. C., for the sale of its goods in England.

During the year 1883 the Siemens Bros. have fitted up electric lighting systems in 20 steamships.

ELECTIONS AND APPOINTMENTS.

The following board of directors has been elected by the Hudson River Telephone Company: James Bigler, Theodore N. Vail, Charles R. Truex, Andrew B. Uline, Charles S. Beardsley, Dexter A. Smith and H. L. Storke.

W. C. Price has been appointed Assistant Superintendent of the Baltimore and Ohio Telegraph Company, New York, and W. A. Schutt, Superintendent of the District service of the same company.

Charles Selden, who, as a Superintendent of Telegraph for the Western Union, has had charge of all lines and offices of the Wabash system, has resigned his place, and on March 1 will enter the service of the Baltimore and Ohio Telegraph Company, with headquarters at Baltimore, having charge of the railroad and commercial telegraph business over the Baltimore and Ohio Railroad Company's lines east of the Ohio River, to and including the State of Maryland.

The annual meeting of the American Telegraph Company, of New Jersey, was held in the Western Union Building Jan'y 30. The following were elected Directors: Norvin Green, Thomas T. Eckert, Jay Gould, Augustus Schell, John Van Horne, Harrison Durkee, George J. Gould, Charles A. Tinker, Roswell H. Rochester, William H. Abel.

A. S. Brown, formerly of the Mutual Union Telegraph Company, has been appointed an assistant to General Manager Eckert of the Western Union.

PERSONAL MENTION.

George H. Fianly, Superintendent of the Brooklyn Police Telegraph Department has resigned, after 27 years' service. He has been placed on the police pension list at $1,000 per annum.

George G. Ward, for the past ten years General Superintendent in this country for the Direct United States and the French Cable Companies, has resigned his position, and will hereafter be connected with the Bennet-Mackay Commercial Cable Company Mr. James Brown, who came from London nearly nine years ago, as Mr. Ward's assistant, has been appointed General Superintendent to fill the vacancy. Mr. Ward will soon open an office in this city for the new company.

Fire Marshal Swenie, City Electrician Barrett, and Commissioner of Public Works Cregier, of Chicago, have been visiting Boston, New York, Philadelphia and Pittsburg, examining the underground telegraph systems with a view to their introduction in Chicago.

Francis W. Jones, late Vice-President of the Union Electric Manufacturing Company, has retired from that position, and received the appointment as Electrician of the Bankers' and Merchants' Telegraph Company.

FINANCIAL.

NEW YORK, Feb. 21, 1884.

The market for telephone securities is firm. The American Bell shares have fairly recovered from the panicky quotations of last month, caused by the action of the United States Court in Philadelphia, and it is therefore apparent that the promulgation of printed documents in the Drawbaugh interest has had little effect upon the market value of the stock. There is little doing in electric light securities, which remain quiet. Our quotations are from the Electric Manufacturing and Miscellaneous Stock Exchange, with the exception of the active telegraph stocks, which are listed at the New York Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	175 00	—	Molecular	4 00	—
Am. Speaking	110	—	New England	47 50	—
Currier-Tele. Bell	2 00	—	N. Y. & Penn	—	82 00
Columbia & Pan	19 87	20 00	Overland	7 00	—
Continental	12 00	—	Peoples	9 00	11 00
Erie	30 00	—	Shaw	20 00	—
Hudson Riv	60 00	90 00	Southern N. E.	—	172 00
Inter-Cont	75	—	Tropical	1 60	—
Mexican	2 50	—	W. I. Tel. & Telph	1 00	2 00
Mexican Central	—	3 25			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	60 00	—	Postal Tel. Bonds with stock	58 00	—
Bankers' & Merchants'	125 87½	125 62½	do. (new Co.)	16 00	—
Postal Tel. (stock)	7 87	8 13	Western Union	76 75	77 00

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	4 00	5 50	Edison European	3 00	—
Brush Ill	—	75 00	Excelsior	—	28 00
Daft	—	85 00	Fuller Elec	—	28 00
Edison	145 00	153 00	Swan	—	40 00
Edison Ill	58 00	65 00	U. S. Electric Light	—	110 00
Edison Isolated	80 00	100 00			

Upon the basis of the price paid by the B. and O. Telegraph Company for the National Telegraph lines to Chicago, Vice-President Van Horne estimates the value of the Western Union property at about $120,000,000.

The Bankers' and Merchants' Telegraph Company has mortgaged its Connecticut property located in 42 towns as security for a loan with which its facilities are to be greatly increased.

The affairs of the old Mexican National Telephone Company having been wound up, its stockholders are entitled to a surrender value of 38 cents per share.

The net earnings of the New York and New Jersey Telephone Company were $128,538 for the 15 months ending December 31st, 1883.

The U. S. Electric Light Company of Biddeford, Me., has declared a dividend of 5 per cent.

The Edison Company for isolated lighting has declared a dividend of 4 per cent. on its paid-up capital.

The Bankers' and Merchants' Telegraph Company has declared a quarterly dividend of 2 per cent., payable March 10.

The Southern New England Telephone Company has declared a quarterly dividend of 2½ per cent.

The U. S. Electric Light Company of Biddeford, Me., has declared a dividend of 5 per cent.

The American Insulator Company has increased its capital stock from $60,000 to $120,000, and the New York Electric Supply and Construction Company from $50,000 to $100,000.

The Mutual District Messenger Company, of Boston, has declared a quarterly dividend of $2 per share, payable March 1st. The net earnings for the last quarter were $5,309.91, over 11 per cent. on the capital.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope, Edgecomb & Butler, *Solicitors of Patents for Electrical Inventions, 32 Park Place, New York city.*

LEGAL NOTES.

United States Circuit Courts.—*Dryfoos v. Wiese*, was a suit brought in the Southern District of New York, for alleged infringement of patent for improvement in quilting machines, original patent having been dated May 1, 1877, reissued January 20, 1878, and again reissued February 24th, 1880. Defendants contended that reissue was not valid and also that there was no infringement. Wheeler, J., held that a claim in a reissue covering an invention clearly beyond that shown in the original is invalid, however short the time elapsing between the reissue and the original patent; although in the present case the first reissue being within a few months of the original, and before other parties appear to have done anything in that region of invention, is not objectionable on that account. The second reissue claimed a process of operating a certain mechanism, being in effect for the combination of the gang of needles and the cloth plate with any feeding mechanism which would reach across the cloth and feed the long side faster than the other. This claim was held to be too broad and therefore wholly invalid; but another claim in the first reissue brought forward into the second, being valid in the first, is not avoided by reason of the invalid claim of the second. This claim, however, was not infringed, as the defendant used a different feeding mechanism.

United States Patent Office.—Commissioner Butterworth has rendered an opinion touching the right of an employee of the Patent Office to file an application for a patent, in view of Sec. 480 of the Revised Statutes, which provides that all officers and employees of the Patent Office shall be incapable, during the period for which they hold their appointments, of acquiring or taking, directly or indirectly, except by inheritance or bequest, any interest in any patent issued by the office. The Commissioner holds that it is equally clear that employees are alike prohibited from filing or prosecuting an application for a patent, inasmuch as such application is the basis upon which the right to a patent rests, and the evidence of the applicant's title to the exclusive right or privilege sought. But since he can acquire no interest in the thing itself, to say that he might nevertheless take steps to establish his title thereto, would be absurd. Public policy and common justice to the inventors of the country who are prosecuting claims for patents before the office, render it necessary that the statute be strictly enforced. Applications in contravention of the statute as construed are directed to be returned with the fee. *Ex parte Buell.* In this case an application for transmitting and signal telegraphs was filed in 1876, showing and describing a certain system. The Examiner required applicant to amend the drawings so as to illustrate the application of the system, whereupon an additional figure with brief description was filed, illustrating a clock dial. In 1883 applicant filed a new application, claiming to be a division of the former one, and relating back to it, in which specific claims were made to the new matter which had been introduced. The Commissioner held that an application based upon matter introduced into a pending application cannot be considered as a division of that application, but must take date from the time of filing, remarking, however, that amendments merely explanatory in their nature are not viewed with the same strictness as those the purpose of which are to serve as a basis for a new claim. *Ex parte Hentz.* In this case it was held that several different claims to a composition of matter, though distinct, covering associations of elements which contribute to the production of a single beneficial result, which do not fall in different classes in the office classification, cover, properly speaking, but a single invention, and may be included in one application. *Ex parte Borden.* Applicant's patent was rejected on reference to a drawing in a prior U. S. patent in which his invention was clearly shown, although no description of it appeared in the specification as issued. The Commissioner held that a novel thing, the invention of a patentee and fully shown and published in the drawing of his patent, even though not belonging exclusively to him, and not included in his claims and even incapable of being claimed upon reissue, cannot be given to a subsequent applicant. If lost by the patentee it has become the property of the public. Even if a published drawing without description fully and clearly exhibits and discloses an invention, it is an adequate and complete reference to a subsequent invention sought to be patented, and must be considered as a prior publication.

CLASSIFIED LIST OF UNITED STATES PATENTS.

From January 22 to February 12, 1884 (inclusive).

Alarms and Signals :—*Apparatus for Transmitting Signals*, A. Abaknowicz, Jan. 22, 292,193. *Magneto Alarm*, J. R. H. Hinton, 292,311. *Signaling Apparatus*, L. J. Crossley, W. Emmott and J. F. Harrison, Jan. 29, 292,642. *Distress Signal*, T. B. Joseph, Jan. 22, 292,317. *Burglar Alarm*, J. P. Hanson and J. P. Christensen, Feb. 5, 292,805, 292,807. *Alarm Signal for Hot Journals*, C. H. P. Cornelius and C. H. Turner, Feb. 5, 292,992. *Bell Ringing Apparatus*, Feb. 12, 293,571.

Clocks :—G. M. Herotizky, Feb. 12, 293,013. *Device for Synchronizing Clocks*, C. N. Talbot, Feb. 5, 292,992.

Commutators :—*Circuit Breaker for Annunciators and Gas Lighting Apparatus*, T. H. Rhodes, Jan. 29, 292,586. *Circuit Closer for Telegraph Keys*, S. J. Spurgeon, Feb. 5, 293,105.

Conductors, Insulators, Supports and Systems :—*Laying Branch Underground Conductors*, W. J. Phillips and G. L. Kitson, Feb. 12, 293,271. *Manufacture of Compound Electrical Wire*, L. L. Smith, Feb. 12, 293,532. *Conduit*, T. L. Smith, 293,533. *Connector*, S. Ryder, Jan. 22, 292,180. *Conductor*, E. Weston, Jan. 29, 292,717; A. A. Cowles, Jan. 29, 292,539. *Insulated Conductor*, W. A. Shaw, Jan. 29, 292,694. *Fusible Safety Strip*, E. Weston, Jan. 29, 292,713. *Device for Connecting Same*, Jan. 29, 292,716. *Electric Circuit*, Jan. 29, 293,718. *System for Electrical Transmission of Power*, E. Weston, Jan. 29, 293,721. *Covering for Underground Cables*, P. H. Vander Wyde, Jan. 29, 292,770. *Compound Cable*, H. Van Hoevenbergh, Jan. 29, 292,772. *Protector for Electric Circuits*, J. W. Dyer, Feb. 5, 293,796. *Aerial Cable*, W. R. Patterson, Feb. 5, 292,847. *Terminal Box for Cables*, 292,848. *Telephone Cable Terminal*, 292,849. *Asphaltic Concrete Conduit*, W. W. Averell, Feb. 12, 293,214. *Insulator for Electric Wires*, A. W. Hale, Feb. 12, 293,242.

Dynamo Machines and Motors :—*Regulator for Motors*, L. W. Stockwell, Jan. 22, 292,382. *Ditto for Dynamo*, E. Weston, Jan. 29, 292,715; E. H. Amet, Jan. 22, 292,397. *Electrical Generator or Motor*, E. Weston, Jan. 29, 292,719; T. A. Edison, Feb. 12, 293,432. *Motor*, A. E. G. Lubke, Feb. 5, 292,930; W. Bradbury, Feb. 12, 293,556. *Dynamo Machine*, F. K. Fitch, Feb. 12, 293,441; J. S. Sellon, Jan. 29, 292,691; W. F. Buckley, 293,625. *Traction Motor*, W. E. Ayrton and J. Perry, 292,529. *Mechanism for Driving Dynamo Machines*, J. R. Markle and J. B. Wayne, Feb. 12, 293,482.

Galvanic Batteries :—I. C. Himmer, Jan. 22, 292,310; T. J. Howell, 292,483; C. L. Clarke and J. Leigh, Feb. 12, 293,503. *Automatic Feeding Apparatus for*, F. L. Pope, 293,372.

Ignition :—*Gas Engine*, A. K. Rider, Jan. 22, 292,178. *Tip for Gas Burners*, A. T. Smith, Jan. 22, 292,374. *Operating Electrical Devices*, A. L. Bogart, Feb. 5, 292,785. *Gas Lighting Attachment for Burglar Alarms*, A. L. Bogart, Feb. 5, 292,786. *Gas Lighter*, E. H. Jenkins, Feb. 12, 293,320.

Lamps :—*Incandescent*, E. R. Knowles and F. E. Idell, Jan. 22, 292,324; E. Weston, Jan. 29, 292,720; T. A. Edison, Feb. 12, 293,434. *Reflector for*, J. S. Beeman, Jan. 22, 292,403. *Holder for*, A. Swan, Jan. 22, 292,447. *Alarm for*, J. Olmsted, Jan. 29, 292,761. *Arc*, O. A. Moses, Feb. 5, 292,840; Feb. 12, 293,495; F. K. Fitch, Jan. 22, 292,293; L. Piette and F. Krizik, Feb. 5, 293,076. *Holder for Incandescent Lamps*, J. Laugnereau, Feb. 12, 293,256. *Electrical Extension Bracket*, J. E. Giles, 293,318. *Socket for Electric Lamps*, S. Bergmann, 293,552. *Combined Gas and Electric Lamp Fixture*, 293,553.

Measurement :—*Galvanometer*, A. K. Eaton, Jan. 22, 292,101. *Means for Measuring Velocities*, F. W. Cushing, Feb. 12, 293,426. *Meter*, T. A. Edison, Feb. 12, 293,435.

Miscellaneous :—*Electro-Magnet and Armature*, I. A. Thumis and S. C. C. Curric, Feb. 5, 293,116. *Magnet*, C. M. Many, Feb. 12, 293,336. *Locating Veins of Metal*, J. Prince, Feb. 12, 293,518. *Electrical Indicator*, E. Weston, Jan. 29, 292,714. *Lightning Diffuser*, L. G. Woolley, Feb. 12, 293,512.

Railway Appliances :—*Switch Circuit Closer*, C. A. Scott, Jan. 29, 292,687. *Interlocking Switch Apparatus*, O. Gassett, Jan. 29, 292,743. *Signaling Apparatus for Crossings, same*, 292,744. *Signal*, J. C. Upham and J. P. Rogers, Feb. 12, 293,381. *Insulation for Track Circuits*, T. A. Edison, Feb. 12, 293,433.

Storage Batteries :—*Secondary Battery Element*, W. E. Case, Jan. 29, 292,469. *Electric Accumulator*, G. Phillipart, Jan. 29, 292,762.

Telephone Systems and Apparatus :—*Magneto Generator*, W. J. Bowen, Jan. 22, 292,153. *Transmitter*, J. H. Cheever, Jan. 22, 292,203; H. E. Waite, Jan. 29, 292,603; H. C. Buck, Feb. 12, 293,561. *Telephonic Transmission*, W. H. Eckert, Jan. 22, 292,212. *Apparatus for do.*, J. F. Mehren, Feb. 5, 292,885. *Magneto Telephone*, T. D. Lockwood and T. W. Lane, Jan. 22, 292,335. *Looping-in Mechanism and Operator's Apparatus for Telephone Exchanges*, E. M. Wilson, Feb. 5, 293,206. *Telephone Switch*, C. E. Scribner, Feb. 5, 293,198. *Annunciator Switch and Circuit*, Feb. 5, 293,197. *Night Signal Circuit for Exchanges*, Feb. 5, 293,196. *Call Box*, J. M. Oram, H. M. Sutton, and H. Garrett, Jan. 29, 292,570. *Receiver*, H. E. Waite, Jan. 29, 292,602. *Gas and Magnetic Telephone System*, J. H. Rogers, Feb. 5, 292,857. *Pipe Telephone*, 292,858. *Telephone Case*, P. Benjamin, Feb. 5, 293,130. *Telephone*, A. Ware, Feb. 5, 292,881; D. Drawbaugh, Feb. 5, 293,154. *Testing Apparatus for Multiple Switch Boards*, C. E. Scribner, Feb. 5, 292,866. *Condensers and Test Circuit for Multiple Switch Boards*, 292,865. *Signaling Apparatus*, L. S. Fairbanks, Feb. 5, 293,209. *Call Bell Switch*, L. Townsend, Feb. 5, 293,118. *Circuit Changer*, C. D. Haskins, Feb. 5, 293,171. *Driving Gear for Magneto Machines*, E. T. Gilliland, Feb. 5, 293,160. *Telephone Apparatus*, Feb. 5, 293,161, 293,162.

Telegraphs :—*Autographic*, M. H. Wilson, Jan. 29, 292,607. *Printing*, H. Van Hoevenbergh, Feb. 5, 292,966. *Automatic*, T. F. Taylor, Feb. 5, 293,110. *Same, System*, 293,111. *Same, Marking Stylus for Automatic Telegraphs*, 293,112.

THE ELECTRICIAN AND ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York City.

TERMS OF SUBSCRIPTION.

United States and Canada, - - - - - - - per annum,	$1.00
Six Copies, - - - - - - - - - - "	5.00
Great Britain and other Foreign Countries within the Postal Union "	1.50
Single Copies, - - - - - - - - - -	.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of the* ELECTRICAL PUBLISHING CO. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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NEW YORK, APRIL, 1884.

THE ELECTRIC LIGHT TESTS AT CINCINNATI.

IT will be remembered that in THE ELECTRICIAN of November, 1883, some editorial comments were made, criticising with considerable severity the methods pursued by the jury of scientific experts to whom was entrusted the tests of electric lighting machinery and systems at the Cincinnati Exposition, then recently closed, in which the opinion was expressed that the results were anything but satisfactory, and should be regarded with suspicion, both from a commercial and a scientific point of view. Soon after the appearance of this article, the publishers of THE ELECTRICIAN received the following communication:

ELEVENTH CINCINNATI INDUSTRIAL EXPOSITION.
Board of Commissioners.

CINCINNATI, Nov. 3, 1883.

Messrs. WILLIAMS & Co.:

Gentlemen,—I see in the last (November) issue of THE ELECTRICIAN an editorial on the "Electric Light Tests at Cincinnati," in which you make statements which are entirely erroneous.

I do not desire to enter into a controversy on the subject, but simply request that you publish nothing until you are informed from reliable sources.

The jury who had the tests in charge are preparing a full report of the instruments used; readings made, and the final results obtained, and I would respectfully suggest that you defer your criticism until then. This report will be published in full.

In regard to your statements that the work of the jury was done in a "hurried, crude and slipshod manner," is entirely false, likewise "that representatives of the various companies were not permitted to be present at all the tests and measurements."

Yours very respectfully,

(Signed) W. L. DUDLEY.

In compliance with the request of Mr. Dudley, we refrained from further comment upon the matter, until after the publication in *Science* of February 15, 1884, of an unsigned article, which we suppose to be the report "in full" referred to in the above letter. We publish in another column of our present issue the first installment of a careful review of this report by F. L. Pope, which will be found to contain ample evidence of the untrustworthy character of the results obtained by the "experts" employed by the commissioners of the exposition. We also publish elsewhere a letter on the same subject from Mr. Howell, the electrician in charge of the Edison exhibit at Cincinnati, in which he seeks to break the force of our criticisms upon the work of the jury, by showing that they made an error of about 1 H. P. in calculating the electrical work in the exterior circuit of the Edison dynamo, apparently as it would seem because they were not aware that the electromotive force of a Daniell cell should be valued at 1.079 instead of 1.100 volts. Mr. Howell's testimony is of considerably more value to the prosecution than to the defense. If our statements need any additional confirmation beyond the figures given by Mr. Pope, it may be found in Mr. Howell's explanation.

It may be true that no formal or official action was taken by the commissioners or by the jury, excluding the representatives of the competing electric lighting companies from the testing room while the measurements were being made, but practically this result was attained by the method of procedure employed.

It is not a pleasant duty to condemn the work of a body of presumably competent scientific men, who have undertaken the somewhat ungracious task of deciding between rival electric lighting systems and machines of nearly equal merit. But it must not be forgotten that vast commercial interests may be involved in the decision, and that in any event the parties immediately interested as exhibitors, as well as that portion of the public who are or expect to become purchasers or users of electric lighting plants, have a right to insist upon a reasonable degree of accuracy and fairness in the results which are authoritatively put forth by such an official body as the Board of Commissioners of the Cincinnati Exposition. Whether or not results of this character have been reached in the present case, is a question which we propose to enable every competent person to determine for himself.

THE GOVERNMENT TELEGRAPH INVESTIGATION.

WHATEVER may be the ultimate result of the testimony lately taken before the Senate Committee on post-offices and post-roads, the accumulation of facts thus obtained is of considerable interest, and we have reason to congratulate ourselves that there still remains a tribunal which has the power to gather and publish them. It is not to be supposed that the general public is sufficiently interested in the question under discussion to examine carefully the vast array of opinions, which are thus obtained from experts, who are men usually identified with the present state of affairs, or who hope to better their condition, by a change in the proprietorship of the telegraphic system from the existing telegraph companies to the national government. There are occasional movements, conceived in the interest of the people, which are the subjects of discussion for years, but gradually obtain increasing momentum with the lapse of time, until the development of public necessity reaches that point when all opposition is suddenly swept

away, and the question of profit or loss disappears amidst the general congratulations upon the successful completion of the work. The Erie Canal, the Pacific Railways, the New York and Brooklyn Bridge, and even the original Morse telegraph itself, are all examples of local or national government assistance in the establishment of enterprises which were too visionary to attract the unaided support of private capital. There are thousands of other instances, however, where private corporations, while not receiving government pecuniary aid, have been granted valuable franchises, by the exercise of which they were enabled to give assurance to investors, which could have been obtained in no other manner. Such privileges, developed by the capital thus attracted, have often become the most valuable part of the property. As an illustration of the value even of a private franchise, it is shown by the testimony taken by the committee, that the New York *World* was sold at one time for the value of its privileges as a member of the Associated Press, $250,000. It may also be mentioned, incidentally, that in the opinion of its General Manager, the Associated Press is not a monopoly. It is simply the most innocent co-partnership that can be imagined. It possesses the same charming features peculiar to all organizations of that kind—very comfortable and cosy to those who are inside, very cold and cheerless to the large and clamorous crowd outside. Whatever may be the record, those who are familiar with telegraphic history are well aware that notwithstanding the success of the telegraph under private administration, it must be admitted to have fallen far short of its possibilities. The management has often been so short-sighted as to thwart its own interests, owing to the narrow view of the world to be obtained from the seclusion of a private office. While on one hand it is asserted that the post-office department is incapable of properly managing the telegraph, on the other we behold a pitiful appeal from the same direction, that the government will not jeopardize the interests of the widow and the orphan, by entering into competition with the present incumbents.

The prevailing agitation is not by any means the offspring of an hour. For the last 15 years it has been before the people, and the discussion has fluctuated in unison with the different lines of policy pursued by the telegraph management. During that time almost the entire number of land telegraph systems in the world, outside of America, have passed into the control of the various governments under which they were formulated. While it is claimed that this has been done to permit the more despotic rulers of the old world to exercise their censorship over the telegraph at will, a more reasonable supposition is, that there is no country in the world where capital is so successful in attaining its selfish ends as in this republic of ours.

The important question of the valuation of existing telegraph properties, is receiving considerable attention in this discussion. It is assumed that if the Western Union system can be duplicated for $20,000,000, the government should not be expected to pay three or four times that amount for the existing property. It is a grave mistake to suppose that the value of such a corporation is merely that of the poles, wires, batteries, instruments, etc., which compose its plant. The patents, franchises, earning capacity, and good will, are by no means the least of its assets; and we have no doubt that a syndicate of capitalists could be found any day who would be willing to pay the par value of the stock, to enjoy the same privileges which will accrue to the government in the event of its assuming control of the business. Without disputing the right of the government to enter the field as a competitor for telegraphic patronage, it would certainly not be in the interest of economy to erect a duplicate system of lines, allowing the original property to be wasted by decay for want of use, although this is a result which could scarcely be anticipated, in view of the rapid development of the telegraph business under the stimulus of competition.

The post-office department has for years past been engaged in active competition with the express companies, and is carrying a large amount of merchandise every day at an actual loss, yet we hear nothing of its ruinous effect upon these companies.

There appears to be an unnecessary amount of investigation expended upon this question. Nothing short of actual experience can satisfy the theorists of both sides, as to whether a universal rate as low as 10 to 25 cents will prove to be remunerative.

WHAT SHALL THE HARVEST BE?

The pit which is to engulf the Bell telephone "monopoly" is being digged deeper and deeper, and scarcely a month elapses in which some new scheme is not developed to aid in the accomplishment of this philanthropic undertaking. To those who are familiar with the antecedents of many of the parties who engineer these raids upon established institutions, their piteous appeals and ingenious arguments in behalf of a long suffering public, are, to use a mild term, exceedingly entertaining. Admitting for the sake of argument, that the utmost which these public spirited and self-sacrificing promoters eventually hope to accomplish could be actually brought about, the question nevertheless arises as to how much of an improvement would be likely to be wrought by the change? Who will guarantee that the philanthropists who now seek to destroy the Bell patents will deal any more liberally with the public, in the event of their success, than the present possessors of the flesh-pots? If the result is to be nothing more than the overthrow of the controlling telephone patent, thus leaving the business open to all competitors—which is the avowed purpose of at least one of these organizations—it is difficult to see what tangible property the purchasers of these alleged telephone "securities" are to get in return for their investment. No small portion of the hue-and-cry about the exorbitant rates exacted for telephone exchange service, comes from a class of people who have no earthly use for a telephone in any case, and to such it is dear at any price. If a business man actually requires facilities of this kind, the rental in the most extreme cases is by no means a very onerous tax. What every subscriber has a right to demand, however, is that the service shall be of the most efficient character, and where the local company is in a reasonably prosperous condition it will usually be found that the management is eager to adopt desirable improvements, and to secure intelligent employees, so that as a matter of fact a subscriber is much better satisfied than he would be by paying a lower rate, and then being continually annoyed by various shortcomings, which in the course of a month would perhaps in the aggregate represent a far greater loss of his own time than the entire rental would amount to. A great deal of literature has been distributed within the past few months in the interest of these different schemes, which is intended to prove that the Bell patents must at an early day be declared invalid; but what investors would do well to inquire into is, whether they are getting anything tangible in return for their money, and if so, what it is. When we learn that a certain group of patents is valued at $4,999,450, we naturally become interested to know how and by whom the price was fixed, and why their validity is any better assured than that of the Bell patents, for instance. It would also be interesting to learn how the "poor inventors" are thriving under the guardianship of these enterprising gentlemen who have suddenly taken such a deep interest in their welfare. To sum up the case, we would ask if it is at all probable that any people are to be materially benefited other than those who are actively engaged in disposing of shares in the enterprise for a moderate cash consideration.

THE LATE COMTE DU MONCEL.

It is with profound regret that we are called upon to record the death of Th. Achille-Louis Du Moncel, one of the most eminent and best known electricians of the day, which took place, after a brief illness, at his residence in Paris, on February 16th. He was a native of that city, where he was born March 6th, 1821. Early in life he manifested a decided talent for drawing, as well as a marked taste for archæology and natural science, his first publication appearing when he was scarcely 18 years of age. In the pursuit of his studies in archæology he subsequently undertook long journeys to the south and east of Europe, the results of which he published in 1847. It was, perhaps, fortunate for electrical science that on account of the unwillingness of his family to provide the necessary encouragement and support, he abandoned the pursuit of art and devoted his attention almost entirely to the study of electricity. The earliest of his writings upon this subject appeared in the *Journal de l'Arrondissement de Valogues* in 1852. From that time until his death, he was a thorough investigator and industrious writer in his chosen department of science. The most important of his works, *Exposé des Applications d'Electricité*, was also one of his earliest, being first printed in 2 volumes during 1853-4, and subsequently republished and enlarged to 5 volumes.

His books, *Le Telephone*, *L'Eclairage Electrique*, *Le Microphone et le Phonographe*, and many others, too well known to require enumeration, appeared in rapid succession, and tended greatly to popularize the subjects of which they treated. He made numerous reports to the Academie des Sciences, and issued a considerable number of pamphlets upon subjects relating to electricity and magnetism. No less than 65 of his printed works may be found in the library of the Society of Telegraph Engineers and Electricians, in London. In 1879, he assumed the scientific editorship of *La Lumière Electrique*, in which he published a continued series of interesting and important articles upon various electrical problems which are still engaging the attention of the scientific world. Probably no author has done more in the direction of familiarizing the general public with the wonders of electricity. His faculty of description was remarkable, and the facility with which he handled the pen, enabled him to make the best use of his genius. Although a practical electrician and inventor, he was, perhaps, more properly speaking, an experimenter, and was very careful in verifying most of the effects which he described.

Personally he was one of the most amiable and prepossessing of men. Poor inventors, inquirers for scientific information, in fact all who were interested in electrical matters, were invariably received with the most distinguished courtesy and treated with the most patient consideration, while the impartiality and accuracy of his judgment was one of his most marked characteristics. His funeral took place on the 20th of February, and was generally attended by all resident scientists.

ELECTRIC LIGHT LITIGATION.

The litigation which has been in progress for the past 2 or 3 years between Charles F. Brush and the Brush Electric Company and C. H. Condit and others, now represented by the United States Electric Lighting Company, is approaching its termination. The action was brought by the former parties in the United States Circuit Court of the Southern District of New York, alleging infringement of two patents granted to Mr. Brush, one for metal-plated carbons and the other for an electric lamp, the latter embracing the well-known ring-clutch movement of the Brush arc lamp, which is alleged to have been used in the Weston lamp sold by the defendants. The ablest attorneys and experts in the profession have been employed, and a vast mass of evidence taken on both sides. The case was recently heard by Judge Shipman at Hartford. The arguments occupied several days, and attracted much attention in legal circles by reason of the unusual array of eminent counsel who took part in the proceedings. It may be some time before the decision is announced.

It has been very commonly supposed that the result of this litigation would have an important bearing upon the future of the arc lighting business in the United States, but we are unable to see that any fundamental principle is involved in the case. The defendants brought forward such strong proof of lack of novelty in respect to the first patent, that proceedings under it were virtually dropped, while the remaining patent has virtually been limited by disclaimers to the particular mechanism of Brush, so that it would seem to be easy to devise an equally efficient lamp movement without danger of infringement upon the patent. The real scope of the position of the Brush Company is due not so much to the strength of its patents as to the foresight, energy and executive ability with which its business was originally established, and an extensive field of operation covered at a time when others had scarcely awakened to the commercial importance of the business, and this has given the Brush Company a prestige that its competitors have found it difficult to overcome. It seems probable, however, that the present suit may be followed by others possibly involving principles of greater importance.

ARTICLES.

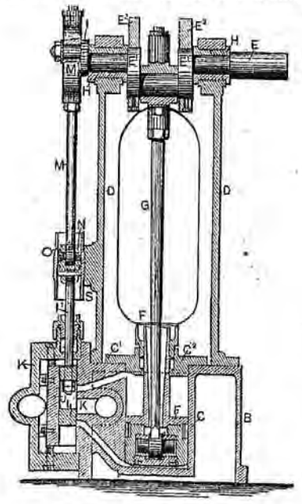
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

V.—SPECIAL FORMS—(*Continued*).

THE ERICSSON AND WESTINGHOUSE ENGINES.

All of the engines which have been considered in the preceding articles are of one general type—that known as the "double-acting reciprocating engine." Before the time of James Watt, the only engine in extended use, even in the limited field in which the steam engine was then employed—that of pumping water from mines—was a "single-acting" engine—the Newcomen engine, which had then almost entirely superseded the so-called engine of Savery. Watt invented, first, the separate condenser, and then the double-acting engine, thus increasing the power of the machine and rendering it, at last, applicable to the turning of a crank and the driving of machinery and mill-work. In the "single-acting engine," the steam drives the piston in but one direction, and the return stroke must be made without the production of useful work. In the "double-acting engine," the steam acts upon the piston in both directions, and with practically equal effect. Thus, a more regular action is secured with a given weight of balance wheel, or the same regularity with a wheel of one-half the weight of that required for the older form of engine. This smoothness of motion is, in such work as is here considered, one of the most essential features of the best steam engine economy. At the speeds which have been now attained, however, the inertia of moving parts becomes so great that moderate variations in the impelling power become comparatively insignificant, and have no perceivable effect upon the smoothness of revolution of the crank-shaft.



THE ERICSSON ENGINE.

The double-acting engine evidently possessed greater power than its predecessor, when of the same size, and the "efficiency of the machine" is correspondingly increased.

The very conditions which have been thus made to aid in securing regularity have, however, introduced a new difficulty: At every revolution of the engine, the crank "turns the centre" twice, and, at every passage of the centre, the direction of pressure upon the crank-pin is reversed, thus producing a shock which is proportional to the difference of pressure, the suddenness with which it is felt at the pin, and the extent of the "lost motion" between the pin and its bearings. Some lost motion must always be permitted here, to avoid danger of heating of the journal and injury to the machine. The counteracting adjustments are found to be, usually, the utilization of the inertia of the reciprocating parts, as in the Porter-Allen engine; the adoption of heavy compression, as in the several engines afterward described, and very careful adjustment of the fit of the brasses on the pin. With the skilful use of these expedients, and with the introduction of a perfection of workmanship, and of such qualities of material, as have never before been seen, the "high-speed engine" has been made successful at as high as 400, and even, in some cases, 600 revolutions per minute. The lower of these figures may be taken as that representing the maximum in standard, and usually best, practice.

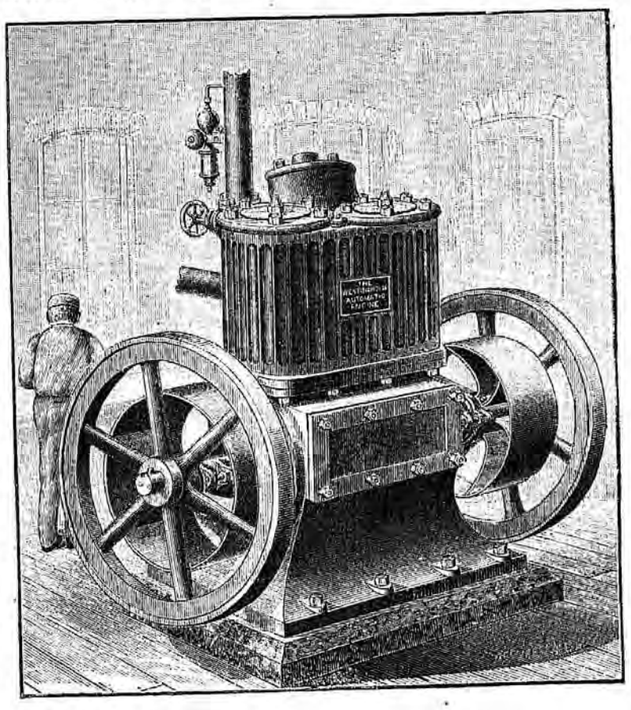
But much higher speeds than these are sometimes demanded; and engines must, in the future, be built to run, regularly, steadily, and safely, at, probably, very much higher velocities. This may, ultimately, lead to radical changes in the design of the now standard forms of fast engines. Nevertheless, the limit of speed has by no means been reached, even at the higher of the above speeds, with the common type of engine. The speed of even 450 times the cube root of the length of stroke, now a common figure, and three times that given by James Watt's rule, is occasionally greatly exceeded. Captain Ericsson designed an engine, some three years ago, for the electric lighting apparatus of the Delamater Iron Works, which has now been running, every evening for two or three years, at 1,250 revolutions per minute, without giving the slightest trouble, or meeting with the most insignificant accident. The piston speed is about twice that of the average "high-speed" engine, and six times that adopted by Watt. It is probably the highest speed ever attained by a reciprocating engine doing work for which it had been designed.

The object of the inventor was to design a steam engine for the special work of driving small dynamo electric machines, and hence to secure great stability and strength, a minimum number of parts requiring lubrication, and absolute certainty that the parts retained should be, at all times, thoroughly supplied with the lubricant. The engine is therefore made a "half trunk" engine, the trunk, *F*, *F*, serving as an oil reservoir. The joint in the eccentric rod is provided with a piston moving in a cylindrical guide, *N*, which is also an oil reservoir. The cylinder, *C*, and base-plate, *B*, are in one casting, upon which is set the hollow frame supporting the crank-shaft, *H*, *E*, and balance wheel. Every journal and rubbing part has an oil reservoir and special provision for effective lubrication. The whole engine is a model of the product of that most efficient kind of ingenuity which seeks definite ends by the most simple and direct means. Its performance leaves nothing to be desired.

The limits to velocity of piston and speed of rotation have, from the beginning of steam engine practice, been thus gradually set farther and farther back; and one after another of the limiting conditions have been successfully met and overcome. The earliest limit was that found in the bad workmanship and material which Watt and his contemporaries encountered, and which gave rise to heated journals at even what would now be considered very low speeds, and at very small powers. This defect being gradually overcome, the next, and a comparatively modern, difficulty was found in wear, and the "pound," which took place when the lost motion of journals in the line of the connecting rod was taken up, at the passing of the centres. This difficulty was met in two ways, as already repeatedly stated—by making use of the inertia of the reciprocating parts, as was done by Porter and Allen, and by heavy compression as is practiced in nearly, or quite, all of the high speed engines of to-day. The first method can be adopted only when careful proportioning, after calculation, of the weights and velocities of

the moving parts, has determined the proper weights of the compensating pieces. The latter adjustment may be made either by calculation or by experimentally finding the compression giving smoothest running. This effect of increasing compression can be most satisfactorily seen in the marine engine, in which, whatever the speed of the machine, and whatever the steam pressure, or however loose the journal, the link may be raised so as to gradually check the pounding at the centres, and finally to eliminate it altogether, the engine often being thus brought to work silently and smoothly at speeds far above those which, without compression, would be very troublesome, if not absolutely dangerous. This is an experiment which the writer has repeated on many engines, and almost invariably with the same satisfactory result.

Some lost motion must always be permitted at the crank-pin, and these expedients are usually found to meet the case. They probably have their limits, however. There comes a time, as speeds are increased, when the weight of running parts, as calculated for strength only, becomes as great as is desirable to effect the compensation by their inertia; there comes a time, as compression is increased, when the "cushioned" steam is carried up to boiler pressure, and this would seem the natural limit in this matter. The next device, chronologically, adopted by the engineer, is that of preventing the lift of the brass of the crank-pin and of the cross-head pin at the turning of the centres, while still leaving the freedom of fit required to give safety from heating. This last expedient is that which has led to the construction of a class of engines which are as peculiar and as typical as either of the classes which have been already described.



THE WESTINGHOUSE ENGINE.—SECTION THROUGH SHAFT.

THE WESTINGHOUSE ENGINE

belongs to this new class, and is here taken as its representative. The change of construction characteristic of this type of engine is a return to the original "single-acting" plan of engine. This has been often proposed, and not infrequently attempted; but the success attained has not, as a rule, been satisfactory. Two, and three, and four, cylinders have been tried, in the endeavor to secure regular motion while taking steam only on one side of the piston; very high speeds of revolution have been attained; but the cost of steam has been found too great, and their use has not become general. The Westinghouse engine has proved itself to possess the elements of commercial success, and is, therefore, to be taken as illustrating what can be done in this direction, by good designing and good business management.

It is evident that, if steam pressure comes upon but one side of the piston, the engine can pass its centre without the brass lifting clear of the pin, and thus may be driven up to any speed without liability of injurious pounding. For enormously high speeds, as the engineer of to-day looks upon them, this is evidently the type of engine to be looked to for smooth and successful working. The illustrations show how, in the Westinghouse engine, this end is reached. The engine has two cylinders, *A*, *A*, fitted with single-acting pistons, *D*, *D*, forming trunks filling the bore of the cylinder, giving a long steam-tight bearing, and taking the connecting-rod pin, *O*, *O*, at a point at which no tendency to rock the piston can be produced. The top of the piston is cored out to prevent transfer of heat from the working to the non-working end. The rods, *F*, *F*, take hold of the crank-pins within an enclosed chamber, *C*, forming part of the engine frame, *E*, *C*. This frame and bed-plate also acts as a reservoir for oil lubricating the journals and pistons, which oil floats on water and is dashed up over the moving parts so enclosed, at every revolution of the engine. No other attention is required than to keep a supply of oil in the chamber, by filling as loss occurs by leakage. In fact, the whole engine is thus shut in by its frame, and its working parts are inaccessible, while working—an arrangement which is at once a means of security and a convenience.

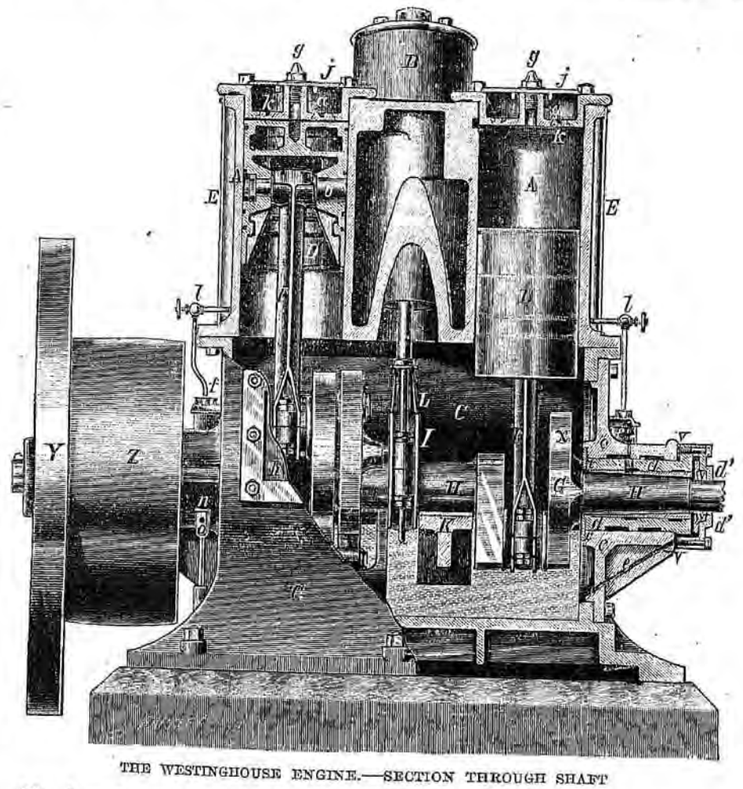
The valve adopted in the Westinghouse engine is a piston valve, of the class already described, but having some peculiarities specially adapting it to its use in this engine. Its guide, *J*, is a piston traversing a cylinder separating the exhaust space from the chamber below. This one valve, *V*, distributes steam to both cylinders, the two cranks being set directly opposite each other. This adjustment of the cranks also gives a perfect balance of reciprocating parts, and secures smoothness of movement of the whole machine, whatever speed may be adopted; and exceptional speeds of 1,000 revolutions, or more, per minute are reached without observable vibration.

The governor, *I*, and its action, are precisely like the same parts in the engines described in several of the earlier articles. It actuates the eccentric, and determines the point of cut-off by varying the throw of the valve, while retaining the lead. The governor is usually so adjusted that it will not come into play until the engine falls 1 per cent. below, or rises 1 per cent. above, the normal speed; its full traverse is effected, also, within this range, the intention being that the speed shall never vary more than 1 per cent. from that fixed as its proper velocity. The range of expansion is from 0 to about 5-8 stroke.

One of the dangers to which fast running engines are peculiarly exposed is that of injury by the entrapping of water in the cylinder, and the plunging of the piston against the mass of incompressible fluid which then fills the clearance spaces. In this engine, in addition to the relief-cocks or valves, which are always fitted to such engines, a safeguard is introduced in the form of what en-

gineers are accustomed to call the "breaking-piece," a part which is made purposely weaker than other portions of the machine, exposed to a common danger, so that this piece may go when danger arises. This piece is always one the replacement of which will give little trouble, and make but little expense. In the Westinghouse engine, such a breaking-piece is made to form a part of the cylinder head. This may be knocked out without injury occurring to any important, or costly, part of the structure.*

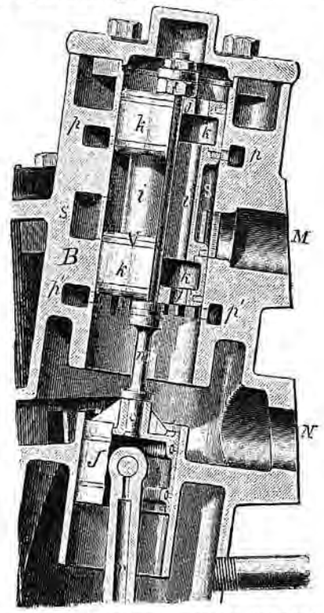
This breaking-piece is intended to yield at a safe pressure—200 lbs. per square inch—and thus save the engine. The workmanship on these engines, so far as the writer has been able to examine it, is excellent; and the material of the best. These are, however, as has been stated, absolutely essential features of every good high-speed engine. The engines are, when finished, set up in the shop and tested up to their rated power, before sending them out; and it is thus made certain that they are in good order and in correct adjustment. The ingenious and novel methods of securing certainty of lubrication, in this engine, the constant direction of the actions tending to produce heavy strains, the small number of parts subject to wear and to breakage, the remarkable success met with in the attempt to reduce the labor of attendance and cost of maintenance, and all other costs causing reduction of commercial efficiency; the compactness, solidity, steadiness, safety at maximum speeds, and general effectiveness of this engine, are such as to make it one of the most interesting examples of the steam engine of to-day that has yet attracted the attention of the engineer.



THE WESTINGHOUSE ENGINE.—SECTION THROUGH SHAFT

* The writer planned an engine, about the year 1869, in which the whole cylinder head was made a safety valve which could lift and discharge the water into the chamber behind it, the cover of the latter being bolted on, while the cylinder-head was only held in place, against a faced joint, by steam pressure.

The economy of the later style of this engine—that fitted with automatic expansion gear, as here described—is probably about the same as that of other small engines of its own class; not, as a matter of course, equal to the economy of large engines of the four-valve type, but great as compared with the class of small engines to which the manufacturer has usually been compelled to resort when demanding but little power, up to the present time. The loss by "friction of engine" is somewhat greater in this form than in the more familiar type of engine. The peculiar advantages possessed by the engine in this direction are its high piston and rotative speed, and the extent to which compression is carried. One of these engines has been driven experimentally up to 2,700 revolutions per minute without any observable ill effect. Their speeds are probably safely made double that of the average "high-speed engine" with which we are now becoming familiar. Compression, as an element in economy of engine, has already been considered at some length. It was shown by the writer, ten years ago, that progress in the direction of improvement of the steam engine has always been retarded by the difficulty of preventing serious losses by cylinder condensation, and that this is the essential element of preventible waste; it was also suggested by him, several years since, that probably the best means of controlling the speed of engine is by the introduction of high compression and its variation by the governor, increasing compression with increasing expansion, and the reverse, and thus, by utilizing the heat of compression, checking cylinder condensation as its increase is caused by extending the expansion period; and it was pointed out that "the best among existing forms of valve gear should, if judged by from the standpoint here taken, be that which, combining a variable compression, is also capable of prompt and exact adjustment by a sensitive and efficient governor."* This suggestion, as has been seen, is fully met by all the later designers of engines of the high-speed class. The engine above described illustrates this use of compression well; the compression is adjustable by the governor, and may thus given be that ratio which is best adapted to the case.



THE WESTINGHOUSE ENGINE.—CROSS SECTION THROUGH VALVE.

Mr. Harris Tabor, in a paper read before the American Society of Mechanical Engineers, following the idea just presented, says of compression: "It is to the proper control of compression that we must now look for further advance in steam economy." It has been seen that this is one of the directions of present advance.

RETROSPECT.—We have now made a tolerably complete survey of the whole modern field of steam engineering as far as it is covered by stationary engine practice, and have seen a very steady progress from the best types of a generation ago to the most representative examples of the most modern forms. It is seen that the direction of change is still that which, as has been often pointed out by the writer, has been observed from the days of James Watt. The principal points found worthy of notice have been the increase in economy and general efficiency by a tentative and empirical, but none the less steady and uninterrupted, method of advance. The pressures of steam have been slowly, but constantly, rising; speeds of piston, and of rotation, have been as constantly increasing; the effectiveness of the governor has been made greater and greater; the ratio of expansion at maximum efficiency has been very slowly increased, by the gradual reduction of cylinder condensation; commercial considerations have been brought definitely into view; the efficiency of engine has been improved by reduction of size, weight, and friction of engine; and thus we have been able to see a gradual change of type of engine effected, the engineer modifying his designs to meet the demands of the time, until we have insensibly, and almost without suspecting that progress has been going on, passed across a new line and entered upon an epoch, in steam engine construction, as marked in its period and as well defined, as to its beginning, as was that which, at the middle of the century, was distinguished by the introduction of the inventions of Sickles, Corliss, and Greene.

* Expansion of Steam, etc., Trans. Am. Soc. Mech. Engrs., 1881; Jour. Fran. Inst., Oct. 1881.

ON THE ELECTRIC LIGHT TESTS AT THE CINCINNATI EXPOSITION.

BY F. L. POPE.

THE report of the tests of electric lighting systems and apparatus, made by the jury appointed by the commissioners of the eleventh industrial exposition, held at Cincinnati in September and October, 1883, which appears in *Science*, of February 15, 1884, is a paper of unusual importance, in view not only of the widespread general interest in the subject, but of the commercial significance of the results which are alleged to have been obtained.

The republication of this paper in full would occupy more space than can well be devoted to it here, and I shall, therefore, confine myself to abstracts embodying its more essential points. In reference to the method of investigation it is said:

> The plan adopted was substantially that upon which nearly all similar trials have been conducted. The energy consumed by the dynamo was measured by means of the dynamometers, and the electrical energy in the circuit was determined by well-known methods. This gave the efficiency of the machine as a generator. The illuminating power of the lamps was compared, and at the same time the electrical energy which they consumed was measured. A combination of the results obtained by these two processes gives the relative illuminating power per unit of energy consumed by the dynamo, which represents the relative commercial efficiencies of the systems. The measurements made, therefore, were of three kinds—dynamometric, electric, and photometric; and they will be considered in the order mentioned.

Two independent dynamometers were simultaneously employed in determining the mechanical energy exerted upon the armature of the dynamos, viz: the belt dynamometer of Dr. Hopkinson,[1] and the recently invented cradle dynamometer of Prof. Cyrus Brackett, of Princeton, N. J. The latter was found to give much the most accurate results, and these were accordingly used in the computation of the jury. Indicator diagrams were taken from the driving engine, which, although not actually used in the final computations, served to check the results obtained by the dynamometers.

The electric measurements consisted in the determination of, first, the strength of the current, and second, the difference of potential between two points in the circuit. The instrument principally relied upon for the measurement of current strength was a Thomson current galvanometer made by White, of Glasgow. A differential galvanometer, devised and constructed by Prof. Brackett, was also observed, but the results were not used in the final computation.

During the tests of the arc light machines the whole current was taken through the galvanometers. With the incandescent systems, however, in which the current was sometimes as high as 170 ampères, this was impossible, as the coils and connections would have been greatly heated. The current might possibly have been safely divided between 4 or 5 instruments; but, these not being at hand, it became necessary to make use of a shunt.

For this purpose the heavy main conductor was cut, and the two ends were inserted into large mercury cups, cut out in a block of wood an inch and a half thick. These cups were also connected by about 40 feet of number 0 copper wire, the ends of both main and shunt wire being well immersed in the mercury, and pressed close together. These mercury cups were connected with 2 others by means of short copper wires, and into the second pair the ends of the galvanometer wires were plunged. As thus arranged, about one-fifth of the current was taken through the galvanometer. Even with this division of the current, it was found, that, when using the strong current from the Weston dynamo, the wires of the galvanometer were somewhat heated; and in order to avoid this result, a short piece of number

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0 wire, not more than 2 or 3 inches in length, was bent so that it could be inserted in the mercury cups, and thus cut the galvanometer out, except during the few moments necessary for taking a reading. During all of the "resting" periods this short wire carried by far the greater portion of the current, and thus tended to prevent the heating of the shunt wire proper as well as of the galvanometer.

The determination of the ratio of the two parts into which the current was divided, or the value of the "shunt multiplier" was, of course, a matter of great importance. In the preliminary measurement of this ratio the current from the Thomson-Houston machine was of great service on account of its steadiness. To begin with, a number of tests were made to discover if the connection resistances were of such importance that any accidental variation in them would perceptibly alter the shunt ratio. The shunt was repeatedly lifted out of the cups and replaced, and the galvanometer connections were broken and remade. Everything that could be disturbed was disturbed; but, upon reconstruction, the result was found in all cases to be practically unaltered. On Sept. 28 a series of 30 measurements was made with the shunt alternately in and out, using a current of 10 ampères. The results agreed closely with each other, and gave (4.6) as the value of the shunt multiplier. On the following day the tests of the incandescent machines began; and the shunt was not moved from its position, nor disturbed, until after the conclusion of the entire work. On Oct. 3, after all of the regular tests had been completed, another test of the shunt was made, with a current of 10 ampères, as before. Ten observations were made, all of which agreed in giving a ratio of a little more than 5.0. This result was quite unexpected, and the discrepancy between it and that obtained from the first test was entirely too great to be accounted for by errors of observation. As circumstances prevented further tests in Cincinnati, it was determined to remove the shunt and all connections to the physical laboratory of the Ohio State University, where a thorough examination of the cause of the difference could be made. This was done; but before any experimental examination had been undertaken, the origin of the difficulty suggested itself. The 2 short wires connecting the mercury cups had been in one case thrown with the galvanometer doubtless, and in the other with the shunt. It was perfectly certain, however, that throughout the tests they had formed a part of the galvanometer. Upon examination this explanation was at once found to be correct. The shunt and galvanometer were connected up precisely as they had been in Cincinnati; and a series of 25 observations gave, when the small wires were a part of the shunt, a multiplier of 4.60; and, when they formed a part of the galvanometer circuit, it was 5.01. The measurements were made by comparing the resistance of the two parts of the circuit by means of the fall in potential, as shown by a Thomson's reflecting galvanometer of high resistance. While in use in Cincinnati, the shunt was constantly carrying a portion of the current; and its temperature was therefore always slightly higher than that of the galvanometer. The difference was small, and it could not be measured accurately; but, on account of its existence, it was thought proper to adjust the shunt multiplier. An excess of heat in the shunt would throw a greater amount of the current through the galvanometer than would go there if the two were at the same temperature; accordingly, the value accepted was 4.9 instead of 5.0, as indicated by the comparison, in which the currents used were much weaker than those transmitted during the tests. It will be observed, the existence of an excess of temperature in the shunt favors somewhat the system in which the stronger current was transmitted.

The measurements of E. M. F. were made with a Thomson potential galvanometer, also by White, and the instrument was afterwards standardized by comparison with a battery of 10 gravity cells in good condition, of a standard Daniell cell by the usual condenser method.

The difference of potential in volts, between the 2 points to which the leading wires are connected, is found by the same process as is used for reducing the readings of the current galvanometer to ampères. In measuring the efficiency of the dynamos, wires were brought from their binding posts to the galvanometer. In the arc light machines the electromotive force was high, amounting to more than 1,200 volts in the Thomson-Houston dynamo; and it was therefore desirable to introduce extra resistance in the galvanometer circuit. From resistance boxes made by Elliot Brothers, an amount equal to seventeen times the resistance of the galvanometer was thrown in, thus bringing the fall in potential in the galvanometer within easy range. Great care was taken to see that the coils were not heated during these measurements; and for this purpose the boxes were opened and the coils exposed to the air, frequent examination being made to see that no rise in temperature took place. Precisely the same arrangement existed throughout the tests of both arc systems. During the photometric tests the wires of the potential galvanometer were attached directly to the lamp under test, so that the fall in potential through the lamp only was measured.

The photometric comparisons were made by means of the Bunsen disc photometer, as modified by Letheby.

It was found most convenient to make the comparison of the arc lights through 1 of the incandescent lamps, as the steadiness and constancy of these could be depended upon during the time necessary for a comparison. In these measurements, a long gallery in the basement of the main building, and adjoining the testing room, made it possible to place the 2 lights, which were being compared, at a distance of 50 feet from each other. The line extended into the testing room, where the photometer bar, 10 feet in length, was placed. An Edison incandescent lamp, nominally of 16 candle-power, was used as a standard. In the first series of experiments, comparisons were made with the arc lamps in 3 different positions; 5 readings of the position of the photometer box and of the galvanometers being made at each position. The lamp was first suspended in its normal, vertical position; then afterwards it was inclined at an angle of 45 degrees, first with its base away from the photometer box, and afterwards with its base towards the same. After such a series had been completed with 1 of the 2 lamps in competition, it was at once removed, and its place was supplied by the other. On the following night the comparison was continued, other lamps having been selected; but the lamps were tested in only 2 positions—the normal position, and that in which the base of the lamp was towards the photometer box, these being regarded as the positions of the greatest importance. Altogether, 25 photometric observations were made in comparing arc lamps. The lamps compared were taken at random from those in use by the exhibitors.

The comparison of incandescent lamps presents questions of far greater delicacy and difficulty. There is one element, in the economy of an incandescent lamp, which does not enter to any extent in the consideration of arc lamps; that is, the life of the lamp. Although of great importance, it did not seem possible, in the limited time which was at the disposal of the jury, to investigate this point. The only fair and impartial method of making such an investigation, involved, in the opinion of the jury, the continuous and prolonged burning of a large number of lamps belonging to the different competing systems. Under the circumstances, it was absolutely impossible to make use of this method.

There exists, also, difference of opinion as to the proper method of comparing the efficiency of 2 incandescent lamps. They may be reduced to the same illuminating power, and the electrical energy consumed by each may be compared; they may be brought to a condition in which they consume the same electrical energy, and their illuminating power compared: or they may be allowed to differ in both of these elements, and comparisons be made in both.

The first method has been pursued in several tests which have been made both in Europe and in this country.

Incandescent lamps are generally made to be equal, nominally, to a given number of standard candles; but, by modifying the consumption of energy, a lamp of nominally low candle-power can be made to produce almost any degree of illumination, from nothing up to the equivalent of several hundred candles, the high illumination being, of course, at the expense of the life of the lamp. If this element is left out of consideration, the efficiency of a lamp increases rapidly with its degree of incandescence. As it is by no means necessary that incandescent lamps should run at a fixed "candle-power," it will follow that the temperature at which a lamp will show greatest efficiency (including the life element), will depend greatly upon its construction.

Taking 2 lamps of radically different construction, however, there will be for each a certain set of conditions as to current strength and electromotive force, and including the element of life, under which it would show its highest efficiency and economy. After such conditions were determined for each lamp, a strict comparison would be possible. The reduction of 2 such lamps to the same degree of illumination would probably be unfair to one or the other, or possibly to both, if the element of life is not considered.

Suppose that a lamp in one system is at its best, *all things considered*, at 15 candle-power, and that one in another reaches its highest degree of efficiency at 16 candle-power. If they are both brought to 15 candle-power, the second must suffer in the comparison; and if both are brought to 16 candle-power, *and the element of life is not considered*, it will again suffer, for the apparent efficiency of the first will be increased by its higher incandescence.

As the labor of determining the most favorable conditions for each lamp would be so great as to necessarily throw that method out of consideration, the jury felt constrained to adopt the last of the three methods mentioned above. The jury assumed, in fact, that the exhibitors of the different systems had already determined these favorable conditions in their own interest; and that in putting their lamps before the public for the entire period of the exposition, each maintaining more than 200 lamps in different parts of the exposition building, they would operate them as nearly as possible in accordance therewith. In other words, it

was decided to compare the lamps as they were used in the exhibit, determining the ratio of their illuminating power, and measuring the electrical energy consumed by each. It is proper to state, that the lamps of both systems were spoken of by their respective representatives as 16 candle-power lamps, although certain marks on the lamps which were supposed by the jury to refer to candle-power did not exactly agree.

To secure impartiality of selection, the jury requested permission to have access to the supply of lamps kept by each company for use in the exhibit, which permission was freely granted. From each, 10 or 12 were selected at random, and carried to the testing room; and from these the lamps which were compared were taken. They were placed upon the photometer bar at a distance of 125 inches from each other, and a system of switches was arranged, so that the galvanometers could be quickly connected with one or the other. Measures of current and electromotive force were made rapidly and continuously during the photometric comparison.

Neither of the two lamps under test illuminated equally in all directions. They were, therefore, compared in 9 different positions, each lamp assuming 3, which were designated respectively "flat," "edgewise," and "45 degrees," and each position of one was compared with all of the other. 5 sets of readings were made at each position, making, in all, 45 comparisons of the 2 lamps. A number of preliminary comparisons were made, which were not considered as forming a part of the actual test. The latter was made on the evening of Sept. 29.

The determination of the efficiency of the dynamos consisted in measuring the power consumed, as shown by the dynamometer, on the cradle of which the dynamo was placed, and at the same time measuring the current and the electromotive force at the binding posts of the machine. The speed of the main shaft being nearly uniform, it was necessary to place different pulleys upon it, in order to secure the necessary speed for the armatures of the different machines. The speed of running being a matter which concerned the exhibitors rather than the jury, they were requested to furnish the dimensions of these pulleys, and accordingly did so. The average speed of the armature of the Weston dynamo for incandescent lamps was a little above 1,030 revolutions per minute, during 3 different series of observations made while the machine was on the cradle. The Edison dynamo was placed on the cradle on the afternoon of Oct. 2, when a series of measurements was made with an average speed of 1,068 revolutions. This was above what may be called the "normal speed," which was due partly to the size of the pulley, and partly to the fact that the engine was doing but little other work, and was probably running a little above its normal rate. In the evening the tests were continued, the speed of the armature being a little below a 1,000 revolutions, the electromotive force being also less. It will be observed that the "efficiency" of this dynamo, under the latter conditions, differs from that under the former by only two-tenths of 1 per cent. Particular attention is called to the fact, that no photometric measurements were made with lamps on the circuit of the Edison machine, which was on the dynamometer, those used being supplied from another similar dynamo, which was run by an Armington and Sims engine, which formed a part of the Edison exhibit. A glance at the results given below will show that the electromotive force in the latter case was much lower than in the former.

Full details are given of the various methods by which the accuracy of the Thomson galvanometers were tested. The E.M.F. of the Daniell cell according to the potential galvanometer was 1.106 volts.

Several tests of the current galvanometer were made by means of a battery of five Grove cells, which were freshly set up. The reading of the galvanometer was noted, and then a resistance of 1 ohm was introduced into the circuit. The first reading was 19, and the second was 9.5; showing that the resistance of the battery and galvanometer was 1 ohm. The electromotive force of the battery was then determined by means of the potential galvanometer. 2 measurements were made; the first giving 9.43 volts, and the second 9.56 volts. Assuming the resistance to be 1 ohm, as shown above, these numbers would represent, in accordance with Ohm's law, the current in ampères. The current, as calculated, from the galvanometer reading, was 9.5 ampères.

Many other tests of a similar character were made, all of which showed that the galvanometers must be admitted to be what they were assumed to be during the tests,—practically correct. But, even if they were somewhat in error, the similarity of conditions under which the competing systems were tested was such that all would be affected alike.

In determining the efficiency of the dynamos, a half-hour run was made after everything was found in order, during which successive readings of the dynamometers and electric instruments were taken as nearly as possible every 2 minutes. From 10 to 20 sets of readings were generally secured. The following tabular summary of results is given, in which the quantities are means of a number of observations:

TABLE I.—EFFICIENCY OF DYNAMOS.

	Thomson-Houston Dynamo for arc Lighting.		Weston dynamo for arc lighting.	Weston dynamo for incandescent lighting.			Edison dynamo for incandescent lighting.	
	Sept. 25.	Sept. 26.	Sept. 28.	Sept. 29.			Oct. 2.	
Electromotive force, in volts	1232.0	1175.0	626.0	69.2	60.0	65.0	124.0	123.8
Current in ampères	10.03	10.08	20.3	168.1	145.7	157.4	124.7	119.3
Electrical horse-power	16.6	15.9	17.0	15.6	11.7	13.7	20.9	19.6
Horse-power consumed	19.52	20.59	19.75	18.55	13.8	15.5	21.96	20.64
Percentage of efficiency	85.0	77.2	86.5	84.1	91.4	88.4	95.2	95.0

PHOTOMETRY OF ARC LAMPS.

Table II. shows the results of the photometric comparison of the 2 arc lamps, and will be easily understood. The arrows show the direction of the light measured in each series; thus, = means a horizontal measurement; ↗ means that the measurement was of the light going upward at an angle of forty-five degrees; and ↘ refers to the light going downward at an angle of forty-five degrees. For convenience, the intensity in terms of the standard (an Edison incandescent lamp) is multiplied by 1,000 before dividing by the number of watts.

TABLE II.—ARC LAMPS.

THOMSON-HOUSTON.						WESTON.					
Direction of light.	Current.	Electromotive force.	Watts.	Intensity in terms of standard.	$\frac{1000\ I}{W}$	Direction of light.	Current.	Electromotive force.	Watts.	Intensity in terms of standard.	$\frac{1000\ I}{W}$
↗	10.2	45.9	467	16.2	34.7	↗	20.7	23.9	495	25.9	52.4
=	10.2	46.7	476	18.2	37.8	=	20.1	23.3	469	17.6	37.4
↘	10.2	46.3	471	85.0	180.3	↘	19.8	21.9	435	32.3	74.4
OTHER LAMPS.											
↗	10.1	46.1	465	18.0	38.8	↗	20.0	25.6	512	30.7	59.9
↘	10.2	46.3	474	98.8	209.0	↘	20.8	25.0	522	51.7	99.2
MEANS.											
↗	—	—	—	17.1	36.7	↗	—	—	—	28.3	56.1
=	—	—	—	13.2	27.8	=	—	—	—	17.0	37.4
↘	—	—	—	91.9	194.6	↘	—	—	—	42.0	86.8
GENERAL MEANS.											
		—	—	40.7	86.4		—	—	—	29.3	60.1

It will be seen that the different lamps differed from each other considerably in their efficiency. This was especially true of the Weston lamp, which was irregular in its action. The numbers under the head of "General means" show the average light in terms of the standard, in all directions measured, and the relative illuminating power per unit of energy. There is a difference of more than 40 per cent. in favor of the Thomson-Houston.

PHOTOMETRY OF INCANDESCENT LAMPS.

The table below, showing the results of the photometric comparison of the incandescent lamps, will need but little explanation. In the first column the relative position of the carbon filaments is shown: thus, | | means that they were parallel to each other, and at right angles to the photometer bar. The 3 positions of a lamp were designated as "flat" (|), "edgewise" (—), and "forty-five degrees" (\ or /). $\frac{W_E}{W_M}$ denotes the watts of the Edison divided by the watts of the Maxim. The column headed $\frac{E}{M}$ shows the actual illuminating power of the Edison, compared with the Maxim as a unit; and the numbers are the

squares of the ratios of their respective distances from the photometer box. The numbers in this column, divided by those in the one preceding, give the numbers in the last column, headed $\frac{E_E}{M_E}$, or the light from the Edison per unit of energy as compared with the Maxim.

TABLE III.—INCANDESCENT LAMPS.

Position.		Edison.			Maxim.			$\frac{W_E}{W_M}$	$\frac{E}{M}$	$\frac{E_E}{M_E}$
Edison.	Maxim.	Current.	Electrom. force.	Watts.	Current.	Electrom. force.	Watts.			
—	—	.648	113.0	73.2	.887	63.7	56.5	1.30	1.11	.855
—	/	.639	114.7	72.5	.887	64.5	57.2	1.26	1.13	.891
—	|	.636	114.6	72.9	.870	61 8	53.7	1.36	1.28	.941
/	—	.622	115.4	71.8	.853	62.2	53.0	1.35	1.65	1.22
/	/	.631	115.4	72.8	.853	61.4	52.3	1.39	4.58	3.29
/	|	.631	115.1	73.3	.887	63.0	55.8	1.31	3.06	3.02
|	—	.631	115.7	73.0	.870	63.6	54.4	1.34	3.71	2.79
|	/	.639	116.5	74.5	.887	63.0	55.8	1.33	1.35	1.02
|	|	.648	114.7	73.5	.853	62.6	53.4	1.38	1.06	1.21

The results of these comparisons in nine different positions make it possible to establish certain comparison equations, from which means may be obtained which will serve to eliminate, to some extent, the errors of experiment.

Let a = the light from the Maxim lamp "edgewise;" then, by working through the different positions of the Edison, the above results give—

$$\text{Maxim} \begin{cases} — & a & 2.39a & 2.77a \\ / & 2.77a & & \\ \| & 3.58a & 3.50a & 3.37a \end{cases}$$

and for means—

$$\text{Maxim} \begin{cases} — & a \\ / & 2.64a \\ \| & 3.48a \end{cases}$$

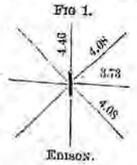
By a similar computation it is found that

$$\text{Edison} \begin{cases} — & 4.58a & 4.45a & 4.36a \\ / & 3.96a & 3.93a & 4.38a \\ \| & 3.74a & 3.58a & 3.86a \end{cases}$$

the means of which give—

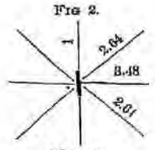
$$\text{Edison} \begin{cases} — & 4.46a \\ / & 4.08a \\ \| & 3.73a \end{cases}$$

FIG 1.



EDISON.

FIG 2.



MAXIM.

Figs. 1 and 2 show the arrangement of these intensities of illumination around the carbon filament; the plane of the filament being vertical, and Maxim edgewise being taken as unity.

For the mean all round, the result is—

$$\text{Edison} = 4.09 \qquad \text{Maxim} = 2.44$$

$$\frac{4.09}{2.44} = 1.676 = \frac{E}{M} \text{ in light.}$$

But from the previous table,

$$1.336 = \frac{E}{M} \text{ in energy:}$$

therefore, $\frac{1.676}{1.336} = 1.25 = \frac{E}{M}$ *in light per electrical horse-power.*

It seems evident that this difference of 25 per cent. in favor of the Edison lamp is largely due to the form of the incandescent filament as compared with that of the Maxim lamp. The latter shows great inequality in illumination in different directions, the light measured from the flat side being about 3½ times as great as that obtained when the lamp is edgewise. The effect of this increased radiating surface is shown in the last column of the above table, from which it appears, that in the comparison of the Maxim, "flat," with the Edison in all positions, the former shows a higher actual efficiency than the latter. If this large radiating surface could be made to distribute its effect around the circumference; the lamp would, in the opinion of many, be greatly improved. It is fair to say, however, that the unequal distribution of light is claimed, by at least some of the representatives of this lamp, to be an important advantage. It was not so considered by the jury.

The form of the carbon filament in the Edison lamp is such that a much greater uniformity of illumination results. While the Maxim form has the advantage of concentrating the radiating surface, the arrangement of the carbon to accomplish this greatly diminishes its effectiveness in the "edgewise" position. In the Edison there is but a single loop; and, furthermore, this is generally curved, so that it does not lie in one plane. As a result, one side of the loop never exactly hides the other, and there is but little loss from that source. It will be seen in the above figure that the illuminating power of the lamp edgewise actually exceeded that in any other direction. This difference was too constant and too great to be attributed to error in experiment. It is attributable, no doubt, to the fact, that in this position the luminous lines lie nearly in the axis of the pear-shaped glass containing them, as viewed from the photometer box; there being, therefore, less scattering of the light in transmission, and possibly some gain on account of reflection. Of course, if a lamp were used in which one of the branches of the loop exactly or nearly covered the other in this position, a different ratio of illumination might follow.

The general conclusions of the jury are summed up as follows:

The results of these tests seem to point to one conclusion of very considerable interest. It happened that the competition in both the arc and incandescent systems was between low electromotive force and great strength of current, on the one hand, and high electromotive force, with weaker current, on the other. In one arc system the electromotive force was almost exactly double, and the current almost exactly half, that of the other. In the incandescent systems, the contrast, although not so great, was very marked. In these trials the advantage was decidedly on the side of high electromotive force.

A critical examination of the results given in the paper, of which the foregoing is an abstract, demonstrates not only that the methods adopted by the jury were utterly inadequate, but that the results arrived at are from the nature of the case fallacious. The method, for example, of determining the comparative efficiency of incandescent lamps by a direct photometrical comparison of 2 lamps with each other, without reference to any fixed or accepted standard, is a very unsatisfactory one, inasmuch as it does not enable the results to be compared with the results of independent determinations, nor does it ascertain the absolute amount of light produced by either lamp, which last is the information above all others of value to the purchasers of electric lighting plants. A still more serious objection to the photometric work of the jury arises from the fact that the lamps were run at different illuminating powers during the comparison; that of the Edison to the Maxim being given as 1676 to 1000. Apparently the tests were made upon the theory that the consumption of mechanical energy is directly in proportion to the light emitted by the lamp. This is, of course, very far from being true, as it is well known that the light increases more nearly in proportion to the third power of the energy. The results given in the tables prove nothing whatever as to the actual comparative efficiency of the 2 lamps, for it is obvious that by adopting the method described in the report, and with no other checks than those used by the jury, the tests may be made to appear in favor of one lamp or the other to any desired extent, by varying the relative illuminating power at which the lamps are run during the comparison. The results of this comparison will be discussed more in detail hereafter.

In reference to the tests for determining the efficiency of dynamo machines, one is at once struck by the fact that no checks whatever were employed upon the measurements of electromotive force and current strength. Such checks might readily have been obtained by measuring the resistance of the generator circuits and of the working circuit, thus giving a wholly independent basis of computation. If separate measurements are thus made of current, of electromotive force and of resistance, and the results are substantially in accordance with each other, the accuracy of all the determinations is necessarily established. It is certain that by dispensing with this obvious and

essential precaution, the jury were led into the gravest errors. This is conclusively shown by the fact that the tabulated results are in some instances physically impossible under the conditions given, and in others are at variance not only with each other but with the fundamental laws of electricity.

As an example of some of these errors, I have analyzed the comparative figures for the Edison and the Weston dynamos for incandescent lighting, which are found in Table I, in the above extract.

These are both shunt-wound machines, and are constructed upon the same general principle, so that similar computations apply to each.

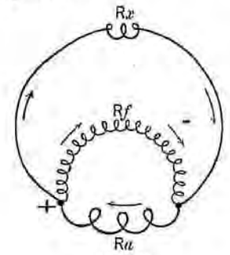


Fig. 3.

Referring to Fig. 3, which is a theoretical diagram of the internal and external circuits of a shunt-wound dynamo, let

R_a = resistance of armature circuit, including brushes.
R_f = resistance of field circuit.
R_x = resistance of external or working circuit between the binding screws of dynamo.

The electromotive force is set up within the armature circuit, and divides itself according to Ohm's law between the field and the working circuit in the inverse ratio of their respective resistances. Hence, if we put

C_a = current traversing armature.
C_f = current traversing the field.
C_x = current traversing the exterior or working circuit, and designate by V the difference of potential, or E. M. F. found by measurement to exist between the binding screws of the dynamo when in action, we have

$$C_a = \frac{\frac{V}{R_f} + \frac{V}{R_x}}{R_a} \text{ ampères} \qquad (1)$$

$$C_f = \frac{V}{R_f} \text{ ampères} \qquad (2)$$

$$C_x = \frac{V}{R_x} \text{ ampères} \qquad (3)$$

The proportion of energy consumed or rate of doing work expressed in watts (1 watt = $\frac{1}{746}$ horse-power) according to Joule's law, will be as follows:

In the armature	$W_a = (C_a)^2 R_a$	(4)
In the field	$W_f = (C_f)^2 R_f$	(5)
In the external circuit	$W_x = (C_x)^2 R_x$	(6)

As before stated, no measurements appear to have been made by the jury to ascertain the values of R_a or of R_f for either of the machines. The value of R_x may be found from Table I by the equation

$$R_x = V\, C_x \text{ ohms.}$$

The writer has however obtained from actual measurements the value of R_f for both the dynamos tested by the jury at Cincinnati, and also the value of R_a for the Weston, but not for the Edison dynamo. The mean value of R_a for this type and size of Edison dynamo is given in the report of the jury at the Munich exhibition[2], in Hospitalier's *Formulaire Pratique*, 1884, p. 225, in a report of F. J. Sprague on the Edison-Hopkinson dynamo,[3] and also in an official publication of the Edison Electric Light Company. [*Bulletin*, No. 21, p. 13.] These are as follows:

TABLE IV.—RESISTANCE OF DYNAMOS.

Edison K Dynamo..	Res. of Armature (R_a). (ohms)	Res. of Field (R_f). (ohms)	Weston Dynamo (No. 1651.)	Res. of Armature (R_a). (ohms)	Res. of Field (R_f). (ohms)
Munich tests (mean)	.046	13.86			
Hospitalier.....	.032	13.00			
Sprague.....	.0325	37.00	Actual measurem't.	.018	24.7
Edison bulletin....	.035				
Actual measurem't.		14.76			

[NOTE.—The resistance of the field (14.76 ohms), as measured in the Edison machine, included a rheostat of 1.05 ohms, which was employed to reduce the capacity to the machine to 212 16-candle lamps, the number then in circuit, so that the resistance of the field coils alone is 13.16 ohms.]

Assuming, therefore, as we may fairly do, the resistance of the Edison armature at .035 ohms, as given in the bulletin, and taking that of the field at 14.76 ohms, as measured, we have the necessary data to compute the rate of work in all parts of the circuit.

Referring to the first test of October 2, as given in Table I, we find V = 124.9, and C_x = 124.7. From this we find by equation (4) the energy appearing in the armature to be 620.6 watts, or 0.832 electrical h.p., and in the field by equation (5) 1056.56 watts, or 1.416 h. p., making a total of 2.248 h.p., of electric energy consumed within the machine. In line 3, of the same table, it is stated that 20.0 e.h.p., appeared in the external circuit. This makes a gross electrical energy developed by the machine of 23.148 e.h.p., but according to line 4 of the table, only 21.96 mechanical h.p. was used for driving the dynamo, and hence it would appear that 1.188 *more horse-power was generated by the machine on this occasion than was put into it.* In this computation the amount of power consumed by friction, Foucault currents, and other minor sources of loss is neglected. No determination of the friction of the armature is given, but in the Edison K dynamo this cannot well be less than 0.5 h.p., which would increase the excess of energy delivered over energy consumed to 1.678 h.p.

A similar computation applied to the figures of the second test of October 2, gives an equally impossible result. In this case we have V = 122.8 and C_x = 119.3, and hence W_x = 14650.04, W_f = 986.35, W_a = 570.05, making a total of W = 16206.44 = 21.74 h.p., electric energy developed by the dynamo, against 20.64 h.p., mechanical energy consumed, or an excess, assuming friction as before, of 1.6 h.p.[4]

From these data we may compute the possible efficiency which would have been shown by a proper test for the Edison dynamo under the conditions which existed at Cincinnati. In the first test of October 2 (Table I.) we have:

Electrical energy in exterior circuit.....	20.000 h.p.
" " " armature.....	0.832 "
" " " field.....	1.416 "
Mechanical energy consumed in friction....	0.500 "
Total energy consumed.....	23.648 h.p.

2. *La Lumiere Electrique*, vol. x., p. 50.

3. *Tel. Jour. and Elect. Rev.*, vol. xiii., p. 199.

4. The letter of Mr. Howell, printed in another column, came to hand after the above had been put in type. He gives for the Edison dynamo Rf = 17.0, and Ra = 0.032 ohms. Computed upon this basis, we have for the first Edison test in table I, V = 124.9, Cx = 124.7, Cf = 7.34, and Ca = 132.04. Hence the rate of work in the several portions of the circuit, in electrical h. p., would be Wx 20.9, Wf = 1.23, Wa = 0.745, or a total of 22.87 h. p. as against 21.96 h. p. consumed in driving the dynamo, being a gross electrical efficiency of 109 per cent., according to the measurements of the jury.

From this it appears that if we assume that the electrical measurements of the external circuit were correct, the actual commercial efficiency of the Edison dynamo is 88.4 per cent. instead of 95.2 per cent. as given in the table, indicating that the dynamometer measurement must have been considerably in error. It is more probable, however, that the error was due to other causes, as will be hereafter shown.

It may be noted that the above result agrees closely with that obtained in a recent series of tests by F. J. Sprague for an Edison-Hopkinson dynamo of a similar structure and capacity,[5] which were as follows, for a mean of 3 determinations of the κ dynamo:

Energy in external circuit	17.98 h.p.
" consumed (total)	20.98 "
Commercial efficiency	85.7 per cent.

The results obtained by the jury for the Weston dynamo will next be considered.

(*To be continued.*)

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

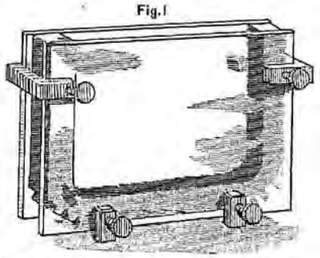
No. XIII.—ELECTROLYTIC VORTICES.

When liquid metallic electrodes are employed to decompose an electrolyte in solution, they exhibit remarkable motions which several previous writers[0] on the subject have regarded as an effect of certain conspicuous rotary currents simultaneously developed in the electrolyte between or over them, and to which I have referred in a previous paper.[0]

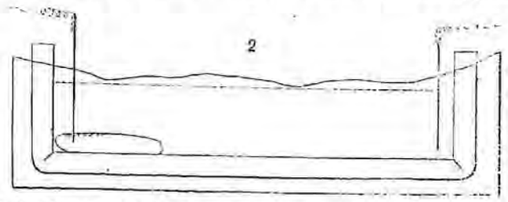
Though inclined to adhere to the views of Paul Erman,[0] one of the earliest students of these phenomena, who considered the movements of the electrodes as strictly electro-mechanical, and the associated vortices in the neighboring electrolyte rather as an effect than the cause of them; it is not my purpose in this paper to discuss their origin, but to illustrate a method of reproducing them under such circumstances that they may not only be most favorably examined by the experimenter, but together with the phenomena, to which they are accessory, be perfectly exhibited to an audience by projection upon a screen.

For this purpose I use a vertical cell like that shown in perspective in Fig. 1; but I prefer to use a rubber strip with a single v shaped cut on the inside in the corners, in order to obtain angular corners and more room.

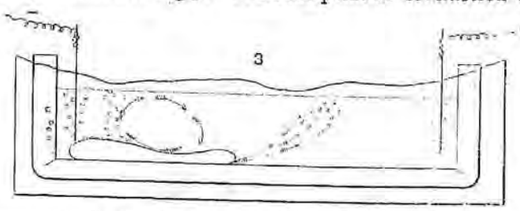
Fig. 1



If in such a cell, filled with dilute sulphuric acid, the lower part of which, without the clamps, is suggested in the following figures, a single globule of mercury be placed, retained near one side by the slightest possible depression made in the horizontal rubber bottom of the cell and platinum terminal wires from a six-cell, pint, Bunsen battery (charged with nitric acid), be arranged as shown in Fig. 2, one in the globule and the other opposite

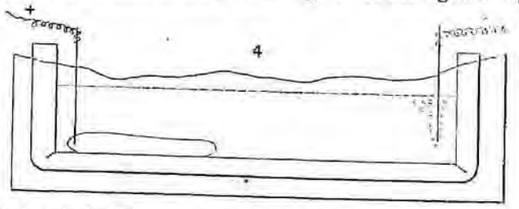


it in the electrolyte, the following experiments may be performed: Let the battery circuit include a pole changer and signal key; on closing circuit, with the pole-changer arranged so that the wire in the globule will be negative, the globule will extend and become contracted near the end, as shown in Fig. 3. From the point of contraction a

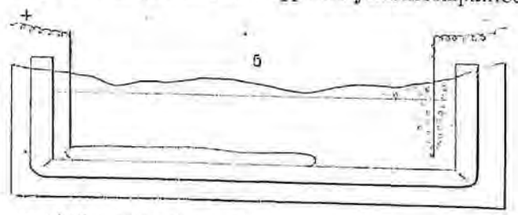


current will be developed in the electrolyte, proceeding backward, upward, forward and downward upon the globule, and will create an oval whirlpool, indicated by the arrows, which may be shown by small, light particles floating in the liquid, or by staining the electrolyte with a vegetable color which will be changed by the constituent of the electrolyte liberated at the liquid electrode. At the same time a second current will be seen, projected outward from under the point of the electrode.

If the poles be reversed by the pole-changer, the globule drops back to its normal length, becomes violently agitated, then abnormally contracted, as if momentarily repelled, and next extends as in Fig. 4. It then gradually



and quietly becomes covered with a film of oxide, which thickens to a crust, through which the end at intervals protrudes, until the globule attains the great length shown in Fig. 5. This phenomenon is apparently not accompanied



by vortical currents in the electrolyte.

If, however, the poles be again reversed, as indicated by the + and — signs in Fig. 6, the crust of oxide breaks, as the globule resumes its normal size. The oxide is then, probably, partly reduced by the nascent hydrogen evolved

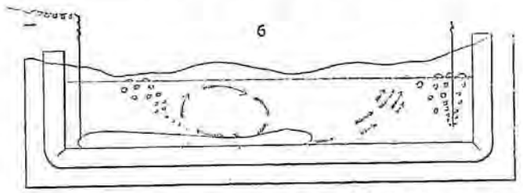
5. *Electrical Review*, (London) vol. xiii., p. 202.

1. See Sir John Herschel, Bakerian Lecture, Phil. Trans., 1824, p. 1.

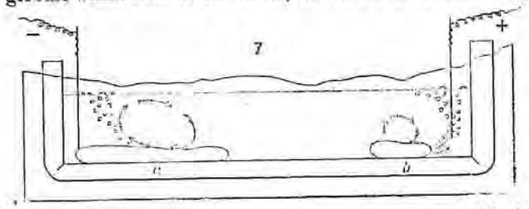
2. Am. Jour. Sci., Vol. XIX., Jan'y, 1880, p. 20.

3. Notice of the simultaneous production of mechanical cohesion and chemical affinity, by Paul Erman, Gilbert's Annalen der Physik, 1809, Vol. XXXII., pp. 301-308.

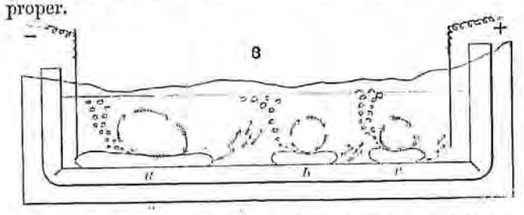
on the globule, and the remainder, a white insoluble substance, renders the solution milky, and serves very well to



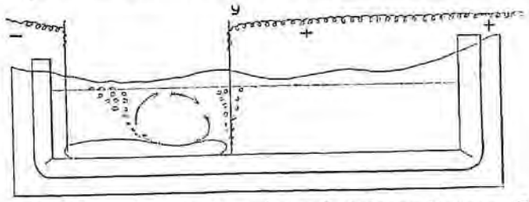
show the electrolytic vortices. The globule then again extends and resumes the shape shown also in Fig. 2, but seems more mobile than at first; and if the battery current be vigorous, it will often extend so suddenly and so far as to part at the contracted point and throw off a small globule which runs to the anode, as shown in Fig. 7.[4] By



breaking and making the current repeatedly, other globules may be in like manner thrown off, all of which follow the first and run to the anode, where they coalesce and remain. If, however, separate slight depressions, as indicated by *B* and *C* in Fig. 8, be made in the bottom of the cell, and these globules, or others purposely added, be retained in place between the electrodes, each one of them will originate a vortex in the electrolyte, shown by the arrows over *B* and *C*, and similar to the vortex over the electrode proper.



Finally, if the anode of platinum be arranged to touch the end of the extended liquid cathode, the globule will contract on contact and instantly extend again, and the constant repetition of this phenomenon will give rise to a continuous pulsation, accompanied at each contraction by a spark. In order to show these experiments on a screen,



it is only necessary to place the cell before a lantern. If the experiments are performed in a horizontal cell with Morton's vertical lantern, the usual[5] horizontal currents may be nicely shown.[6]

4. The agitation of the globule is probably caused by the oxidation of occluded hydrogen. In a sol. of sodic sulphate it becomes sodium amalgam. See Am. Jour. Sci. Ibid.

5. Draper's Memoirs.

6. Am. Jour. Sci. Ibid.

MECHANICAL EXPLANATION OF ELECTRICAL UNITS.

BY F. B. CROCKER AND C. G. CURTIS.

(*Concluded from page 56.*)

The next unit which we have to consider is the unit of *quantity*—the *coulomb*. We have already remarked that quantity of electricity is not quantity of energy; and perhaps we could best define the meaning of the term quantity in electricity if we kept on in this negative way and said what it did *not* mean, for this term is very apt to be thought to signify a great deal more than it really does. In static electricity it is very useful, because in that case we have electrified or charged bodies which it is very natural to look upon as bodies containing a certain *quantity* of electricity. But in dynamic electricity, quantity is a term of a similar nature to the term momentum in mechanics—it has to be multiplied or divided by something before it means anything. It does not correspond to static effect, or work, or rate of work, or any other of the mechanical magnitudes; and, of course, in dynamic electricity a quantity of electricity can only exist as a current, and can only be measured as strength of current, therefore we might as well consider it as a current in the first place, and nothing else. In fact, quantity is really little more than another way of looking at strength of current. It is the result of maintaining a certain current for a certain time, *i. e.*, the product of current by the time that it lasts. If the strength of current in a given circuit is two amperès, and the circuit is kept closed for three seconds, then we say that six coulombs of electricity have flowed through the circuit. But, as we have remarked before, neither coulomb nor ampère alone mean work. We must have another dimension or factor of work also, and this factor is volt. If we introduce this factor we then have *volt-coulomb*.

We have seen above that volt-ampère, the product of the unit of electromotive force by the unit of current strength, is the unit of rate of work. Now, let us see what volt-coulomb, the product of the units of electromotive force, and quantity is. We have just shown, a few lines back, that a coulomb is an ampère multiplied by time. It is an ampère which *lasts* a certain time (1 second). It follows then that a volt-coulomb is a volt-ampère multiplied by time also, because multiplying them both by volt does not change the relation between them. But, volt-ampère is rate of work, and rate of work is work divided by time. Hence, when we multiply rate of work by time, the time cancels out and work alone remains. Therefore, volt-coulomb is the electrical unit of work or energy. It corresponds to the mechanical unit foot-pound. When we speak of 10 volt-coulombs it is exactly equivalent to saying 7.373 foot-pounds of electrical energy.

It is customary in explaining the electrical units to pursue an entirely different course from the one which we have followed. In treating volt-coulomb, for example, it would be said that if a certain electromotive force or electrical pressure move a certain quantity of electricity through a circuit, a certain amount of *work* will be done. If the electromotive force be one volt and the quantity one coulomb, then the work done will be one volt-coulomb, which is the unit of electrical work. But *is* this an explanation?

There is really no such thing as electrical *pressure* or *quantity*. We choose to call certain properties of electricity by those names; but the only reason that we have for so doing is the fact that there is a rather far-fetched analogy between the phenomena of electricity and those of hydraulics. When we see *explanations* of this sort, it always makes us think of those metaphorical *explanations* of the ancients, such as "Nature abhors a vacuum," etc.

The last unit which we have to consider is the unit of *capacity*—the *farad*. It is of little or no importance in

electrodynamics; in electrostatics it is used to measure the capacity of condensers, etc. A condenser is said to have a capacity of 1 farad when it will contain a charge of 1 coulomb of electricity at a potential of 1 volt. If the potential be raised to 2 volts the same condenser will then hold 2 coulombs, and so on. The farad is peculiarly an electrical unit, and it does not correspond to any of the mechanical units.

The above is not intended as an exhaustive treatise on units, it is merely an informal discussion of the subject, in which we have attempted to bring out the relation between the electrical and the mechanical units, and, as far as possible, to reduce the electrical units to a simple mechanical basis. Because many are too apt to look upon electricity as something like a branch of witchcraft, and the sooner they realize that it is not, and that it deals with plain work, horse-power, etc., like any other form of energy, the better.

We have also carefully avoided the use of mathematics in this article; not by any means because we have not a very high opinion of its value. Mathematics—yes, the *higher* mathematics, is essential where great accuracy is required, or where difficult problems are to be solved. The subject we have been writing upon could, without doubt, be set forth much more perfectly in mathematical form. But, unfortunately, nine persons out of ten, either because they have not received a mathematical education, or because their minds do not happen to be of that particular constitution, are unable to understand a mathematical explanation as well as a non-mathematical one. Moreover, mathematical discussions of this subject are very common. Some of which are complete and satisfactory expositions, but most of them merely inform us that a volt, for example, is 10^8 C. G. S. electro-magnetic units of electro-motive force, and that its dimensions are $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2}$, the perusal of which leaves the reader knowing almost as much as he did before. The accompanying table is given as a resumé of the foregoing.

VALUE OF THE PRACTICAL UNITS.

Nature of the quantities to be measured.	Symbols.	Synonyms.	Corresponding Mechanical Quantities.	Name of the Practical Unit.	In terms of each other.	In terms of Mechanical Units	In terms of Heat Units.
Strength of current.	S.	Current. (C) Current strength. Intensity. (I)	Static Effect.	Ampère.	Volt ÷ Ohm or Coulomb ÷ second.		
Electromotive Force.	E.	Potential. Difference of Poten. Electrical tension. pressure.		Volt.	Ampère × Ohm.		
Resistance.	R.	Reciprocal of conductivity.		Ohm.	Volt ÷ Ampère.		
Quantity.	Q.			Coulomb.	Ampère × second		
Capacity.	C.			Farad.	Coulomb ÷ Volt.		
Electrical Work.		Electrical energy. Energy in the form of electricity.	Work or Energy.	Volt-Coulomb.	Volt × Coulomb or Volt-Ampère × second.	.737 foot pounds or .102 kilogram-metres.	.00095 pound-Fahr. unit, or .00053 pound-centigrade unit.
Electrical Rate of work.		Electrical power. " Horse "	Rate of Work or Power.	Volt-Ampère or Watt.	Volt × Ampère or Volt-Coulomb ÷ second.	.00134 horse-p'w'r or .102 kilogram-metres per sec.	.00095 pound-Fahr. unit per second, or .00054 kilogram-cent unit per second.

ABSTRACTS AND EXTRACTS.

WHO WAS THE DISCOVERER OF ELECTRO-MAGNETISM?

In a history of electric telegraphy, now in course of publication in the London *Electrician*, J. J. Fahie seems to have established the fact that the credit of the discovery of the magnetic effects of electricity belongs properly to Oersted, the Dane, rather than to Romagnosi, the Italian, for whom the honor has been claimed by many recent writers.

Mr. Fahie quotes in full the recital of Romagnosi's experiment, which originally appeared in the *Gazzetta di Trento*, of August 3, 1802:

ARTICLE ON GALVANISM.

The Counsellor, Gian Domanico de Romagnosi, of this city, known to the republic of letters by his learned productions, hastens to communicate to the Physicists of Europe an experiment showing the action of the galvanic fluid on magnetism.

Having constructed a voltaic pile of thin discs of copper and zinc, separated by flannel soaked in a solution of sal-ammoniac, he attached to one of the poles one end of a silver chain, the other end of which passed through a short glass tube, and terminated in a silver knob. This being done, he took an ordinary compass-box, placed it on a glass stand, removed its glass cover, and touched one end of the needle with the silver knob, which he took care to hold by its glass envelope. After a few seconds contact, the needle was observed to take up a new position, where it remained, even after the removal of the knob. A fresh application of the knob caused a still further deflection of the needle, which was always observed to remain in the position to which it was last deflected, as if its polarity were altogether destroyed.

In order to restore this polarity, Romagnosi took the compass box between his fingers and thumbs, and held it steady for some seconds. The needle then returned to its original position, not all at once but little by little, advancing like the minute or seconds hand of a clock.

These experiments were made in the month of May, and repeated in the presence of a few spectators, when the effect was obtained without trouble and at a very sensible distance.

Here, says Mr. Fahie, it will be seen that Romagnosi uses only *one* pole of the pile, *and never speaks of the circuit being closed*—facts which show that his experiment has no resemblance to that of Oersted. The effects which he describes are, moreover, easily explainable on another hypothesis. The compass needle, we may imagine, received a charge of static electricity by contact with the charged pole of the pile. Being insulated, it could not part with this charge, and, consequently, as soon as it had attained the same potential as the voltaic pole, mutual repulsion ensued. As the needle belonged to "an ordinary compass-box," we may assume that it was neither strongly magnetized, nor delicately suspended. Friction at the point of support, then, might more than counterbalance the directive force of the earth, and so the needle would always remain in the position to which it had been last repelled. The "restoration of polarity," or the bringing back of the needle to the magnetic meridian, by merely holding the compass-box steadily between the fingers and thumbs, although savoring of legerdemain, was really due to a "simple turn of the wrist." Romagnosi may have imagined that he held the compass-box *steadily*, but there can be no doubt that his hands suffered a slight and imperceptible tremor, which, aided by the directive force of terrestial magnetism, sufficed to shake the needle into a north and south position. Another, and perhaps more convincing argument against the supposition that Romagnosi had any share in the discovery of electro-magnetism is that he himself never claimed any, although he lived down to the year 1835, or fifteen years after the announcement of the Danish philosopher.

TELEGRAPHY IN JAPAN.

The Japanese telegraph net, which was commenced in 1871, embraced, at the beginning of last year, 3,929 miles of road and 9,345 miles of wire. The total number of telegrams forwarded during the year, amounted to 1,272,756, of which 96 per cent. were written in the Japanese tongue. Japanese having no alphabet of individual letters, it has been necessary, for telegraphic purposes, to make up combinations of Morse characters, representing the sounds of each of the syllables contained in the so-called Katakana. For this purpose letters of the international code have been used, and been supplemented by others made up of fine dots and strokes, which represent a total of 47 signs, minus the figures. The alphabet that had been formed in that way answered well enough for about eight years. From a school of telegraphy for the instruction of young Japanese, some 227 regular and assistant telegraph officials have been drafted, and there are now 97 students left in that institution. They are taught to speak and write English and French, and they generally receive a primary education similar to that given in England. The average charge for conveyance of twenty Japanese characters, at a distance of 60 miles, is three *sen*, or rather less than a penny. On the line from Tokio to Yokohama, the transmission takes place for seven *sen*, or about 2¼d., to a distance of 20 miles. In 1880 there were open to the public 112 offices; besides these there were 70 in connection with the various departments of the state, the railways, and the police stations. There are now in use 343 Morse apparatus, 26 Block instruments with one needle, and 29 telephones on the Bell system. In the school of telegraphy there are 71 instruments of various descriptions for practicing purposes; and, in the Straits of Shimonoski, five cables have been laid.

A FOUNDATION FOR A NEW TELEPHONE COMPANY.

Mr. J. J. Fahie contributes to the London *Electrical Review* the following extract from the Davy MSS. No. 6, which he supposes to refer to some kind of telephone or telephonic relay:

"The plan proposed of propagating communications by the conjoint agency of sound and electricity—the original sound producing vibrations which cause sympathetic vibrations in a unison-sounding apparatus at a distance, this last vibration causing a renewing wire to dip and magnetize soft iron so as to repeat the sound and so on in unlimited succession."

The sheet from which I copied these remarkable words is headed "Exclusive Claims," and seems to have served as an *aide memoire* to the drawing up of some statement. It was written very early in 1838.

By "causing a renewing wire to dip and magnetize soft iron," Davy meant closing a relay in the circuit of which was an electro-magnetic sounding apparatus.

ELECTRIC STREET LIGHTING.

A special committee was recently appointed by the Common Council of Grand Rapids, Mich., to investigate the various electric lighting systems in use. Eighty circulars were sent out, 54 of which were responded to with the desired information. Of this number 14 cities were lighted exclusively by electricity. The average price paid for lamps of 2,000 c. p. was found to be $217 per year, the lowest being Bay City, Mich., where they pay $100 each for lamps burning till midnight 250 nights during the year. The highest rate prevails at Nashville, Tenn., being $365 per year. Thirty-one other cities use electricity for street lighting. Of these 25 use the Brush, 3 the Thomson-Houston, 1 the Van Depoele, 1 the United States, and 1 the Fuller. The system used at Evansville, Ind., was recommended by the committee. Ten towers and 60 arches are used, with the Brush arc lamp. The towers are 150 feet high, with 4 lights of 4,000 c. p. on each. The arches are placed diagonally across the corners of two streets, so that the lamps placed upon them throw their rays in 4 different directions, to their full capacity, without obstruction. All of the cities visited had sent out committees of investigation, and all had reported in favor of electric illumination.

A DRY BATTERY.

C. Schueler, of Dresden, has invented a dry battery, consisting of a copper cylinder open at both ends, in which is placed another open cylinder of amalgamated zinc. The filling is composed of plaster of Paris moistened with a saturated aqueous solution of chloride of zinc, containing 7 per cent. of common salt. A stiff paste is made in this way, and poured into the space between the 2 cylinders, where it soon hardens and sets. The electro-motive force is not stated.

ELECTRIC FOSSILS.

A writer in a daily paper says, speaking of a recent archæological discovery: "In no strata, however deep we dig, do we come on fossil telephones, remains of hammerless chokebore guns, apparatus for electric lighting, and the other relics which quaternary culture should have bequeathed to us." We think that if the writer will take the trouble to dig into the piles of patents in our Patent Office, he will find plenty of fossil telephones, fossil dynamos, and fossil electrical apparatus of all kinds.—*Electrician.*

LITERATURE.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Engineering (London), Feb. 8, 1884—The Hochhausen systems of electric illumination, No. II (illustr.) Electric ship signal lights. Feb. 15—*Bright's* electrical fire alarm; an electric governor for steam engines. Feb. 22—The Vienna electrical exhibition; the French telegraph system (illustr.); *Matthew's* dynamo electric machine (illustr.)

Engineer (London), Feb. 8, 1884—*G. Gore* on relations of heat to voltaic and thermo-electric actions of metal in electrolytes. Feb. 22—Editorial on electric lighting.

Electrician (London), Feb. 9, 1884—*Prof. Chas. H. Cross'* report on experiments with the Brush storage battery. *D. G. Fitzgerald* on the physical theory of the Gramme machine. Feb. 23—*A. Crompton* and *G. Kapp* on new instruments of measurement.

Electrical Review (London), Feb. 16—*Profs. Ayrton* and *Perry* on direct reading electric measuring instruments. Feb. 23—*W. L. Robb* on the galvanic behavior of the amalgams of zinc and cadmium.

Scientific American (New York), Feb. 16—*Dr. Meldon's* electric motor. March 22—Electric light tower at Hell Gate (illustr.)

RECENT PUBLICATIONS.

Craig, I. E. Radiation a function of gravity; a new theory of light, radiant heat, electricity, and magnetism. Camden, O., *Author*, 1884. 21 p. 8°.

Day, R. E. (See Dynamic Electricity.)

Dynamic Electricity, its modern use and measurement, chiefly in its application to electric lighting and telegraphy; including: 1° Some points in electric lighting by Dr. J. Hopkinson. 2° On the measurement of electricity for commercial purposes, by J. N. Schoolbred. 3° Electric light arithmetic, by R. E. Day. (Science series, No. 73.) New York, *Van Nostrand*. 32°, 103 p.

Gray, A. Absolute measurements in electricity and magnetism. London, *Macmillan & Co.*, 1884. 16+207 p., illustr. 16°.

Hopkinson, Dr. J. (See Dynamic Electricity.)

Hospitalier, E. Formulaire pratique de l'électricien. 2e année. Paris, *Masson*, 1884. 12+308 p., illustr. 12°.

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CORRESPONDENCE.

NEW YORK AND VICINITY.

A New Project for Lighting the City.—The Electric Light Poles are Not to be Removed.—An Attack on the Electric Light Wires by the Fire Commissioners.—Assay of a New Metal for Electric Wires.—The Electric Light for Lighthouse Service.—Western Union Real Estate.—The New Scott Printer.

A VERY important electric lighting project is now being developed, which promises to solve the problem of the economical production of electricity in a novel manner. In all manufacturing processes, the utilization of waste is a most important factor in determining the profits of production. It is the value of the residual products, that have enabled the gas companies to bid defiance to the competition of any other light. Now, it appears that the New York Steam Company has determined to engage in the electric lighting business, as a profitable disposition of the stock of steam which it has left on hand every night. This company has furnished steam for more than a year past in the down-town district, through pipes radiating from the Greenwich Street station, for the purposes of heating as well as running elevators and machinery. It was found that there was very little demand for steam from 6 o'clock at night until 6 in the morning, and the consequent waste of blowing it off every evening, led to the conception of a plan for utilizing it in the electric light business. The Parker electric lamp and dynamo has been selected for use, and the New York and Brooklyn Electric Light Co. has been organized to carry on the business. It has purchased an interest in the Sawyer-Mann incandescent lamp patents, and arrangements are now being made to introduce them. It is supposed that the surplus steam will more than supply this demand for lighting purposes, and other schemes are being devised to utilize it all. If the steam company is now doing business at a profit, it is obvious that it has unusual facilities for producing electricity during the night at a cost which is merely nominal. The system is said to have been approved of by such well-known electricians as William Hadden, Stephen D. Field, and Prof. Elisha Gray.

The suits brought against the electric light companies, by some of our uptown citizens, which were intended to prevent the erection of poles, and the removal of some which were already placed, have been decided in favor of the companies by Judge Ingraham, who said that the structures had not closed the street to any appreciable extent, but were in entire consonance with the purposes for which streets were intended to be used. The city authorities were authorized to contract for public lighting, and the wires were consequently used for a public purpose. The trial of these suits gave rise to much of the senseless clamor about the dangers in the air, which was the most prominent topic in some of our city dailies at about that time.

A minor crusade against the electric light wires, has been undertaken by the Fire Commissioners, who have asked the Common Council to pass an ordinance requiring their owners to place the wires now in use upon opposite sides of the street from the fire alarm wires. It is hardly possible to do this in many cases, and as the poles have already been located under supervision of the city officials, the companies will no doubt make a strong fight to hold their ground, especially as the damage caused by their wires is comparatively insignificant.

During the past year many attempts have been made to induce capitalists and manufacturers to invest in the ownership of a new metal or alloy which was said to have been produced from iron slag. Its conductivity and tensile strength were remarkable, and it was said to be exactly what was required for the manufacture of electric wire. A Mr. Sherman is said to be the inventor or discoverer of the metal, and among others Ex-Senator Jones of Nevada, was invited to invest $50,000 in it. He presented a sample of it to the official government assayers in this city who pronounced it pure tin. A card has since been published, signed by Charles J. Eames and W. W. Chipman, in which they say there is no deception in the matter and that they know the metal is made from iron slag, so that the opportunity for a permanent investment is apparently still open.

Elaborate tests have been in progress for some time past at the lighthouse department depot at Tompkinsville, S. I., for the purpose of determining the practicability of using electric lights in the government lighthouse service. The mechanical appliances are all in place, and will be started as soon as the globes arrive, which are being made to order, in France. Gen. Duane, who has charge of the lighthouse station, says:

"We shall test all the varieties of electric lights that appear to be of practical value. We have begun with the best, as far as we can judge, that has yet been presented for test. When the globes arrive we will start the light, and then send experts to the Long Island shore, where they will be equi-distant from the tower here and the Highlands' light, which is also of the first order. The experts, by means of very sensitive instruments, will then determine the relative merits of electricity and oil."

The Western Union Telegraph Company has recently sold for $100,000, the building on Broadway immediately adjoining its property, corner of Dey Street. It is also constructing a handsome building on Broad Street, adjoining the Stock Exchange, which will form a very desirable location for the Gold and Stock Department, as well as for its own auxiliary offices. It also has a new building at 23d Street, which will be the upper terminus of the pneumatic tubes and underground wires.

Proposals for city lighting for the year beginning May 1, have been submitted by the U. S. Illuminating Co. for 282 arc lamps, and by the Brush Illuminating Co. for 475 arc lamps, at the uniform rate of 70 cents per night each.

The Gold and Stock Telegraph Company have recently placed on exhibition at the Stock exchange 3 of the new stock printers, invented by Superintendent George B. Scott. These instruments are faster than any now used by the company, and if continued tests, develop no weak points, they will doubtless be adopted for use in this city.

NEW YORK, March 17, 1884.

PHILADELPHIA.

The Commercial Telegraph War.—Radical Changes in the Local Telephone Management.—The Dynamo Substituted for the Battery.—Electric Light Companies at Loggerheads.—City Tax on Underground Conduits.—The Electrical Exhibition.

THE continuance of severe winter weather, in stagnating the operations of the underground and electric light companies, has temporarily put upon the telegraph and telephone companies the burden of affording excitement to the outside world. So far as the rejuvenated Baltimore and Ohio company is concerned, public interest in the operations of the telegraph has been well sustained. In my last letter, I noticed the propensity of this company not only for securing the Western Union's trusted managers and chiefs, but also for opening up for business in Western Union offices.

Recently, another bitter fight has arisen over the possession of a Western Union broker-office in Third Street. This was considered an excellent "stand," for a telegraph office—No. 48 South Third Street—although but a fenced-off corner in a broker's office. The office has been for years in the hands of the Western Union Company, and although the B. & O. might have taken up its position close by, yet it determined to have this particular office. Having first secured the operator—Mr. Thomas J. Fahy—it entered into negotiations with the tenants of the building, and found that the Western Union paid no rent for the little corner it used. The Baltimore and Ohio thereupon had a lease executed, to go into effect Saturday, the 1st inst., and notice was accordingly given to the Western Union to quit. This they refused to do, and the operator was ordered to hold the place at all hazards. He accordingly locked himself in his corner enclosure, and remained there all of the night of Friday, the 29th ult. The siege was kept up throughout the following Saturday and Sunday, the beleaguered operator having his meals handed in over the transom. On Monday, the 3d inst., patience having ceased to be a virtue, the tenants, Messrs. Howell Brothers, ordered an onslaught, and in very short order the little office was torn down, and the instruments and switchboard were flung into the street. Western Union messengers were engaged in picking up the *débris* from the gutter, while Baltimore and Ohio linemen were running in their wires. In addition to these heroic measures, Howell Brothers, had William B. Gill, Superintendent of the Western Union, William H. Conn and Andrew P. Sell, operators, and George Ryley, a lineman, for the same company, arrested, and held for trial, on charges of trespass, forcible entry and detainer. The other side, in turn, preferred similar charges against William G. Jones, Assistant Superintendent of the Baltimore and Ohio, Thomas J. Fahy, an operator for the same company, and Charles Howell, the broker; and they, too, were held for trial. Meanwhile the B. and O. shingle hangs out from the disputed office, and they are in full possession.

Since then the Baltimore and Ohio has taken away William H. Dillon, the Western Union chief operator at Tenth and Chestnut Streets, and one of the most efficient operators in the country, as well as a thorough electrician. Mr. Dillon becomes manager of the B. and O. main office here. This company has now secured from the Western Union headquarters here the Superintendent, Manager, Assistant-Manager, and Chief Operator, as well as some of the best managers at down-town branch offices. That the war is not likely to end soon, is shown by the fact that the Baltimore and Ohio Company complains that 11 of its wires running into the Commercial Exchange, were cut by unknown parties on the morning of the 6th inst. The Western Union has appointed Joseph T. Wilde Chief Operator at its main office, in place of Mr. Dillon.

The Postal Telegraph Company opened here for business on the 19th, their main office being located on Third and Chestnut Streets.

The Bankers' and Merchants' Company has taken away Sup't James T. Maxwell, of this district, and made him General Superintendent, with headquarters at New York, his place here being filled by M. S. Smith. Josiah W. Dyer has been appointed manager here for the same company. The B. and M. is in no way behind in the race for public patronage, and has finished its new lines from Philadelphia to Reading, Penn., thus giving the latter city a competing line to Macungie and Allentown, and southward from Reading to Pottstown and Norristown to Philadelphia, via Barren Hill.

Some radical changes have also taken place in the management of the Bell Telephone Company in this city, including the resignation of President Thomas E. Cornish, General Manager John E. Zeublin, and Treasurer James A. Palmer, the latter becoming General Superintendent of the Clay Commercial Telephone Company. The stockholders of the Bell Company have elected the following officers: President, Henry Bentley; Vice-President, James Merrihew; General Manager, Dr. Samuel M. Plush; and Treasurer, A. A. Ziegler. George Snyder remains as Superintendent.

Mr. Bentley, the new President, is too well known to electricians to need more than a passing mention. A man of great executive ability, a prolific inventor, and a strict disciplinarian, with a handsome stalwart *physique* that seems to be made of iron, there can be no doubt of his entire fitness for the new duties imposed upon him.

Dr. Plush, the new General Manager, is also an inventor, and a most assiduous worker. He relinquished the General Superintendency of the Philadelphia Local Telegraph Company to enter upon his new duties. He says he will make the Philadelphia Exchange the most efficient in the country, and it's a very cold day when he or Mr. Bentley fail in anything they undertake.

William P. Wheatland has succeeded Dr. Plush as General Superintendent of the Local Telegraph Company.

Mr. Bentley, who is now President of the Local Telegraph and the Bell Telephone Companies, has made some great improvements in the former service, two dynamos, located at Third and Chestnut Streets, now being used to work all the stock wires. They were perfected and arranged under the direction of Dr. Plush, and effects, he says, a saving of fully 50 per cent. as compared with the expense of using the old-time battery. All the wires entering the main office of this company are connected with the Plush Electric Protector, an ingenious device of Dr. Plush, to protect the apparatus against lightning and crosses with electric light wires.

Another telephone stock dispute was brought into court here on the 19th inst., the contest this time being over the stock of the Clay Commercial Telephone Company, and the defendants being the incorporators of that company and George W. Bratton and Henry Clay, the inventor. The complainant is Frank H. Cheyney, who claims to have acted as an intermediary between Clay, the poor inventor, and certain capitalists. This was two years ago, when the prospects did not seem as bright as now, and in return for his services Cheyney avers that he was promised a one-twelfth interest in the concern. The "Clay Commercial" Company was organized last November, in Camden, N. J., and is now said to be doing a prosperous business. Cheyney claims one-twelfth part of the capital stock, and has brought a suit in equity here to compel payment.

The Electric Light companies have also fallen to fighting among themselves, the "Brush" Company (aerial) having locked horns with the company that rivals it by lighting Chestnut Street. President Johnstone, of the latter company, will not let any of his rights go by default, and there will yet be music in the air, and underground too, over this dispute. The former company, which has leased the Brush plant, has filed a bill in equity against the Underground Electric Light and Power Company for the purpose of establishing the exclusive right of the former to furnish electric lights in this city. It claims that under the act of incorporation its own right so to do is exclusive, "until the said corporation shall have, from its earnings, realized and divided among its stockholders, during five years, a dividend equal to 8 per cent. per annum on its capital stock." It then recites how the defendant company has seized upon the city lamp-posts, and lights the streets through underground conduits, and prays for an injunction and compensation for damages suffered.

The Pennsylvania Railroad Company has abandoned the use of nearly all its aerial lines between its general offices on Fourth Street and the Broad Street station, a distance of over a mile, and is now using the underground (Brooks') system. There are three telephone and a number of telegraph wires in constant use.

The Brush lights on Chestnut Street failed for a few minutes at midnight on the 29th ult., and the street was consequently left in comparative darkness. At the same time a loud report in the vicinity of the works startled the residents. It was soon learned that a large pulley wheel, 24 inches wide and 30 inches in diameter, had burst, causing a total extinction of the lights. The 5 "emergency" engines were at once set to work, and the lamps were relighted after a delay of only 5 minutes.

The underground companies have been battling rather successfully for a reduction of their taxation by the city. On the 26th ult. a committee of councils agreed to the following: "That an annual license charge of $20 per running mile be made on all conduits, tubes or pipes for electrical conductors not exceeding 2¼ inches in diameter; of those not exceeding 6 inches, $40; 12 inches, $80, and over 12 inches, $125."

"The Goebel Sectional Electric and Pneumatic Delivery Company" sold its goods and effects, consisting of four patents and some office furniture, on the 14th inst.

Another company to be called "The Pneumatic and Electric Conduit Company," has been formed in company to work these patents.

The work of breaking ground in West Philadelphia for the forthcoming electrical exhibition has commenced. The building is to be constructed of wood and glass, on a stone foundation, and will resemble in appearance the famous "Agricultural Hall" at the Centennial Exhibition, having four towers, one at each corner, and an arched dome running the entire length of the structure. The entire building will cover 6,700 square feet, having a frontage of 202 feet on one side, 312 feet on another, 160 feet on the third side, and 283 feet on the fourth. There will also be an annex building. The European display promises to be very fine, 20 applications having already been received from Germany, and 6 from England. It is also understood that Belgium will make a particularly interesting historical display. Indeed, especial attention is to be devoted here to tracing the rapid progress and vast growth of electricity. I might mention here my recollection of the interesting collection of historical works on this subject and valuable relics, made by Mr. Latimer Clark, of London, and though I have not yet seen any indication of his intention, we shall hope to see them here.

Arrangements are going on, on an elaborate scale, for the proper entertainment of the American and British Associations for the Advancement of Science, which will sit here coincident with the Electrical Exhibition. The local committee expects to have fully 2,000 guests on its hands, and intends to out-do Boston in her generous round of banquets, receptions and excursions extended by her to the same members two years ago.

PHILADELPHIA, March, 15, 1884.

CHICAGO.

Telegraph Wires Hindering the Firemen.—Cutting Pliers added to the Equipment of the Trucks.—The Famous Underground Ordinance.—Electric Lighting from Central Stations at a Standstill.—A Home-made Galvanometer for Dynamo Currents.—Coming Telegraph Changes.

A PARAGRAPH has been handed me which again brings up the subject of underground conductors for electrical purposes, around which I have made some inquiries among those most interested from various standpoints. The text, if I may be allowed to so christen the two line paragraph, is as follows:

"It is said that Chicago firemen recently spent 15 minutes cutting telegraph wires before they could get at a building."

As no complete data are given, it can only be a matter of conjecture, as to what particular fire is referred to, but this fact does exist, and is on record. The fire in December, at 159 Dearborn Street, licked up property to the amount of $100,000, and was, without doubt, seriously affected by the network of wires on that route, 40 of these having to be severed before the Department could get to work satisfactorily. As the fire occurred at 8.30 p.m., the delay was still further increased by reason of the darkness. The time occupied in cutting is somewhat exaggerated, but from 7 to 10 minutes were consumed before the obstruction was removed, and this is probably the case referred to.

In a more recent case, February 17, Jeune's grocery, on Madison, between Clark and Dearborn, a similar, though less, delay was encountered from the same cause. In this instance only about 15 wires were severed. These are not the only cases where aerial wires have been a positive detriment to promptness in conquering the fire fiend. The liability to this kind of annoyance, while overhead wires are permitted to remain, has induced the authorities to equip each Hook and Ladder truck in the Department—9 in number—with a peculiar form of shears having rubber insulation on the handles. These are quite light, but are so combined as to leverage as to enable the user to cut a quarter-inch steel wire with perfect ease. The *modus operandi* is simple enough. An extension ladder is raised, the fireman climbing as it goes up, and the wires are clipped near the pole at one end of the stretch.

The ordinance covering the wire question is strict and thorough, and as Chicago has become somewhat prominent in this matter, perhaps a portion of it may not be inopportune. I copy from the Code, Article LXII, secs. 2,022 to 2,024 inclusive:

"No person shall hereafter erect, construct, or put up any telegraph pole, telegraph line or wire, or electric conductor, in any street, avenue or alley, within the corporate limits of the city of Chicago, under the penalty of $100 for each and every offense, and each and every day such telegraph pole, line or wire, or electric conductor shall be continued or maintained after the first conviction, shall constitute a new and separate offense.

"No person, company or corporation, to whom permission and authority has heretofore been given to erect and maintain telegraph poles and lines in the city of Chicago shall, from and after the 1st of May, 1883, maintain or use any

telegraph pole, telegraph line or wire, or electric conductor, in any street, avenue or alley in said city, under penalty of $50 for each and every day such person, company or corporation shall maintain or use any such telegraph pole, line, or wire or conductor after said day and year last aforesaid.

"From and after the 1st day of May, 1883, every telegraph line or wire, or electric conductor, used and operated within the corporate limits of the city of Chicago, shall be laid under the streets of said city, and at such depth from the surface, that the necessary excavation incidental to laying the same shall not expose or endanger any water or gas pipes, sewers or drains, or any parts thereof."

This was passed and approved two years before the date contained in the last paragraph, by which time it was believed some feasible underground system would have been evolved by electricians. But the day arrived, and every indication pointed to the fact, that so far from the question being solved, it was really becoming more intricate. It was a Gordian knot, the cutting in twain of which did not loosen its strands. A species of compromise of a temporary character was agreed upon, and aerial cables, in which 25 to 50 wires were grouped, greatly diminished the visible overhead nuisance, and lines of short poles were made by cutting off the masts which were so plenty throughout the centre of the city. This is the present status of the underground muddle. It has come to be generally conceded that nothing short of a subway having capacity for wires many inches apart, in which linemen, repairers and the like can work at ease, will be sufficient for the purpose. Telegraph and telephone companies well know that with the same kind of underground facilities which Paris and London afford through their subways—the sewers of the former and the underground railway of the latter—their lines would be far less liable to damage, more readily reached in case of need, and more cheaply maintained, than as now run overhead, and they would gladly avail themselves of a similar system of underground way.

The city has not been peremptory or arrogant in urging the law, which seemed to ask an impossibility, but has been as lenient as possible under it. Wires crossing thoroughfares, run previous to the passage of the ordinance, were permitted to remain temporarily for electric lighting purposes, but woe-betide the wire gang who had the audacity to string a wire contrary to law. There have been several instances of "jerked to justice" of this nature since the birth of the ordinance.

The authorities purpose taking their own medicine, as I stated in a recent letter, as soon as the weather will permit, and all the North and West side wires belonging to the corporation will be brought to the new fire-alarm office, underground, which will test the whole matter experimentally and practically, as well.

Electric lighting at present is at a comparative standstill here. The Central plant system does not seem to obtain generally, for the reason that the underground ordinance is a bar to the promiscuous stringing of the wires. One company has 2 plants where wires are run into several buildings on different streets, one of these having 54, the other 33 lights. In the former case 1, and in the latter 2 dynamos are run by the same engine, but on separate circuits. There are some others, but the number of plants of this nature is quite limited.

All the companies of note are represented in Chicago, and I am told there are in all something upward of 60 arc light plants in the city. The incandescent system, principally the Edison style, is making some headway, and this latter company is wiring a monster plant, of which I may say something in the future. Outside the city the companies are all doing more or less work, having no legal embargoes placed in their way.

I have been shown a very simple galvanometer for heavy currents, made by the electrical expert of the Fuller Company here, Mr. Fish. There is nothing remarkable about it particularly, but I will describe it for the benefit of those in charge of dynamos, any one of whom can readily make one for his own satisfaction. It consists simply of a toy horseshoe magnet suspended within the coils, only 2 in number, of 6 or larger insulated copper wire, by an unspun fibre of silk. On the 2 poles a light pointer is attached, which traverses the face of a horizontal brass scale of degrees. The terminals of the 2 wires are led into the main circuit, so that the entire current runs through the coils, and a simple arbitrary guide is thus made for the benefit or amusement of the engineer.

Some changes are taking place in Telegraphic circles. The advent of the Bankers' and Merchants', who will shortly open up at 144 Madison Street, will probably carry off several of the W. U. operators, as well as some from the other companies. Already Bob Stewart, of the B. & O. is announced as the Gen. Supt., and C. G. Sholes, formerly a chief in the Western Union, is to have a district superintendency; while J. E. Petit's place in the new company will be that of chief operator. The wires are expected in from the East in about 6 weeks—dependent somewhat on weather—and the wires of the Board of Trade lines to St. Louis, the lines of the Pacific Mutual, from thence to Kansas City, Atchison and Topeka, has a fine "Westward ho!" outlook for this last candidate for telegraphic favors. The Mutual Union still holds out at the northwest corner of Lasalle and Washington, with a few wires and operators, catching now and then a message whirled in by a stray corner eddy, or from some one of its old patrons, who can thus show his disdain for the Western Union by snapping at his own nose. The premises thus occupied are posted for renting, but it is not at all probable that they will be occupied by any rival company. The Western Union will not be likely to be caught by a trick of that nature a second time. The Postal Company is pursuing the even tenor of its way, and the officers claim that they are handling a fair proportion of business to all points they reach.

WASHINGTON.

Congress and the Telegraph.—The Postal Telegraph and Cable Co. Ready for Business.—Electric Lighting at the Capitol.—The Potomac to Furnish Power for City Lighting.—The Experimental Tower System.

THE Senate Committee on Post-offices and Post-roads has concluded that it will hear no further argument in the matter of the Postal Telegraph. The friends and opponents of the measure and representatives of every important interest affected by the proposed legislation have been given the fullest opportunity to present their views, to which the committee have listened attentively, and had it all printed for reference in preparing a bill—a duty which the committee will at once proceed to perform. While no further time will be spent in hearing argument, it is not improbable that a few practical men may be called from time to time, as progress is made in perfecting the bill, to furnish the committee with data as to costs or other matters connected with the practical building and operating of telegraph lines. If such are called, they will be selected from those not interested for or against the scheme. Senator Hill is a believer in a government system of telegraphy, but is not, nor are many members of his committee, satisfied as to the most practicable plan for accomplishing the object. There will be a protracted discussion before a definite agreement on this point is reached. Mr. Anderson's bill, similar in its general features to Senator Edmunds', slumbers in committee at the House end. This is quite proper, as the Senate committee has spent a great deal of time and money in gathering information, which is equally valuable to the House. It is therefore probable that nothing will be done by the House committee formally on the subject until the Senate bill is received, although it is within my knowledge that the individual members are giving much thought to the subject.

It seems to be the motto of the present House to "do nothing to-day that can be done to-morrow, because to-morrow you may be sorry you did it"—or in other words, to leave everything, except the appropriation bills and other absolute necessary legislation, to the next session after the Presidential election. If there were no other reason (and there are many), it would be safe to predict that no telegraph bill will pass the House at this session. My belief is that a bill will be reported to the Senate, and a long discussion had on it, and that it will probably be passed by that body; but I have no idea it can be even got before the House this session. The election may put a new phase upon the whole question.

The Postal Telegraph Company, a corporation that by the way is often confounded by the similarity of name with the government scheme, has been laboring under great difficulties in consequence of the exceptional weather the past winter, is pushing on its underground work, and now expects to reach its office, 1423 F St., by the end of the month. The system is that of Mr. Hurlburt—paper tubes laid in asphalt, through which the wires are run, with openings at each street crossing. Meanwhile, the company has been granted permission to connect with their air lines outside the city by temporary wires strung overhead, to be taken down on the completion of the underground work. With these wires the company opened their office for business to-day. Mr. Wm. H. Allen, formerly of the Cable Department of the Western Union New York office, and private secretary to Collector Simmons, of the Boston Custom House, during the latter's occupancy of that office, has been selected as manager, and is giving a great deal of energy and practical business talent to the work. The company has but two wires ready for use, but are running others, which will be completed in time for the underground connections.

Since my last the United States Electric Light Company have been able, by the completion of the new approaches to the Capitol, to put two of their arc lights at either end of the building, and the effect is very fine. The Senate and House wings, the wide-paved passages and stairs, and the surrounding grounds make a magnificent appearance under their brilliant light. The Brush-Swan Company, under the management of Mr. A. A. Hayes, President, are pushing things. Their first station has been established on Second St., between B and C, two squares from the Capitol. The building is 80 by 30 feet—a substantial brick structure. Boilers, engines and machinery are now being put in. It is the intention of this company to utilize the water-power of the Potomac, a short distance above Georgetown, for the purpose of generating the electricity for their storage batteries; but to meet a demand for an exhibition of the tower system of lighting, the present station, which will always be a valuable adjunct to the water-power process, has been established.

The wide streets and avenues—the former running at right angles with each other and the latter radiating from various centres; the large number of public spaces or reservations and the generally low class of buildings in the city combine to give Washington unusual advantages for the application of the tower system. Mr. Hayes is sparing no expense in his efforts to make his experiment a success. Everything is being done as systematically and thoroughly as if to last a hundred years, so that there will be no necessity for replacing temporary by permanent fixtures if he succeeds. The first display will be from the summit of the Capitol dome, with fourteen lamps of 4,000 candle-power each; ten same, c. p., from the Washington Monument, 400 feet high, with a wide open reservation on every side, and six from a mast on the highest tower of the Smithsonian Institution, which also stands in a position isolated by a large park from surrounding buildings. The district authorities take an active interest in these experiments, and have relaxed their regulations as to overhead wires sufficiently to permit Mr. Hayes to run air lines until he can demonstrate his system of high tower lighting. The time for the exhibition has not been definitely fixed, but will be made as early as practicable to meet the wishes of Senators, Representatives, and other officials.

WASHINGTON, D. C., March 17, 1884.

BOSTON.

The Oldest of the Fire Alarm Systems.—An Extensive and Well-Organized Department.—The Mutual District Messenger Co.—Inspection of Electric Lamps by a City Committee.—Half of Them Will Probably Be Discontinued.—Ravages of the Sleet Storm.—Electric Light Wires Escape Serious Damage.

THE Boston Fire Alarm Telegraph is a staid and reliable institution (one of the oldest in the country), and has been conducted as becomes the sentinel that guards and overlooks the immense interests and property of Boston and its annexed territories. It has been a source of pride to the Bostonian—rather, I should say, *one* of its sources of pride; for Boston has no institution but what her citizens are proud of—at least I never heard of any. When the alarm sounds and the responding apparatus rushes and rumbles through the street, if in the daytime, the citizen pays no attention to it beyond counting the warning strokes; if at night, he simply turns over in bed, satisfied that the vigilant attendants are doing their duty, and he need not worry. Does this sound like pride or egotism? who ever heard of it in Boston? When you have employed a servant for a long term of years, and found him always faithful and on time, simple praise is neither pride nor egotism.

The Fire Alarm office has for its working force 13 men—the superintendent and assistant, 3 operators, a foreman of construction, 6 repairers and assistants and 1 battery-man. The city is divided into 10 fire districts, each being placed under the charge of an assistant engineer.

The number of fire boxes now in use is over 325, and over 300 miles of wire are operated and cared for. Wire has been run to place the bells in the city proper on independent circuits, thereby rendering an alarm on the house gongs more certain. Nearly 50 of the Tooker keyless fire alarm box doors are now in use—some for over 2 years—and give satisfaction. It is the intention of the fire authorities to place them from time to time in localities where needed, as they save much valuable time in giving an alarm after the discovery of a fire, doing away with the necessity of hunting up a key, as by them any citizen who discovers a fire can at once repair to the nearest box and give an alarm. The Serson and Kauffer battery is in use in the department, being regarded as the best. The public clocks, 40 in number, are under the care of the Fire Department.

The estimated value of the entire property in its

charge is	$100,000
with bells and clocks	87,000
making a total of	$137,000

The telephone is freely used in connecting the several houses with the Central Office, which by the way is a pleasant place to visit, and one of the "shows" of the city. The walls are beautifully sheathed with maple and cherry, handsome carpets on the floor, and with the elegant strikers, galvanometers, etc., the room presents a fine appearance.

The Mutual District Messenger Co., which recently declared a quarterly dividend of 2 per cent, is now one of our best managed concerns. It is entirely out of debt, and has an exclusive contract of 11 years with the Western Union Company for the collection and delivery of telegrams. Its net earnings last quarter were $5,400. The total stock is $250,000, of which $50,000 is in the treasury.

The Lamp Committee of the city government are to personally inspect the location of each electric street light, and pass upon its necessity. As stated in my last letter there are in use 381 electric lamps. The expense is considered enormous; they cost more than one-fourth as much as the 9,623 gas lamps, and displace less than one-seventh as many. It is thought that about one-half of the electric lamps will be dispensed with, and the remainder used on parks and squares.

We have had a united wail from our city papers since the last sleet storm about the overhead wires—"they must go underground." The fire alarm wires were down; but we don't hear that the city are to put *them* underground. With our present knowledge, only the *dead* go underground. The "ordinary" mind cannot comprehend the case at all. The telephone wires, to the number of 900, were disabled—many lines down, others crossed up. The delay in telephone service has been due to so many of the housetop fixtures being broken down, which have had to be reconstructed. Men were brought from the outlying New England divisions to the city to restore the wires. Covered wires were saturated with water from the continuous rain and snow. The electric light companies escaped with the least loss, and with the exception of one night, when all lights were out by order of the mayor, they have been in successful operation.

BOSTON, March 17, 1884.

PROVIDENCE.

A New City Ordinance for the Supervision of Telegraph Lines.—Progress of the Standard Multiplex Company.—The Sleet Storm.—The B. & O. Telegraph Company.—Electric Light Interests.—The Underground Agitation.

THE joint committee on ordinances in this city gave a public hearing last Thursday to all persons interested in the substitute ordinance, which will probably be adopted, and under which ruling all companies using or running electric wires will have to come.

The substitute imposes certain conditions, such as marking the poles of the different companies, tagging the wires, and also revokes the 30 day clause in the old ordinance. The provisions of this clause are that the city, before removing a pole in the streets, is obliged to give 30 days notice to the owners.

The meeting was attended by representatives of the different electrical interests in the city, none of whom made any objection except the counsel for the Rhode Island Electric Light Company. The city of Providence has never thrown any obstacles in the way of telegraph companies; on the contrary, it has afforded them the utmost facilities in its power. When the Mutual Union Company came in, 3 years ago, the abuses of the streets were loudly denounced by the newspapers, and the feeling of the public against such proceedings greatly intensified.

At the above named meeting of the committee, the petition of the Standard Multiplex Telegraph Company was brought up for objection. Supt. Duxbury, of the Providence Telephone Company, objected to the granting of the petition, until he could learn whether or not, on account of the proximity of the Multiplex wires to those of the Telephone Company, there would be any disturbance, such as that experienced when the American Rapid Company had its automatic system in use. Mr. Goodwin, of the Multiplex Company, stated that there was no noise attendant upon the operations of the system; but owing to the objection the matter was carried over.

The new company has engaged an office at No. 3 Exchange Place, on the second floor, where it will begin the work of revolutionizing the telegraph business in a similar manner to that done by the American Rapid 4 or 5 years ago. It goes without saying, that the steady going Morse is still holding its own against all other systems, and I believe is bound to continue in that line.

The storm of last Saturday, which made such havoc in Boston, was very destructive in this section. It broke down wires on every turnpike line, and prostrated 4 of the new Multiplex poles near Attleboro.

Old telegraph men bear these troubles with equanimity, but the lessees of private wires cannot understand that it is impossible for the Western Union to furnish them with phantom circuits which will work as well as the real.

The current topic of the week is the resignation of Manager Sheehan, of the Western Union office, and his appointment as Ass't Sup't of the Baltimore and Ohio Telegraph Company, with headquarters at Boston. Mr. Sheehan served successively in the People's, Insulated, Franklin, Atlantic and Pacific, and American Union Companies, until the tidal wave of 1881 brought him to the Western Union, along with the many American Union men who have now cast their lot with the Baltimore and Ohio. He will enter upon his new duties on the 1st of April. His successor has not been appointed, although it is said that it will fall to Mr. Hurlburt, the present chief operator, who is most worthy of the place, being a man of experience, excellent judgment, and courteous to the last degree. He is popular with his subordinates, and enjoys the esteem of the people among whom he has lived for many years.

The appointment of Mr. Sheehan sets at rest all rumors about the Baltimore and Ohio building East.

I learn by the daily papers, that "6 wires will be put up to start with, 2 No. 6, 2 No. 8, and 2 No. 10, all copper." This reads like an error, unless the B. and O. has struck a copper mine. The paper states also that the company will enter the city underground, which is probably another romance. The lines will probably be completed about August 1st, although the announcement is made for June.

I regret that in my February letter I unintentionally said that the Narragansett Electric Lighting Company gave an exhibition of incandescent lights. Now I learn that that company has no incandescent light, and therefore could not make such an exhibition. The Narragansett people are progressing very well, and the sup't Mr. H. C. Bradford, is busily at work setting poles and stringing wires. Since the change in proprietors, the Narragansett Hotel has again begun the use of electric lights, greatly to its advantage.

The contract with the city for street lighting during the coming year has been secured by the Narragansett company. It is at present held by the Rhode Island Electric Light Company, whose bid was 58 cents per lamp. The Narragansett people are to supply the 75 lamps at 55 cents each per night.

The underground question is being agitated among certain influential parties. When the city authorities compel electric wires to be put underground, our city fathers will have to wait longer than ever for a response, or a satisfactory working of the telephone. This little instrument is too handy to be buried, and when the impossibility of working it through underground wires is demonstrated the whole question will be dropped. The fact is, that this is a servant which is indispensable.

PROVIDENCE, R. I., March 15th, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, 115 *Nassau Street, New York City.*

SYMPATHETIC TELEGRAPHY.

[4]—Will the old notion of "sympathy" between two pieces of steel, although separated, never die out in the popular mind?

There is an old story of the Crusades, of a brave knight, imprisoned by the Saracens, who telegraphed his wife, by means of a compass, of his whereabouts, and thus enabled his friends to rescue him.

And now comes M. De Packville, in the *Revue Scientifique*, stating on the authority of Galileo, in his "Dialogues," that about 1625 the notion of such a possibility was current throughout Europe.

The senior editor will remember, several years ago, a meeting in Jersey City, at the shop of Dr. Bradley, at which the Doctor, the editor and the undersigned were engaged in the discussion of some electrical conundrum, when we were interrupted by the entrance of Mc——, who was then employed running an electric light for the Erie road, at its office, on the corner of Broadway and Fifth Avenue, displaying nightly an advertisement of the Erie Railway on a blank wall.

Mc—— entertained us for an hour on his sympathetic telegraph, which was to be ready for trial in a few days. His apparatus was made in this way:

A sheet of steel, of the proper length, was made of double width; it was then cut *nearly* in two, lengthwise. Having been tempered and magnetized, it was separated, making two needles, "which," said Mc——, "having been magnetized while the two were one, had a sympathy for each other that nothing could destroy."

These needles, mounted with a single strap under each, made two quantity galvanometers. Each instrument was provided with a cell of battery and a circuit-closer key; and Mc——'s theory was, that if he closed the circuit on one galvanometer, and deflected its needle, the other, no matter how far away, would be deflected in sympathy. This was an improvement on the old Troubador knight's arrangement.

Poor Mc——! He took one instrument to Philadelphia, and attempted to deflect the other one in New York by it. But the sympathy had oozed out, and the scheme was a failure.

A few days ago, an embryo electrician in Pennsylvania sent me a sketch of *his* invention. It was Mc——'s over again—except that he moved his needle, as the old knight did, with his finger.

I wrote him not to expend a cent on it for patent purposes until he had consulted Drawbaugh, for the Eberly's Mills electrician was undoubtedly the first to invent it. I told him that if he obtained an assurance that D. did *not* invent it, he could stock it for fifteen millions and sell the stock on the Drawbaugh boom.

MILWAUKEE, WIS., February 13, 1884. C. H. HASKINS.

JOULE'S LAW.

[5] The difficulty that Mr. C. L. Buckingham says electrical students find in understanding how it is that doubling the current-strength will much more than double the heat developed in a given time, illustrates so exactly the general misconception of the term current-strength (as we have pointed out in our "mechanical explanation of electrical units"), that we can not refrain from noticing it. The only reason that a student should not understand why twice the current-strength should develop four times as much heat or energy in a given time, is because he makes the mistake of thinking that energy and current-strength are the same thing. If they are not the same thing, there is no reason for being surprised that the heat developed is not proportional to the current strength, for it might just as well be proportional to the square or cube or any other power of the current-strength for all he knows. If the student were taught the difference between current-strength, which is merely a *static* effect, having nothing to do with *time* or *energy* necessarily, and current-energy, which is a *dynamic* effect proportional to the *time it lasts*, before he learns that one is proportional to the square of the other, he might not think it strange that the heat developed should not increase with the current-strength.

CHARLES G. CURTIS.

140 Nassau Street, New York.

THE TESTS OF THE EDISON DYNAMOS AT CINCINNATI.

[6]—Having been present at Cincinnati during the electric light tests last fall, and knowing perhaps better than any one else the conditions under which the Edison machine was run during the test, I take this opportunity of making a statement which may check some of the rather harsh criticism upon the jury conducting the tests.

"The most casual inspection, to one familiar with the law of operation of dynamo-electric machines and electric lighting plants," certainly shows a most remarkable result. A more careful inspection clears away most of our doubts, and the following statement will, I think, clear them all away. The report of the committee—*Science*, Feb. 15, p. 182—shows that the Thomson volt-meter used by the committee when compared with the Daniell cell gave the e.m.f. of the cell to be 1,106 volts, consequently, the readings of this instrument were too high in the ratio of 1.106 to 1.079. As the constant of the current galvanometer was determined by comparing its permanent magnet with that of the volt-meter, the same correction must be applied to the current readings. Applying these corrections to the first column of results on the Edison machine, we get—

E.M.F. in volts	121.8
Current in ampères	121.7
Electrical horse-power	19.87
Horse-power consumed	21.96
Percentage of efficiency	90.4

The resistance of the magnet circuit of this machine is 13.3 ohms, but as this machine was running 168 revolutions per minute faster than its normal speed, we were obliged to insert some resistance in the magnet circuit during the test. This resistance was about four (4) ohms, making the magnet circuit 17 ohms. Calculating the energy wasted in the magnet circuit on this basis—121.8 volts over 17 ohms, it is 38,612 ft. lbs. per min., or 5.3 per cent. of the power consumed. The current in the magnet circuit was 7.1 ampères. Adding this to the outside current we get a total of 128.8 ampères. This acting over the resistance of the armature, which is .082 ohms, develops 23,515 ft. lbs. per minute, or 3.2 per cent. of the power absorbed, leaving 1 per cent. to be accounted for by friction. The driving pulley being directly over the armature pulley, the machine was adjusted until the loose side of the belt was as slack as it could be run without slipping, thus reducing the sum of the tensions of the two sides of the belt to a minimum, and consequently making the friction a minimum. This slackness of the belt was remarked upon by the jury, but as I wished it to be so it was not changed. The bearings were in perfect order, and both run cold during the entire test, being watched by me personally, and I think 1 per cent. will cover the losses from this source. We are thus enabled to account for all our power consumed without considering any liability to error, which, under the circumstances, was fully 1 or 2 per cent. Hoping you will find space for this in your April number, I am yours,

EAST NEWARK, N. J., March 14, 1884. JOHN W. HOWELL.

[We print Mr. Howell's communication with pleasure, the more so, because it not only serves so far as it goes, to confirm our own statements in respect to the incorrectness of at least one of the results arrived at by the jury, but also supplies what has hitherto been lacking, the actual values of the field and armature resistances of the Edison dynamo at the time of the test. The additional information given by Mr. Howell as to the manner in which the tests were conducted is also of interest. As to the standardizing of the Thomson potential galvanometer, we would remark that the value of the Daniell cell, as obtained by the jury by means of that instrument, agrees very well with those given by the following excellent authorities:

Sir W. Thomson, (papers on elect. and mag., p. 245)	1.12 volts.
Latimer Clark, (jour. soc. tel. eng., vol. ii., p. 27).	1.11 "
F. Kolrausch, (pogg. ann. vol. cxli.)	1.14 "
" " (physical measurement, 2d ed,, p. 286)	1.11 "

It would seem most probable that the galvanometers of Thomson are graduated to agree with his own determination, viz., 1.12 volts.

Our criticisms are not directed to the performance of the Edison dynamo, as Mr. Howell seems to suppose, but to the methods and results in general of the jury. The percentage of commercial efficiency of the Edison dynamo as figured out by Mr. Howell, is at least not an irrational one, which is more than can truthfully be said of the percentage given by the jury for the same machine.—EDITOR.]

CHEMISTRY OF THE DANIELL BATTERY.

[7]—Will you permit me to question the correctness of the statement in your review of Lieut. Swift's book concerning the explanation of the chemical action in the Daniell Battery. When it is known that the chapter referred to was written expressly for Swift's book by one of the eminent professors of physics in Johns Hopkins University, your electrical editor will doubtless acknowledge his error and amend his criticism.—MARYLAND.

[If the "eminent professor" will read our criticism and profit by it, we doubt not that it will be greatly to the advantage of the students who may hereafter attend his lectures.—EDITOR.]

QUESTIONS AND ANSWERS.

[14.]—**Electric Light Engineering.**—R. C. C., Cleveland, O., writes: "Can you refer me to a cheap but good work on connecting up incandescent lamps, including information on running wires from generators, etc., along streets and into houses?" Ans.—We know of no work on this subject, although much of the necessary information may be found scattered through the columns of the various electrical journals during the past 3 years. Dredge's *Electric Illumination* contains information on the subject, and is well written and illustrated, but is a large and quite expensive work.

[15.]—**Electricians and Electrical Engineers.**—A. J. N., Holyoke, Mass., asks: "What is the difference between an electrician and an electrical engineer?" Ans.—An electrician is, or at least should be, a person thoroughly versed in the theory of electricity and the laws by which it is governed, but it is not essential that he should have any special knowledge of its practical applications beyond laboratory work. An electrical engineer, strictly speaking, is one whose business it is to make practical applications of these laws to industrial purposes. Such a person must necessarily also be more or less of an electrician, although long practical experience often goes far to supply deficiencies in theoretical knowledge.

[16.]—**Electrical Engineering as a Profession.**—C. McD., Stockport, Ohio, says: "I am 19 years old, with a fair education. Please inform me as to the prospects for young men as electrical engineers?" Ans.—The prospects in the future at the present time appear to be better in electrical than in almost any other branch of engineering. If he is in a position to afford it, a young man can best qualify himself for a good position by first taking a course in some such institution as the Stevens Institute of Technology, at Hoboken, N.J., the Massachusetts Institute of Technology at Boston, or the Cornell University at Ithaca, N.Y. All these institutions give a thorough practical, as well as a theoretical training and their graduates usually secure good positions without much difficulty. If not able to do this, then the only other way which we can recommend, is for him to secure a position, no matter in what capacity, in some electrical manufacturing establishment, or with an electric lighting or other electrical company and work his way up. The greater number of our most successful electrical engineers have begun in this way. There is no short road to eminence in this business any more than in any other; but an intelligent and enterprising young man has unusual opportunity for advancement. There is no line of work in which intelligence, industry and executive ability are more highly appreciated than in this.

[17.]—**Books on Telegraphy.**—G. A. B., Knowlesville, New York, inquires whether Pope's *Modern Practice of Electric Telegraph*, is as good a book for the student in telegraphy as Abernethy's *Modern Service of Commercial and Railway Telegraphy*? Ans.—We should recommend Abernethy to begin with, as it is more modern and gives the most general information in relation to the telegraphic business as now conducted. After becoming somewhat familiar with this, Pope's work will be found valuable to the student, as it goes more fully into the theory of the art.

[18.]—**Electric Lamp for Stereopticon.**—S. M., Mohawk, N. Y., writes: "I want a better light than the calcium for a stereopticon without going to the trouble and expense of using a powerful arc light. I have thought that perhaps that I could successfully use the sun lamp, illustrated in THE ELECTRICIAN, vol. ii., p. 329, and produce a light of 400 or 500 candle power with battery of 30 or 40 bi-chromate cells. Can you give me the necessary information as to shape, size and number of cells, size of carbons and marble block for lamp, length of arc, gauge of wire, etc. Ans.—We are unable to gather any information whatever as to the actual efficiency of the sun lamp beyond the general statement that it requires considerably more electric power in proportion to the light produced than the arc lamp. This being the case, there is no way of ascertaining the battery power required except by actual experiment. It cannot be calculated, on account of the lack of necessary data. To the best of our judgment, it would require too large a battery power to be successfully used in the way you propose.

[19.]—**Proportions of Dynamo Machine.**—J. J. L., New York, gives certain proportions for a dynamo machine designed to be capable of being used as a motor, and inquires if they are such as will be found efficient in practice. We cannot reply to this question unless our correspondent will send us more detailed information, as the efficiency of a dynamo machine depends largely on the relation of the parts to each other, as well as upon the dimensions. If our correspondent will send a sketch of his proposed machine, so that we can understand precisely what he proposes to do, together with his address, we will be pleased to give him all the information at our command.

[20.]—**Coating for Interior of Wooden Battery Cells.**—F. M. G., Chelsea, Mass., asks:—"What kind of varnish or coating can I put on wood which will not be attacked by the solutions of a bi-chromate battery?" Ans.—Marine glue will answer your purpose. Dissolve 1 part raw india-rubber in 12 parts benzine, and to the solution add 20 parts powdered shellac, heating the mixture over a fire with the utmost caution. Apply with a brush.

ELECTRICAL NEWS AND NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

Annual Meeting.

THE annual election of officers for the New York Electrical Society took place March 5th. The following are the officers chosen for the ensuing year: President, Professor P. H. Vander Weyde; 1st Vice-president, Geo. B. Scott; 2nd do., C. S. H. Small; 3d do., E. A. Leslie; 4th do., E. L. Bradley; 5th do., W. J. Johnston; 6th do., Gerritt Smith; Recording Secretary, A. A. Knudson; Financial Secretary, Minor M. Davis; Treasurer, F. W. Jones. Extra members of the Executive Committee: Thos. R. Taltavall, Gerritt Smith, C. O. Mailloux and George Worthington.

When the election was concluded, Mr. F. W. Jones placed in the hands of the society $20, to be awarded to the author of the best paper read before the society within the next three months, the President and two members of the society to make the award. The society is to prescribe the length, subject, etc., of the paper, and competition is to be open only to members in good standing.

A hearty vote of thanks was tendered to Mr Jones for his generous interest, and to the retiring officers, after which the meeting adjourned.

DISTRIBUTION BY SECONDARY GENERATORS.

ON the 18th of February Gaulard and Gibbs addressed a communication to Sir Charles T. Bright in his capacity as President of the English branch of the Société Internationale des Electriciens, requesting an appointment at which he would attend to verify the results obtained from the secondary generators which they are introducing.

In declining the invitation on the ground that it came more properly within his professional jurisdiction, Sir Charles took occasion to inform the gentlemen that it would be more proper for them to arrange with some other electrician, as he invented and took out a patent for the system used by them October 23, 1878, No. 4,212.

THE TELEGRAPH.

The Baltimore and Ohio Co. has established a "market wire" between Washington, Baltimore, Philadelphia and New York, bringing them into direct communication.

The Public Postal Telegraph Co. has been incorporated, capital stock $100,000, with the privilege of increasing to $20,000,000. Business will be transmitted by a new system.

Articles of incorporation for the People's District Telegraph Co. have been filed in the King's County Clerk's Office at Brooklyn. The capital stock is $60,000.

A war of rates has begun in Texas between the W. U. T. Co. and the Gulf, Colorado and Santa Fe R. R. The lines of the latter reach but 4 points outside of the State.

A working arrangement has been affected between the Rapid Transit Telegraph Co., of Minnesota and the B. & O. Telegraph Co.

The Northern and Southern Telegraph Co. has announced the completion of its lines from Norfolk, Va., to Goldsboro, N. C., with several minor offices between those points.

The Postal Telegraph and Cable Co., and the Bankers' and Merchants' Telegraph have filed petitions for charters in the Rhode Island legislature.

The Postal Telegraph and Cable Co. has made a proposition to the government to undertake the telegraph business in connection with the Post-office Department at rates varying from 15 to 50 cents for 20 words.

The United Telegraph Company of Brooklyn, which has 13 offices and about twenty miles of wire, has formed a working arrangement with the Baltimore and Ohio Telegraph Company, and has severed its relations with the Bankers' and Merchants' Company.

A memorial to Congress in favor of a government telegraph has been defeated in the Iowa legislature.

THE TELEPHONE.

Domestic.

It is reported that the New York and Pennsylvania Telegraph and Telephone Co. will soon erect a line from Erie, Pa., to Ashtabula, O., connecting with the Cleveland Telephone Co. This will give Cleveland telephonic communication with Erie, Meadville, Titusville, etc.

A telephone transmitter with 20 contact points has been brought out by Webster Gillett, of Ypsilanti, Mich., which is intended for a telephone trial over one of the Atlantic cables.

Recent experiments show the photography of sound vibrations to be a practical process. A small, thin platinum plate was attached perpendicularly to a thin iron plate, which, as in the telephone or phonograph, was fixed on a wall piece and vibrated to sound. With a solar microscope an image of the platinum plate was focused on a screen, after which a prepared photographic plate was quickly moved across, in the plane of the screen, by a strong spring, while the mouthpiece was spoken to. A bounding line between light and shadow was thus obtained on the prepared plate, forming a curve closely corresponding to the sonorous vibrations—simple curves for vowels, complicated ones for consonants.

ELECTRIC LIGHT AND POWER.

Domestic.

Sedalia, Mo., is to be lighted by electricity.

The work on the new Edison electric light building at Middletown, O., is progressing rapidly, and the company promise to have the works in running order in a short time.

The *Ilion Citizen* printed its entire edition, March 13, by electricity, using the Parker electric motor, which derived the current from a Parker 10-light dynamo 15 rods away. It is the first newspaper in the country thus printed.

The Edison Electric Light Company of Cumberland, Md., has been incorporated and given the right to erect the necessary works.

The Brush-Swan Electric Light Company now illuminates the city of Norfolk, Va. No other city in that State is lighted by electricity.

The United States Electric Lighting Company's plant at the new state Capitol, at Albany, is being largely increased. Since fall 30 arc lights have been added, and the work of installing the incandescent lights in the Court of Appeals and Insurance Departments is in progress. The work is well done, and the lights are highly satisfactory, and it is to be hoped that before another session of the Legislature the incandescent lights will be used in the Senate and Assembly Chambers.

Sioux City, Iowa, has a thriving electric light company which is very successfully operating a plant of 40 Weston lights.

An electric light company has been formed at Moline, Ill., and on the 9th ult., started its plant of 50 Weston arc lamps. The plant is run by a Buckeye engine. The new style Weston lamps are used, which deserve special mention both on account of the tasteful appearance of the lamps and the steadiness with which they burn. The Moline people are delighted and the electric light company promises to be a great success.

Citizens of Orange, N.J., have pledged $40,000 for the formation of a company to supply the city with electric lights.

The Pennsylvania Company's depot in Chicago, one of the finest in the world, is to be illuminated by 95 electric lights.

The Maxim Electric Light and Power Company, of Philadelphia, have been awarded the contract for lighting the new government buildings in that city, and the work of installing the plant is now in progress. The plant is to consist of 100 Weston arc lights and 600 Maxim incandescent lights which are supplied by 8 Weston dynamos driven by 2 Porter-Allen engines of 100 h.p. capacity each.

The framework for the government electric light at Hallett's Point, Hell Gate, has been finished, and it is expected that the machinery will be placed in a few weeks. The tower is 250 feet high. The dynamos and lamps will be supplied by the Brush Company.

The Decatur, Ill., Jenny Electric Light and Power Company was recently organized with a capital of $25,000.

The Chapman Electric Motor Company was incorporated in New York, March 17. It is to manufacture motors and other apparatus under the patents of Wm. H. Chapman. The capital stock of the company is fixed at $500,000.

The Edison Illuminating Company organized at Utica, N. Y., by A. B. Johnson, who committed suicide last fall, is to be dissolved, and the subscriptions returned to the stockholders.

The Olmstead Electric Manufacturing Co. has been organized at Minneapolis, Minn., with $500,000, for the introduction of the Olmstead lamp and dynamo. These are being manufactured by the Pray Manufacturing Co., which is also interested in the Electric Co.

Several Minneapolis capitalists are interested in the Goodson electric lamp, which is claimed to possess some novel and valuable features. The inventor is a native of that city.

Foreign.

The electric light is not everywhere considered an improvement upon the old-fashioned modes of illumination. One of the latest and best systems was recently introduced into the Court Theatre at Stuttgart, and it was supposed that the orchestra would find it very satisfactory. Instead of welcoming the change, however, they have just petitioned the management for a return to the old-fashioned oil lamps that they had been using previously. They say that electric illumination has proved objectionable, because its brilliancy, with many, unpleasantly affects the nerves. They also assert that they now find it more difficult to follow the guidance of the leader. A committee of experts, composed of oculists and disinterested musicians, has been appointed to examine into the matter.

THE RAILWAY SERVICE.

The electric block signal system is to be introduced on the Lake Shore and Rock Island railways between Chicago and Englewood.

The Philadelphia and Reading Railway Co. are having the numbers painted on the headlights of their locomotives, in order to facilitate their reading by the night telegraph operators.

The officials of the consolidated road have decided to introduce an electric block signal system on the deep winding cut by which all trains on the road enter and leave New Haven, Conn. This cut is considered the most dangerous on the road.

SUBTERRANEAN LINES.

Domestic.

Articles of incorporation of the Globe Electric and Underground Conduit Company were filed in the County Clerk's Office March 17. Its capital stock is $2,000,000, divided into 200,000 shares of $10 each. Its incorporators are J. Clayton Erb and William D. Neilson, of Philadelphia, and J. Morris Welch, George R. Cinnamond and Charles Reynolds Logan, of this city.

SUBMARINE CABLES.

The general public little realizes the steady extension of the submarine telegraph cables. There are now over 80,000 miles of them at work, representing a capital stock of about $170,000,000.

The Duxbury-St. Pierre section of the Anglo-American cable, which was interrupted for over three months, was repaired March 8th, by the company's steamer Minia.

The international convention for the protection of submarine cables was signed at Paris, March 14, by 27 delegates. Mr. Morton, the United States Minister, and M. Henry Vignaud, the second Secretary of Legation, signed for America.

The new Bennett-Mackay Cable Company will land one end of its cable on Cape Ann, Mass., and has bought land for this purpose at Cape Hedge, Long Beach. A cable station is to be erected at Rockport, the dimensions of which will be 60x45 feet, and two stories high. The cable will be laid about two feet underground for a distance of 1¼ miles to the station in the town. The Eastern landing is to be at Waterville, Ireland, within six miles of the Direct U. S., and ten miles from the Anglo-American Company's station.

MISCELLANEOUS.

Several accurate photographs of lightning flashes have been secured by Mons. Robert Haensel, of Reichenberg, Bohemia. The flashes are shown as long, continuous sparks, and in one of the pictures the point where the spark met the earth may be seen. The landscape is clearly defined in the photographs, affording a means for calculating the length of the lightning's path through the air, which, in one instance, was estimated at more than a mile.

A society called the Syndical Chambers of Electrical Workmen has been formed in Paris to promote the technical training of men employed in electric work of different kinds, by collecting for them in some central building useful drawings, models, specimens, etc., obtaining information and instruction for its members, and enabling them to meet and exchange observations and experiences. Appeals are made for the co-operation of industrial and scientific men of influence.

ARCHITECT Clark has assigned a room in the main portion of the Capitol at Washington to thoroughly test the electric teller and recorder for legislative bodies, invented by Mr. F. W. Crosby and Charles Williams of Boston. By this electric system it is claimed that a yea and nay vote can be taken in the house in two minutes. Beside taking it, the roll is printed on a slip, and can be immediately read by the clerk.

MANUFACTURING AND TRADE NOTES.

Domestic.

Harris & Wardwell, Birmingham, Ct., have finished their contract with the Southern New England Telephone Company for delivering wire for the telephone.

The Postal Telegraph Company, Ansonia, have received the new cylinder to repair their broken down Wheelock engine. They have also added five more of the massive Wallace dynamos, and are about to start up another row of plating tanks. The work of putting up apparatus for lighting their works with electricity is also nearly completed.

The Palmer Wire Company, of Palmer, Mass., manufactured last year 3,000 tons of iron and steel wire valued at $400,000.

ELECTIONS AND APPOINTMENTS.

The following directors of the Brush Electric Illuminating Company have been elected: William L. Strong, A. D. Juilliard, David L. Einstein, William A. Wheelock, S. M. Schafer, J. M. Fisk, W. L. Pomeroy, S. B. Sturges, C. M. Rowley, Julius Catlin, Jr., Woodbury Langdon and William M. Bliss.

The Swan Incandescent Electric Light Company has elected the following trustees: Edwin Einstein, David L. Einstein, William L. Strong, Thomas J. Montgomery, A. A. Hayes, Charles M. Rowley, Lyman P. French, William J. Montgomery, George W. Stockly and A. D. Juilliard.

At the annual meeting of the Merchants' and Bankers' Telegraph Company, held in Hartford, Conn., March 20, the following were elected directors: C. W. Foster, J. G. Case, George E. Dimock, F. H. May, F. Morrison, A. W. Dimock, G. S. Mott, G. P. Smith and John R. Hegeman.

At the annual meeting of the Mutual District Messenger Co. of Washington, held in New York, March 19th, the following officers and directors were elected: W. F. Chester, President; W. F. Allen, Sec. and Treas. Directors: W. H. Woolverton, W. F. Allen, G. F. Lowell, M. Riebenack, C. E. Pugh, H. W. Pope, C. H. Sewall, W. F. Chester, H. McGonegal.

PERSONAL MENTION.

Thomas A. Edison and wife are spending a few weeks at the Magnolia Hotel, St. Augustine, Fla.

William B. Van Size, formerly of the Western Union Legal Department, New York City, has accepted a position with the American Bell Telephone Co., of Boston.

Henry Van Hoevenbergh has been appointed electrician of the Baltimore and Ohio Telegraph Company, with headquarters in New York.

FINANCIAL.

NEW YORK, March 20, 1884.

The general stock market is unusually dull. There is considerable activity in opposition telephone stocks, especially those in which competing telegraph companies have become interested. Electric Light stocks continue very dull, there being no disposition to realize on the part of present holders, nor inquiry from investors or speculators. Our quotations are from the Electric Manufacturing and Miscellaneous Stock Exchange, with the exception of the active telegraph stocks, which are listed at the New York Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	172 00	173 00	Mexican Central	—	3 00
Am. Speaking	110 00	125 00	Molecular	4 50	9 50
Currier-Tele. Bell	3 00	—	New England	—	26 00
Columbia & Pan.	23 50	25 00	N. Y. & Penn.	50 00	78 00
Continental	12 00	—	Overland	8 00	17 00
Dolbear	5 00	10 00	Peoples	9 50	15 00
Globe	9 00	11 00	Shaw	10 00	—
Hudson Riv.	60 00	100 00	Southern N. E.	—	175 00
Inter-Cont.	75	—	Tropical	1 40	2 00
Mexican	2 25	2 75	W. I. Tel. & Telph.	1 00	2 00

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	50 00	65 00	Postal Tel. Bonds 1st 6%	60 25	60 50
Bankers' & Merchants'	125 87½	126 37½	do. (new Co.)	—	14 50
Postal Tel. (stock)	—	—	Western Union	73 12½	73 25

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	2 00	4 00	Edison Isolated	55 00	90 00
Brush Ill.	45 00	70 00	Edison European	3 00	15 00
Daft	—	65 00	Excelsior	20 00	—
Edison	136 00	145 00	Swan	—	40 00
Edison Ill.	55 00	75 00	U. S. Electric Light	95 00	110 00

Providence Telephone Co.'s stock is quoted at $176.

Ten shares Mutual District Messenger Co. of Boston have been sold at $125 per share.

The Western Union Telegraph Co. has declared its usual 1¾ per cent. quarterly dividend, payable April 15. The net surplus for quarter ending Dec. 31 was $130,217.

The $5,000,000 capital of the Peoples Telephone Co. is said to represent $450 in cash and $4,993,550 in patent rights.

The directors of the Bankers' and Merchants' Telegraph Company have decided to issue $1,000,000 of stock, making the total issue $3,000,000. The new stock is offered at par to the shareholders of record on April 18, at the rate of one share for every two shares held by them.

The Treasurer's statement of the American Bell Telephone Co. gives the following gratifying exhibit of the result of the year's business to Feb. 29, 1884:

	1882-3.		1883-4.		Increase or Decrease.
Earnings	$1,576,031 57	....	$2,295,594 07	....	$719,562 50 I.
Expenses	603,987 19	....	820,102 70	....	216,175 41 I.
Net Earnings	$972,044 38	....	$1,475,491 37	....	$503,387 09 I.
Dividends paid	$595,000 00	...	$1,051,479 00	....	$456,479 00 I.
Car. to Surplus Ac.	334,597 32	....	334,441 61	....	555 71 D.
Bal. to Income Ac.	168,081 51	....	348,884 17	....	180,895 63 I.
	$1,098,678 83	....	$1,734,804 78	....	$636,795 92 I.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope, Edgecomb & Butler, *Solicitors of Patents for Electrical Inventions, 32 Park Place, New York city.*

LEGAL NOTES.

United States Supreme Court.—*Bussey* v. *The Excelsior Co.* This case was an appeal from the Circuit Court for the Eastern District of Missouri, and was for alleged infringement of certain patents for cooking stoves. The invention relates wholly to specific devices, and no general principles of importance were passed upon in deciding it. *Zane* v. *Soffe.* Appeal from the Circuit Court for the Southern District of New York. Complainants alleged infringement of patents for self-acting faucet. The Court held, that in view of the fact that certain mechanical equivalents of the combination claimed had been before known and used, the patent could be construed to cover only the specific devices set forth in the claim, hence it was held that the defendant did not infringe, affirming the decree of Circuit Court. *Lake Shore and Michigan Southern Railway Co.* v. *National Car-Brake Shoe Co.* Appeal from Circuit Court for the Northern District of Illinois. This was a suit for infringement of a patent for an improved shoe for car-brakes. The Court held, that as the structure has the same four parts in combination that was claimed in complainants' patent, with merely formal and not substantial mechanical differences, infringes such claim. *Illinois Central Railway Co.* v. *Turrill*; *Michigan Southern and Northern Indiana Railway* v. *Same.* Appeal from the Circuit Court for the Northern District of Illinois. This was a case respecting the profits to be recovered in a

case of infringement, when part of said profit was derived from infringing and part from non infringing machines, and is too intricate a question to be intelligently considered in an abstract. The Court held, that death of the patentee since the appeals were taken does not prevent the further prosecution of the suits by his legal representatives.

Supreme Court of the District of Columbia.—*In re Hatchman.* This was an appeal from a decision of the Commissioner of Patents. In his application Hatchman made several claims, one of which was rejected on prior patents, whereupon it was erased by his attorney, and the patent issued for the remaining claims. Application for reissue was made a few weeks afterwards, in which it was sought to renew the rejected claim. Commissioner denied the reissue, on the ground of the canceling of the original claim by the duly authorized attorney of the applicant. It was held that the legal effect of the action of an applicant and his attorney is the same, and that when a claim in an original application is rejected upon reference and erased by the attorney and a patent is accepted for the remaining claim, there has been no inadvertence, accident or mistake, within the meaning of the law, and the patentee is not entitled to a reissue embracing the canceled claim.

United States Circuit Courts.—In the Southern District of New York, *Adams v. Howard.* Infringement was alleged of two patents for improvement in lanterns. Defendants insisted that there was no patentable improvement, and that invention was also anticipated by a lantern described in a prior application for a patent by another party. Objections were also urged to the title of complainants. Wallace, J., held, that a simple change which others failed to discover, and which remedied a grave defect, constituted a patentable difference, and that a prior application for a patent alone, in the absence of other evidence that the invention described was ever constructed, is not sufficient to defeat a patent. *Andrews v. Hovey.* This suit with a large number of others was brought in the Southern District of Iowa, alleging infringement of reissued patent No. 4,372 of Nelson W. Green. This is the celebrated driven-well patent. Shiras, J., held, that because the patentee made public the knowledge and use of his invention, and then for four years took no action for procuring a patent, under the circumstances the invention was abandoned to the public. Held, also, that the reissue was void as covering an invention different from that embraced in the original patents, and also that more than ten years before the invention of the patentee, wells were driven by a process not distinguishable from that of the patentee, for public and continuous use, sustaining defense of want of novelty. Love, J., sitting in the same case, held that the two years limitation in the act of 1839 is general, and applies to all cases in which the invention had been in public use or on sale for more than two years prior to the application, whether with or without consent and allowance of the inventor.

United States Patent Office.—*Ex parte Matthews and Race.* A patent containing one broad claim was granted to applicants, November 16, 1869. After 12 years' litigation, the Supreme Court of the United States held that the patent covered a broader invention than patentees had a right to claim as new, whereupon they applied for a reissue with restricted claims. The primary Examiner held that a delay between the original patent and filing the present application was a bar to reissue. On appeal, Commissioner Butterworth held that they might make such application, and that in this particular case, six months was hardly sufficient to constitute unreasonable delay. Held, also, that unreasonable delay is a bar to reissue even though it is sought to narrow and restrict the claim; but the rule as to laches is more rigid in cases where the applicant seeks to broaden the claims. *Ex parte Clarke.* This was a case in which an application was filed December 11, 1882, certain claims of which were put into interference. Under rule 125, matter not in interference was withdrawn from the first and made the basis of a second application, upon which second application a patent was granted February 20, 1883. Said patent contained a disclaimer covering all features shown but not claimed therein, and also a clause reserving the right to claim such feature in an application filed previously. During the pendency of the first application, and after the patent had issued on the second, a third application was filed with claims covering the matter described, in both the first application and the patent. Held, that under the circumstances the third must be regarded as a division of the first application, and therefore the invention claimed in the latter cannot be deemed to have been abandoned by reason of its being described in the patent, and that neither of the applications referred to should be allowed until amended so as to disclaim the invention shown but not claimed therein, with proper cross-reference to the application in which such claim is made.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From February 19 to March 11, 1884 (inclusive).

Alarms and Signals:—*Bell Pull*, A. S. Bunker, Feb. 19, 293,626. *Marine Messenger*, J. C. Henderson, 293,735. *Thermostatic Registering Apparatus*, C. W. Weiss, 293,828. *Call Bell*, D. Boyd, 293,938. *Gong*, J. Redding, 293,-989. *Fire Alarm and Extinguisher System*, C. E. Buell, Feb. 26, 294,008. *Alarm for Steam Gauges*, H. Carley and T. McKenna, Feb. 26, 294,193. *Annunciator*, I. H. Farnham, 294,212. *Watchman's Time Recording System*, G. W. Davis, March 4, 294,371. *Thermostat*, A. K. Rider, 294,405. *Door Pull*, C. Belle, March 11, 294,842.

Clocks:—*Secondary Clock*, V. Hhmer, Feb. 26, 294,131. *Device for Synchronizing Clock Pendulums.* Same, 294,132. *Clock*, G. B. Welsh, March 4, 294,359.

Commutators:—*Cut-out for Arc Lamps*, H. C. Townsend and C. L. Buckingham, Feb. 19, 293,931. Same, 293,948. *Circuit Closer for Telegraphic Instruments*, J. Neiling, Feb 26, 294,256. *Commutator for Dynamo*, F. B. Rae and C. L. Hedley, 294,270, Z. T. Gramme, March 4, 294,613. *Automatic Cut-out for Helices*, F. L. Pope, March 4, 294,669. *Automatic Cut-out*, C. S. Pinkham, 294,404.

Conductors, Insulators, Supports and Systems:—*Machine for Laying Wires*, H. B. Cobb, Feb. 19, 293,632. *Cable*, W. R. Patterson, Feb. 19, 293,775. *Lock Wire Insulator*, T. McGrory, 293,901. *Power Distribution System*, E. Thomson, Feb. 26, 294,095. *Conductor*, F. L. Pope, 294,148. *Underground Wire Conduit*, C. H. Trask, Feb. 19, 293,688; H. B. Cobb, March 4, 294,365; E. Verstraete, 294,703. *Making Joint Connections in Cables*, R. S. Waring, March 4, 294,516. *Repairing Defects in Conductors of Lead Cables*, same, 294,540. *Insulator for Wires*, W. W. Meach, 294,563; A. W. Hale, March 4, 294,884. *Composition for Insulation*, J. Fottrell, 294,457; W. V. Wilson, 294,557. *Mandrel and Die for Cable Presses*, R. S. Waring, 294,544. *Mandrel for Cable Presses*, same, 294,537, 294,539, 294,540, 294,542, 294,547, 294,548, 294,550. *Apparatus for Drawing Cables into Pipes*, W. R. Patterson, March 4, 294,560. *Compound Cable*, R. S. Waring, 294,536, 294,538; March 11, 295,086. *Cable*, same, 294,541, 294,543, 294,545. *Underground System*, T. J. Perrin, March 11, 294,906. *Wire Connector*, T. S. Stevenson, March 11, 294,988. *Wire Supporter*, R. C. Stone, 295,072. *System of Haulage*, W. E. Ayrton and J. Perry, 295,094. *Tip for Conductors*, W. A. Childs and F. Shaw, 294,851. *Uniting Electric Cable*, R. S. Waring, March 11, (reissue) 10,468. *Branching Cables*, same, (reissue) 10,459.

Dynamo Machines and Motors:—*Dynamo Machine*, A. E. G. Lubke, Feb. 19, 293,758; W. Hochhausen, Feb. 26, 294,043; E. Thomson, 294,094; G. W. Fuller, March 4, 294,458; R. J. Sheehy, 294,688; C. M. Ball, 294,719; C. M. Lungren, March 11, 294,892; C. Richter, 294,918. *Motor for Electric Regulators*, C. J. Van Depoele, Feb. 26, 294,165. *Automatic Brake for Motors*, W. Hochhausen, Feb. 26, 294,041. *Electro-Magnetic Machine*, J. W. Nystrom, 294,066. *Motor*, W. T. Waters, Feb. 19, 293,929; M. Bacon, March 4, 294,717. *Regulator for Dynamo*, W. Hochhausen, Feb. 26, 294,038, 294,039, 294,040; A. G. Waterhouse, 294,160, 294,170; C. E. Ball, 294,180; C. L. Buckingham, 294,307.

Galvanic Batteries:—A. Haid, March 4, 294,463; O. C. D. Ross, Feb. 26, 294,235.

Ignition:—*Electric Gas Lighter*, E. L. Shute, March 11, 295,059.

Lamps:—*Arc*, C. L. Buckingham and H. C. Townsend, Feb. 19, 293,944; W. P. Freeman, Feb. 26, 294,027; H. A. Earle and E. Goltstein, March 4, 294,455; C. J. Van Depoele, 294,532, 294,533; A. Welsh, March 11, 295,088. *Double Arc Lamp*, W. Hochhausen, Feb. 26, 294,042; A. G. Waterhouse, Feb. 26, 294,291. *Combined Gas and Electric Light Fixture*, L. Stieringer, March 4, 294,627. *Light Regulator and Cut-out*, R. J. Sheehy, March 11, 295,038. *Holder for Carbons of Incandescing Lamps*, A. Welsh, March 11, 295,087. *Hanger Board for Lamps*, W. Hochhausen, Feb. 26, 294,045. *Manufacture of Incandescing Lamps*, W. Holzer, Feb. 19, 293,879. *Incandescent Lamp*, W. Hochhausen, Feb. 26, 294,044.

Metallurgy:—*Iron Ore Separator*, C. Faber, Feb. 26, 294,021. *Process of Making Copper Salts*, J. K. Kessler, 294,051.

Miscellaneous:—*Voltaic Plaster*, W. F. Stark, Feb. 19, 293,679. *Safety Device for Elevators*, J. W. De Castro, 293,851. *Photographer's Retouching Point*, H. H. McElhiney, Feb. 26, 294,050. *Lighting Sewing Machines*, O. Healy, 294,128. *Spooled Wire*, A. B. Malin, March 4, 294,740. *Retouching Machine*, C. H. Shaffer, March 11, 294,817.

Railway Appliances:—*Car Brake*, J. E. Withers, Feb. 19, 293,993. *Railway Signal*, O. Gassett, Feb. 26, 294,030; Bert Buys, 294,116. *Grip for Electric Cars*, J. C. Henderson, March 4, 294,618.

Storage Batteries:—*Secondary Battery*, A. Haid, March 4, 294,464, 294,465.

Telephone Systems and Apparatus:—*Acoustic Telephone*, H. E. Huston, Feb. 26, 294,238. *Telephone Support*, G. A. Wilkins, Feb. 26, 294,297. *Telephone Circuit*, C. E. Scribner, Feb. 26, 294,336. *Central Office Apparatus*, F. M. Lytle and J. A. McCoy, March 4, 294,483. *Time Signal for Toll Lines*, A. S. Hibbard, Feb. 19, 293,736.

Telegraphs:—*Printing*, H. Van Hoevenbergh, Feb. 19, 293,622, 293,926. *Electro-Mechanical Movement*, same, 293,923, 293,924, 293,925. *Page Printing Telegraph*, same, 293,927. *Means for Printing from either of Two Type Wheels*, same, 293,928. *Unison Mechanism*, S. D. Field, 293,959. *Quadruplex*, B. E. J. Ellis, 2 3,036. *Multiple Circuit Controller*, W. McCarty and Charles M. Fitz, 293,974. *Telegraph Key*, C. Plumb, 293,979. *Telegraphic Transmitter*, R. C. Stone, March 11, 295,074, 295,075.

Expired Patents.—A list of the more important electrical patents which have expired during the first three months of the year 1884, with the date of expiration, is subjoined:—J. Olmsted, *Electro-Magnetic Car Brake*, 61,0-0, Jan. 8; G. G. Percival. *Lighting Gas by Secondary Batteries*, 61,247, Jan. 15; A. J. B. De Morat, *Anti-Induction Cable*, 61,325, Jan. 22; S. Gardiner, *Lighting Gas by Electricity*, 9,611 (reissue), Feb. 19; J. J. E. Lenoir, *Autographic Telegraph*, 62,141, Feb. 19; T. S. Hall, *Railroad Switch Alarm*, 3,859 (reissue), Feb. 26; E. Holmes, *Electric Circuit Breaking Clocks*, 9,209 (reissue), March 26; D. Brooks, *Telegraph Line Insulator*, 63,206, March 26.

BUSINESS NOTICES.

THE ELECTRICIAN AND ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York City.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

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Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of the* ELECTRICAL PUBLISHING CO. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York City.*

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NEW YORK, MAY, 1884.

ELECTRIC LIGHTING FROM A COMMERCIAL POINT OF VIEW.

WHATEVER the future popularity and success of the electric light may be, it appears to be generally conceded that little or no profit can be derived from its production at a price per unit of effective light below that of illuminating gas. Perhaps the most serious of the many mistakes which have been made in the establishment of electric lighting as a profitable and permanent business was the premature announcement of many of its enthusiastic promoters that it would be found to be a cheaper illuminant than gas, which, with certain exceptions due to the presence of special conditions, has not proved to be the case. Had the ground originally been taken that the light was of better quality, more healthful and more convenient—in fact that it was a luxury, well worth its increased cost to those who could afford to use it, the public demand for it might perhaps not have been quite so rapidly developed, but there can be no doubt that the business would have been in a far more satisfactory condition to-day than it actually is.

In the lighting of streets and public squares there is little question but that the electric light is fairly worth much more than gas, yet we notice that an attempt to curtail its use is being made in Boston, and perhaps in other cities, upon the ground that it is considerably more expensive than either gas or oil. In opposition to this action a large number of the most prominent and substantial citizens of Boston have petitioned the municipal authorities to increase the appropriation for electric lighting from $94,000 to $125,000, and to provide a corresponding number of additional electric lamps. In this memorial attention is directed to the fact that the streets of the city have never been adequately illuminated until the introduction of electricity for that purpose, that this introduction has brought about a material reduction in the price of gas; and that the police department testify as to its value in the prevention of crime. The public interest in this question is so great that a representative of the Boston *Traveler* was recently detailed to obtain the views of some of the most prominent and intelligent citizens as to the comparative merits of electricity and gas. There seems to be a general unanimity in the opinion of the persons visited, that the electric light is more satisfactory to the public than any other, and the principal objection which appears to have been raised against it was its occasional interruption. It is very probable that this opinion was based upon the experience of the past year, during which the service was not in all respects as reliable as it has since become.

In this connection it may be remarked that the manner in which street lighting has been undertaken in most cities has not by any means been conducive to the obtaining of the best results. The installation of a plant equal to any emergency which is at all liable to occur, with lines substantially constructed, and everything of a permanent character, can scarcely be expected from the lowest bidder, especially where there is no certainty of a renewal of the contract after the expiration of the first year. That such work has been undertaken at the rates which have been published, seems to indicate an anxiety to exhibit electric lights at any price, rather than any immediate earning of profits. It is certainly encouraging to learn that there are a considerable portion of the public who are sufficiently appreciative of the merits of electric lighting to express their willingness to pay, if necessary, a reasonable excess over the cost of other systems, in order to secure its unquestionable advantages.

RIGHTS OF TELEGRAPHS ON RAILROADS.

As we have had occasion to mention heretofore, the question of securing a feasible right of way, is gradually becoming a matter of serious consideration in the construction of new telegraph lines. The most desirable routes along the various railroads in all parts of the United States have been very generally monopolized by the Western Union Telegraph Company, the result being that its competitors have been compelled to take to the public highways, and it has been necessary to resort to various strategic operations, in order to avoid the possibility of aggressive interference by enraged property-owners. An effort is now being made in Massachusetts to secure equal privileges on railway property, for all telegraph and telephone companies requiring them. A bill for this purpose is being considered by the committee on railroads of the Massachusetts legislature, and the representatives of various electrical companies, among others, representatives of the Postal Telegraph and Cable Company and the Baltimore and Ohio Telegraph Company, have appeared before it, and have pointed out the various difficulties and obstructions which they are compelled to encounter in consequence of their routes being confined wholly to the public highways. The legality of exclusive contracts for railroad rights of way by telegraph companies has never until recently been tested in the courts, but if they can be overthrown

the status of the various opposition lines will be greatly improved. The decision of Judge Wallace in the United States Circuit Court, in a recent case, is to the effect that such contracts are in contravention of the act of Congress of July 24, 1866, and are valid only in protection of the rights secured by the original parties for their own purposes. Judge Wallace says:

"The complainant can take nothing by the agreement beyond such an easement as is necessary for its legitimate use in constructing and operating its lines. It could not acquire the right to dictate to other telegraph companies upon what terms they may be permitted to construct and operate competing lines; nor could the railway company put it out of its power to permit any telegraph company to enjoy the privileges given by the act of Congress by a cession of that power to the complainant."

This was the case in which the Western Union Telegraph Company applied for an injunction to prevent the Baltimore and Ohio Telegraph Company from erecting and operating a telegraph line on the West Shore railway. The managers of the Western Union Telegraph Company may at least derive comfort from the reflection that in the event of a consolidation these competing lines will be at once available for use, and will moreover be of considerably greater value than the rickety lines which have been heretofore absorbed, many of which were of so little practical availability as to be immediately abandoned after the change in ownership had taken place.

Existing corporations will do well, however, not to ignore the fact that there is unquestionably a growing sentiment amongst the people in this country that undue advantage must not be taken of the chartered privileges granted by the commonwealth. The theory of such concessions is that they are bestowed in the interests of the public, and that the people are supposed to derive tangible benefits therefrom. When it becomes generally apparent that such charters are being diverted from their original object, and are becoming instruments of monopoly and oppression, the establishment of commissioners with arbitrary powers, acting in the interest of the people, may be expected as the natural outgrowth of an aroused public sentiment.

PROGRESS OF THE TELEPHONE BUSINESS.

The annual report of the American Bell Telephone Company, gives a very complete resume of the growth of the telephone business during the past year. There was a slight decrease in the demand for new instruments, the output being but 57,299 against 60,337 during the previous year. This is accounted for upon the supposition that exchange managers had devoted more attention than heretofore to connections between adjacent towns, the wire mileage for this purpose having increased from 13,653 to 29,359. It appears doubtful, however, if this is the true reason for the decline. It is, to say the least, quite as probable that there has been an actual falling off in the demand for instruments, especially on the part of a certain class who have taken them because they were a popular novelty rather than for the reason that they actually required them in their business. Notwithstanding the admitted convenience of the telephone, it is well known that its use is objectionable in many cases, and hence it is not surprising that the demand should be diminished in some quarters, while increasing in others. The fact that 165 new exchanges have been equipped and 25,798 new subscribers added, is sufficient evidence that there is a legitimate and healthy growth of business. The interest of the parent company has become so identified with the welfare of subsidiary companies, that prosperity of these is carefully noted. A very significant feature of the report is the remark that "the tendency toward consolidation of telephone companies noticed in our last report has continued, and is for the most part in the interest of economical and convenient handling of the business. * * * As methods are devised for making the telephone commercially useful over long lines, the advantages of this centralization of management will be still more apparent."

There is no disguising the fact that the formation of a monopoly, which shall embrace all the telephone exchanges, is one of the probabilities of the future, and it is also true that the telephone service may in this manner be made more satisfactory. Such a consolidation is not, however, so essential as in the telegraph business, for the reason that a telephone customer has no basis for a claim either for error or delay, although he may have sufficient reason for complaint. All exchanges are, however, interested in giving their subscribers good service, but they may not be as well prepared to adopt improvements as they would be under the fostering care of a strong centralized general management.

The destructive effects of sleet storms, which were thought by some of the early telephone managers to be greatly overrated, are now much better understood, and form a very potent reason why the wires should be placed underground as soon as practicable. Attention is, however, directed to the merits of aerial cables, which are rapidly coming into use, and at present seem the most feasible remedy for the annoyances and dangers of the open wire system, now generally used. The company has been so successful in pointing out the objections to underground telephone wires, that they have in most cases been exempted from any compulsory change.

The rates established for telephone service have given rise to much complaint. This is the natural result of independent exchange management, where different rates have been established in different cities, although the best of reasons may exist for the discrepancy. This state of affairs is being gradually improved, and experience will no doubt suggest appropriate remedies. The rates for telegraphing are by no means in a settled and satisfactory condition, although forty years have elapsed since the business was started. The legal expenses incurred in maintaining the telephone patents continue to constitute a serious tax upon the business, amounting to $120,893 against $112,688 for the previous year. At present there is little hope of any diminution in this expense, although the counsel of the company express their entire satisfaction with the status of the different cases. There can be little question that the managers of the American Bell Telephone Company have acted wisely in fortifying their position by acquiring large interests in the numerous local companies, the dividends from which already amount to one quarter of the revenue for telephone rentals, which latter is now its most important resource, being $1,695,678 against $1,257,054 for the previous year. It can scarcely be expected that so promising a future should be tamely abandoned, upon a mere perusal of the life and adventures of Daniel Drawbaugh, and there certainly appears to be, as yet, no indications of such a policy being in contemplation.

POPULARIZING THE TELEGRAPH.

There is a prevailing impression that the people generally abstain from using the telegraph more frequently on account of the expense. This appears to be the foundation for all of the movements which have been made in favor of a government telegraph. Unless special attention was directed to the fact, few would realize how seldom the telegraph is resorted to by the masses, unless some special emergency requires its use. We refer more particularly to the individuals who form the bulk of our population—who go daily to and fro between their homes and their labor, and receive the wages for which they toil. It is no reflection upon the intelligence of these men that they do not patronize the telegraph. They may have plenty of friends living at a distance with whom, perchance, they may exchange letters, but unless cases of sudden emergency arise, and they seldom do in the life of each individual, such people may live happily for years, and never realize the fact that they are oppressed by the existence of a telegraph monopoly. It is by considering cases of this kind that we may realize the distinction between a letter and a telegram in social life. The one bearing upon its face the familiar writing, the merry jest, the state of the family health and prosperity—matters which do not concern the world at large, and which would be deprived of their almost sacred character, if not placed under seal. The other bare and formal, the handwriting of a stranger, the names wrongly spelled; a communication whose only merit may be that it was quickly transmitted, and, alas, even this merit is often more imaginary than real. It is difficult to realize that any tariff can be framed which will induce our non-telegraphing public to call for the latter day counter blank—an article, by the way, about as well adapted for chirography as a buckwheat pancake—and endeavor to write thereon, "I now take my pen in hand to inform you that I am well, etc." In these days of hand-to-hand strife, by which the toiler keeps the wolf from the door, he is governed to a great extent by that wise adage of the late Ben Franklin—"never buy what you don't want because it is cheap." We do not by any means ignore the fact that the item of telegraphing forms a very considerable proportion of the expense in many lines of business, yet the percentage upon the transactions which these telegrams represent is too small for consideration. Where the telegraph enters into business relations with the people, however, promptness and accuracy is of far greater importance than cheapness. It would appear, therefore, that any change which proposes a cheap inferior telegraph service, fails utterly in its supposed mission of supplying a long felt want. The claims of the press for a low rate, by reason of its large patronage, is perhaps entitled to consideration. Although with cheapness we find less discrimination in the transmission of news, and the most probable result would be the telegraphing of large amounts of rubbish, only to be consigned to the waste basket. The present rates for telegrams, considering their actual value to the sender, are no more burdensome than the charges for the delivery of trunks, for cab hire, or for the numerous petty services which a citizen incurs at every turn.

A GOVERNMENT DEPARTMENT OF PATENTS.

Senator Orville H. Platt, of Connecticut, deserves the sincere thanks of all American inventors, for his able speech in support of a bill providing for the organization of the patent bureau into an independent department of the government. In reviewing the past history of the nation, he gathers not only from statistics, but from his own personal recollection during the past fifty years, an array of arguments, which should certainly convince the most skeptical person of the paramount importance of the inventor's cunning in utilizing the crude forces of nature for bringing about the remarkable progress of our country during that period. The railroad, he said, is the child of patented inventions; the production of cotton, silk, broadcloth and linen, is due absolutely and entirely to the perfection of machinery for their manufacture. The daily press, the teeming books, are part of our civilization. They are all dependent upon patented inventions. The carpet, the piano and the carriage conduce to our comfort and our convenience, and they also are children of patents. The number of patents granted from 1790 to 1837 was about 10,000. The number granted from 1837 to 1884 is over 300,000. The agricultural interest is deeply indebted for its present development, to the marvellous results of patented inventions. Think of the crops raised, he said, without improved plows, without seeders, without cultivators, without mowers, without harvesters, without threshing machines. Think of the crops hauled to market by horses. Think, if it be possible, of the wheat converted into flour without patented milling processes; and say what proportion of profitable agriculture in this country is not due directly to patents and to the patent system of the country. The truth is, and there is no avoiding it, that we can not disconnect in this country invention, manufactures and agriculture. The triumph and success of one is the triumph and success of all. In reply to the argument that the western farmers had been oppressed by the barbed-wire patent, he pointed out the fact that the old post and board fence cost $1 per rod, while the wire fence cost but half that amount. Already the actual saving to the farming interest by this invention amounted to $55,192,240.

Although the Patent-office is the only branch of the government which is self-supporting, it has been crippled in its administration to such an extent that the work in its different divisions is from 2 to 7 months in arrears. It is believed that if the change suggested be made, and the working force properly reorganized, the administration of this most important department will be vastly improved.

THE ELECTRIC LIGHT TESTS AT CINCINNATI.

The continuation of the article on the above subject, from the April number is unavoidably postponed until the June issue.

ARTICLES.

THE INTERNATIONAL ELECTRICAL EXHIBITION.

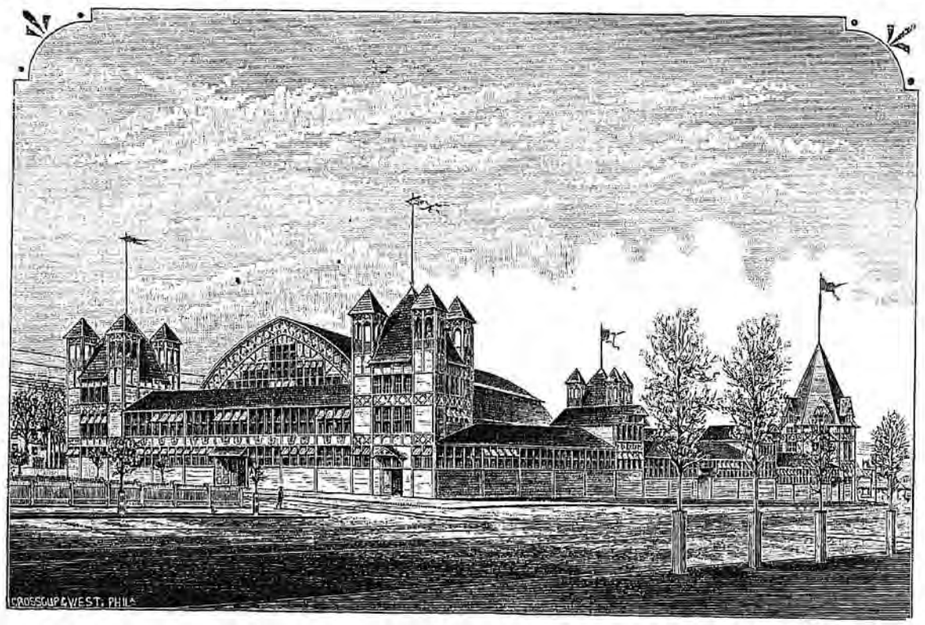
TO OPEN AT PHILADELPHIA, SEPTEMBER 2D, 1884.

THE accompanying view of the building in which this exhibition is to be held, will enable our readers to form some idea of the importance of the event, for there can be little doubt that all the available space will be fully occupied. It would appear somewhat strange that an exhibition of this kind had not been arranged for in this country before this time, if we did not consider the fact that it has only been made possible by the extraordinary development of electrical matters during the past five years. There is probably no institution in the country which could manage this undertaking so satisfactorily as the Franklin Institute, and every effort is being made by its officers to insure its success. It will be generally conceded that Philadelphia is the best possible location that could be selected for the exhibition, and we are sure that no person who is in any manner interested in electrical science, can well afford to neglect this opportunity for

100	square feet at	20	cents		$20 00
200	" "	17½	"		35 00
300	" "	15½	"		46 50
400	" "	14	"		56 00
500	" "	13	"		65 00
600	" "	12¼	"		73 50
700	" "	11⅔	"		81 00
800	" "	11	"		88 00
900	" "	10½	"		94 50
1,000	" "	10	"		100 00

All spaces over 1,000 square feet will be charged for at the rate of 10 cents per foot.

The main building which is now in process of erection, is to be finished by June 15. It will be rectangular in form, 283x160 feet, the four towers at the corners being each 60 feet high. The main roof consists of a central arch 100 feet span, and 200 feet in length, while 2 smaller ones with a span of 30 feet each, will run parallel to it on either side joining the towers. There will also be a large annex, triangular in shape, 1 story in height. The main entrance will be at the corner of 32d Street and Lancaster Avenue, another at 33d Street corner, and one at each of the other towers. It is thought that the meeting at Philadelphia of the American Association for the advancement of Science, and the presence of many representatives of the British Association which will also meet in August of this



THE INTERNATIONAL ELECTRICAL EXHIBITION BUILDING.

examining the thousands of devices which will represent the fertility of our inventors in its various branches. The regulations for the guidance of exhibitors have already been prepared, from which we learn that articles will be grouped as follows: 1, apparatus for the production of electricity; 2, electric conductors; 3, measurements; 4, applications of electricity, subdivided into apparatus of large and small power; 5, terrestrial physics; 6, historical apparatus, and 7, educational and biographical. By a special arrangement of the United States Treasury Department, all foreign exhibits will be passed through the custom houses free of duty. The following schedule gives the rates adopted for the letting of space:

All spaces under 10 square feet $2
From 10 to 100 square feet.....20c. per sq. ft.

year at Montreal, will attract a numerous and influential scientific gathering in Philadelphia during the holding of the exhibition. Congress has also been requested to authorize the convening of a National Conference of electricians in Philadelphia at the same time. All indications seem to show that the occasion will be one of the greatest value and interest to electrical people in Europe as well as America.

No notice has been given of reduced rates of transportation in connection with this exhibition, but it is to be hoped that the various railroad corporations will make liberal arrangements for excursion rates, which will of course have considerable influence upon the attendance. Fortunately this matter is largely under the control of the Pennsylvania Railroad Company, which will no doubt take proper care of the interests of Philadelphia.

ELECTRO-MAGNETS.[1]

BY J. T. SPRAGUE.

THERE is still some confusion about the meaning of the "strength of a magnet," and the various terms, "magnetic moment," "free magnetism," "magnetic force," and "lifting power." It is not intended to deal with these subjects here, except so far as is necessary to explain the principles of electro-magnets, but it is essential to make clear the distinction between magnetic strength and lifting power.

1. The *strength of a pole* is measurable by the field it can set up or by the attractive or repellent force it can exert upon another magnet. The *unit* strength of pole is that which at one centimetre distance repels a similar and equal pole with a force of one dyne.

2. Now the essential feature of magnetism is its equal opposite dualism; in every magnet there are equal N. and S. forces present; in every magnet there must be a N and S. end, and in some sense a N. and S. pole; but it by no means follows that the two ends of, say, a bar magnet, constitute *two poles of equal strength*, for one pole may be stronger than the other, notwithstanding the equal opposite magnetism.

3. Taking a bar magnet, equally magnetized throughout, and having equal opposite N. and S. poles, either end may be capable of lifting a fixed weight—say, 1 oz.; let the bar be formed into a horse-shoe, and it will no longer lift only the weight due to its two poles, but several times that weight. Lifting power, therefore, depends upon something besides magnetic strength; it depends upon the arrangement of the poles, or really upon how much of the whole magnetic force is concentrated within the armature by which the lifting power is exerted. Figures 1 and 2

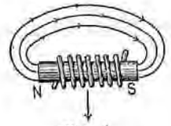


FIG. 1.

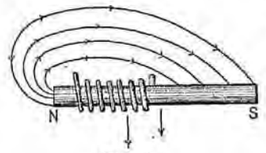


FIG. 2.

will explain these relations. Figure 1 is a bar of iron with a helix over its whole length, giving equal magnetism throughout, and constituting equal N. and S. poles. Now, if we assume that pole N. can hold up 1 oz. weight, when a current passes sufficient to *saturate* the bar, we can make it hold a greater weight with the same current by adding a piece of iron to the S. end. We can do so because we have increased the *magnetic capacity* of the system. Figure 2 represents this result attained in a different way, that is by using a longer core to the same helix. Now we have no longer equal magnetism throughout the core; we have equal N. and S. magnetism truly; but the middle or neutral point of the magnet would no longer be at the middle of the bar, but brought considerably nearer the N. end; therefore, the N. pole would be stronger than the S. pole, and would hold a greater weight, because the lines of magnetic force are of necessity more concentrated at that end.

4. The action of the horse-shoe magnet is like that of the straight bar, so far as its internal forces are concerned, but its polar ends are brought so near each other as to concentrate its field of force into a small space, and to enable it to induce powerful magnetism in an iron armature entering into the field and absorbing all its lines, so as to form a closed magnetic circle. Therefore, in a horse-shoe, the difference between pole strength and lifting power is not only so much greater than in a bar, as before stated, but this difference becomes greater the nearer the ends are brought together—that is to say, the same electro-magnet will have a smaller field for action at a distance, yet with greater lifting power, if its poles are 1 in. apart, than if they are 2 in. apart. The reason is that the magnetic force becomes more intense when exerted upon the smaller mass of the shorter armature.

5. Therefore, all the common statements as to laws of attraction are mere fables; each particular construction has its own action, dependent upon the nature of the field it produces. But there are proportions of the several parts of the electro-magnet from which the maximum advantages are to be obtained, corresponding to the desired conditions. As to this particular point of attraction, we have at once this rule; *if great holding power, or great attractive power at a short distance is required, bring the poles near each other, either by construction or by pole pieces; if a more even and distant action is desired, open the polar space.*

6. Figures 3 and 4 will serve as references to explain the proportions. C and D are the cores on which helices are placed, the latter being wound upon the reel or spool H. B is the yoke which connects the cores together, and A is

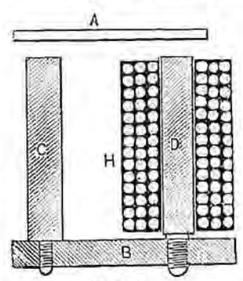


FIG. 3.

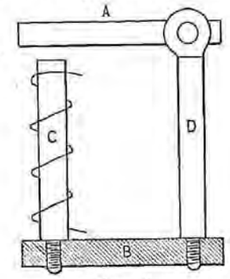


FIG. 4.

the moving armature. The best relation of these is that they should be of equal lengths, that B, the yoke, should be of greater mass of metal than the cores, and A, the armature, of equal mass, but spread out into a broader surface, in order to readily absorb the lines of force issuing from the ends of the cores.

7. Figure 4 shows a method of obtaining sharp attraction on an armature by hinging it to the end of one pole, so that it plays angularly through a small space, and is very quickly magnetized from that pole; instead of hinging, the pole may be slightly rounded and fitted with a pin passing through a conical hole in the armature. The core D may in many cases be left without a helix, so that it acts like the polar extension in Figure 2.

8. The *cores* carrying the helices should each have a length of six times their diameter, or twelve times in the case of a straight bar.

The *helix* should be of the same thickness as the core, making its diameter three-fold that of the iron core.

These dimensions of maximum efficiency are found to result from the combinations of a variety of functions.

9. *Cores* vary in magnetic strength in the ratio of the *square root of their diameters* and also of the *square root* of their lengths. *Lengthening the core* distributes the field to a greater distance, and increases residuary magnetism; therefore, magnets intended for rapid working should have short cores.

10. *Hollow* cores are as effective as solid metal of equal diameter, provided the tube or shell is sufficiently thick to absorb the full effect of the current; one-fourth the diameter is usually sufficient, but the ends of the tubes must be closed with iron plugs somewhat thicker than the shell. The best mode of forming such cores, when small, is to drill out the solid metal to the required depth, and then to slit the tube lengthwise, to prevent the formation of induced or Foucault currents in the core at every change of the magnetic condition.

11. The six-fold length and unit thickness of helix is that which (combined with above ratio of core) gives the greatest magnetic result for the shortest length of wire.

1. From the *English Mechanic*.

Within practical limits, each *spire* or convolution of wire, whether close to or distant from the core, has equal magnetic effect; but one turn of the distant wire would make two turns of wire of half the diameter, and therefore have double magnetic action for the same resistance; on the other hand, lengthening the helix to gain this would reduce the total magnetism by increasing polar length, and diminishing the number of turns at each section.

12. Concentrating the wire of the helix, for a fixed length of wire, at the polar ends, as in Figure 2, adds to the polar force in a bar magnet (at one end) so long as one-third of the core is covered. Professors Ayrton and Perry compared four bars, each 1 ft. long and ⅜ in. thick, with equal lengths of wire wound—1, equally over the whole; 2, coned to each end; 3, equally over half the length; 4, on half and coned towards the end. The lifting powers and distant actions upon a needle were with the same current, which was below the limit of saturation.

1 lifted 45oz., widest field
2 " 57oz., weakening
3 " 57oz., at equal
4 " 77oz., distances.

In horse-shoe magnets better effects are obtained by even distribution of the wire upon the two arms; but if a very small and quick play of the armature is desired, the wire may be brought more closely up to the ends.

13. The magnetic strength is proportionate *to the current* and also to the *number of turns* in the helix. It is usual in formulæ to express this as Ct; but it will simplify the conception of the law of action to combine the two into one fact, and say it is as the *current turns*. Even this is indefinite, and it is still better to add another to our unit system, and collate magnetic effects to the *ampère turns*, to which a few experiments would give a definite value.

We may obtain a certain magnetic strength from a given core under many varying conditions of current. Thus 100 turns of thick wire carrying a 10 ampère current = 1,000 ampère turns; 1,000 turns of a smaller wire with 1 ampère current, still = 1,000 ampère turns, and 10,000 turns of fine wire with current, 1 ampère gives also 1,000 ampère turns. Each would constitute a magnet of equal strength, and it would depend upon the resistance of the circuit and the electromotive forces at disposal, which organization would be best suited to any given case. To equally magnetize two cores of different diameters (that is, to bring two masses of the same quality to the same degree of saturation), the ampère turns must be in the proportion of the square roots of the cubes of the diameters.

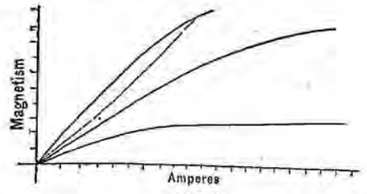


Fig. 5.

14. But this law only holds good within a certain range of magnetic increase. If we were to express it diagramatically, the growth of magnetic strength in any given magnet would be represented by the dotted line in Figure 5, and would rise indefinitely with the current. But the action is a steadily diminishing one, such as is represented by the three curved lines, which all tend to a limit at which increased current does not add to magnetic strength. This is the limit of *saturation*.

15. The limit of saturation is different for different materials. The lowest curve of Figure 5 represents the *capacity* of hard steel, and the others the capacity of different qualities of iron, showing that the *same current* will develop different magnetic strengths in different irons, so that one quality will reach its limit of saturation at a point far below that of another. Soft iron has, in fact, eight times the capacity of steel, which is the reason that electro-magnets are better than permanent ones for dynamo machines.

16. *Steel* has two limits of saturation. 1. That to which it can be carried by an electro-magnet, or even by the old processes of magnetizing. 2. That which it will retain under ordinary circumstances; between these two limits it reacts with currents as iron does, giving up the excess charge of energy in the form of induced currents.

17. It is in the neighborhood of this lower limit of permanent magnetism of steel and regular magnetic increment that the law of ampère turns applies, and it is also at about this range that electro-magnets will do their best work. It is evidently bad economy to force them up towards saturation, for two good reasons. 1. It requires growing increase of current to proportionately increase the magnetic strength. 2. The increase of current involves expenditure of energy in the ratio of the square of that increase, besides the extra loss from resistance due to the heat generated in the wire.

18. The maximum attractive power capable of being developed in iron was found by Joule to be 200 lbs. per square inch of core surface, equivalent to a force of 13,800,000 dynes per centimetre. Prof. Rowland gives the capacity of iron at 1,390 C. G. S. units per cubic centimetre; but various authorities range from 400 to 1,000 for steel, and, as will be understood from Secs. 15 to 18, each quality of iron has its own specific capacity, to be ascertained only by experiment.

19. The selection of the most suitable size of wire is determined by the resistance of the rest of the circuit. For maximum work, irrespective of other considerations, the resistance of the helices of the electro-magnet should be equal to that of all the rest of the circuit, including the battery. For rapid action, as in a vibrating armature or telegraphic relay, the resistance should be made much lower than this, to prevent the counteracting influence and damage of extra currents. But it should be understood that the term resistance is employed in this way merely as a convenient means of measuring and comparing the wires of different sizes and lengths, which can be put into the helix of certain required dimensions. Resistance, as such, is objectionable and must be kept as low as possible by the use of wire of a high conductivity.

20. Various formulæ are given for determining the sizes of wire required; but I prefer, for the sake of general readers, to deal with the subject physically rather than algebraically. A helix is a certain space which is measurable in cubic inches, or, as it is usually round, in cylindrical inches, by taking the square of the external diameter, and deducting from it the square of the diameter of the internal tube, which gives the sectional area of the wire space, and this, multiplied by the length of the helix, gives its capacity; then, multiplying by 2,247 grains per cubic inch, or 1,765 per circular inch, we have the weight as solid copper. From this a deduction has to be made, varying with the size of the wire and the nature of its covering, and also with the skill employed in winding it on the helix. In the case of silk covered wires, it will vary from .75 for wires about 16 to 20, .60 down to 26, .50 at 32, and .30 at 40 gauge.[2] The solid weight, multiplied by these ratios, will give the actual weight of metal which can be placed on the helix.

21. Having thus the weight of metal at disposal, W, and the resistance it is to give, R, we can ascertain the diameter of wire to be used. In fact, a simple rule-of-three sum will give us the ohms per pound—

As W is to 7,000 grains, so is R to ohm lb.

A reference to the table given in most works on practical telegraphy will then show the suitable size of wire, or it may be calculated from the constant of 1 mil. wire

2. These numbers refer to the Birmingham gauge.

$\frac{3,416,825}{\text{ohms per lb.}}$ = square of area in mils. of the required wire.

Therefore, the square foot of the quotient gives the area, and the square root of this the diameter.

The logarithmic calculation is exceedingly simple, as it consists only of deducting the logarithm of the ohms per lb. from 6·5336228, and dividing the remainder by 4, which gives the logarithm of the diameter required.

22. The simplest mode in practice of ascertaining the proper ratio is to prepare a mandrel, in which are cut recesses exactly 1, 2, or 3 inches long, to suit different sizes of wire, and to wind a layer of wire in one of these, so as to learn the exact number of turns per inch. The diameter of the bare wire will give the number of turns of it which would occupy the inch, and the difference is the space occupied by the covering.

23. The first thing to be considered in designing an electro-magnet, is the definite mechanical work it is to be required to perform. Every action means the expenditure of a certain definite amount of energy which can be measured in foot-pounds, and the construction of the magnet must be such that the current passing it will supply this energy, which, for the time being, acts as a resistance added to that due to the wire itself. In designing the electro-magnet it is necessary, therefore, to adapt the size of the core to the dimensions which will give the attractive power which is calculated as necessary, and afterwards to adjust the size of the wire and its resistance to the conditions of the circuit, because, while a stout wire may give the required conditions close to the source of the current, a fine wire may be necessary at any considerable distance.

Then the battery power must be arranged to give, not merely the current required to pass in the magnet, but the electromotive force necessary to pass that current when the magnet is doing work; it is here that failure generally arises.

24. Set up a battery and magnet with a galvanometer in circuit, and note the current; now give the magnet work to do in holding up a weight, and *the same current will no longer pass*. This seems a paradox, that a smaller current should pass when it has to do work than when it merely traverses the wire; but it is easily explained. Let the battery and magnet have each a resistance of 1 ohm, and the battery an E. M. F. of 6 volts, so as to pass a current of 3 ampères, and let us assume, for the convenience of figures merely, that the added work reduces the current to 2 ampères. This means that *the work is equivalent to a resistance of* 1 *ohm* added to that of the wire. Now the energy expended in accordance with Joule's law, is in the ratio of $C^2 \times R$, be the resistance of what order it may. Hence, we have, at first energy supplied by the current $3^2 \times 2 = 18$ joulads[3] per second.

Under the second conditions, we have it $2^2 \times 3 = 12$, less energy supplied by the reduced current to the increased resistance.

But in the first case, the whole 18 joulads are expended in heating the battery and wire; in the second case, only 8 are so expended, while 4 are employed in work.

25. If, then, the magnet is so arranged that it will require 3 ampères to do its work, it is evident the E. M. F. must be increased in proportion to the extra resistance represented by the work; it must, therefore, be raised to $C \times R = 3 \times 3 = 9$ volts, and then we shall have energy $3^3 \times 3 = 27$ joulads, of which 18 are used in battery and wire as before, and 9 remain to do the mechanical work. Therefore, in all cases, the battery must supply the current required while work is doing, not merely that calculated from the measured resistances.

26. As usually constructed—that is, in the horse-shoe form—the electro-magnets do not utilize all the magnetic effect of the current, which acts externally as well as internally, but in the opposite direction. The armature is magnetized, of course, but only by induction from the core, and part of the power must be diverted to the external field of the helix. This external power may be utilized in various ways.

27. A few years ago, great claims were made as to the advantages of surrounding the helix with an external tube of iron connected to the core at the lower end by a disc of iron. This was patented under the name of the "altandi" magnet—a barbarous word invented to convey some idea of exaltation; but the construction had been frequently employed before. Figure 6 will explain it.

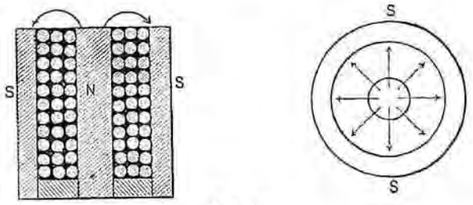


Fig. 6.

It will be seen that though there is only one core, this is still a true horse-shoe magnet, the other arm being a cylinder surrounding the core. The effect is to produce an intense, but very limited field, represented by the arrows, giving, no doubt, great holding power, but with attraction exerted only at a small distance.

28. A modification of this has been employed in some electric bells, which is shown in Figure 7.

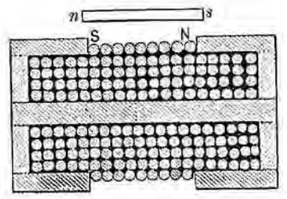


Fig. 7.

In this a cylinder is placed on each end, and the opening in which the field is produced is at the middle of the core.

29. Perhaps the greatest power may be obtained by a further modification of my own, in which the external action of the current is taken up by the armature, which is thus magnetized by the current, as well as by induction. Figure 8 shows this:—

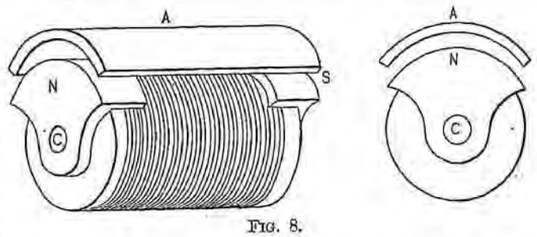


Fig. 8.

C is the core, fitted with two pole pieces, N, S, extending over one-third of the end of the helix; A is the armature in which the outside action of the current produces poles *n s* opposed to those of the magnet, so that a powerful attraction draws down the armature which constitutes part of a cylinder fitted to the pole pieces.

3. The term *joulad*, is here used to express the unit rate of doing work, now more usually termed a *watt*.—[Editor.]

EXPERIMENTS WITH THE TÖPLER ELECTRIC MACHINE.

BY P. ATKINSON, A.M.

EXPERIMENT I.

To prove that the apparent time in the electric discharge is an optical illusion.

The carriers on the revolving plate of a Töpler afford special facilities for this experiment. They are usually six discs, arranged in a circle, and present the appearance of a continuous bright ring when the machine is operated in the light; but when operated in the dark, they are seen only when the spark renders them visible; and, instead of the bright ring, each appears by itself, apparently motionless, and as perfect in form as if really so, just as if the movement of the plate were momentarily arrested during the passage of the spark.

This apparent time of the spark may be estimated at $\frac{1}{4}$ second; but if the carriers were really visible during that time, the ring-like appearance would be unavoidable, as will appear from the following calculation:

Suppose the revolving plate to have an average speed of $4\frac{3}{4}$ revolutions per second, it is evident that each carrier would make a complete revolution in less than $\frac{1}{4}$ second; so that if that were the actual duration of the spark, each would be continuously visible round the entire circle, and hence even a single carrier would produce the bright ring. But it is only necessary to this result that each should be visible until it takes the place of its predecessor—that is during its passage of $\frac{1}{6}$ of the circle, which reduces the time to $\frac{1}{24}$ second.

But if they were visible even half that time, $\frac{1}{48}$ second, and each were $1\frac{1}{2}$ inches diameter, and their distance, from centre to centre, $5\frac{1}{4}$ inches, we would have 6 ellipses, each having a length nearly twice its breadth.

From this it is evident that the smallest conceivable duration of spark must produce an ellipse; but as each presents the appearance of a circle, with no tendency to elliptical form, the conclusion is inevitable that the apparent duration of the spark is an optical illusion, and that its time, if any, is so nearly zero, that it cannot be estimated.

We must conclude, then, that at the instant of discharge the image of the carrier is photographed on the retina of the eye, and at the next instant darkness supervenes; but the sensation on the retina has a momentary duration, during which the carrier appears stationary, while in reality it may have passed entirely round the circle.

It is important to notice, in this connection, that the appearance and disappearance of the carriers depends on the rapidity of the discharge; and when the spark is made so short and rapid as to be apparently continuous, the carriers appear and disappear with each snap, like a succession of views in a rapidly moving panorama, proving that the apparently continuous spark is a succession of sparks so rapid as to give the impression of continuity.

As a flash of lightning is only the same thing on a grander scale in nature's own laboratory, we must conclude that the passage of electricity from cloud to cloud, a distance often of many miles, is so rapid as to defy human calculation. We notice this in chain lightning, when the flash, sometimes three to five miles long, is seen throughout its entire length at the same instant, as if suddenly photographed on the cloud.

EXPERIMENT II.

Transmission of Power by Static Electricity.

Two machines are necessary for this experiment—one called the primary, and the other secondary. The secondary should be a very light running machine; hence it is better to make it smaller than the primary, and the driving wheel and switch may be dispensed with.

Let the machines be placed near each other, in the same relative position, the secondary in front; connect them together by conducting cords or wires, joining similar pairs of Leyden jars, and let the sliding electrodes be separated beyond sparking distance. Now let the primary machine be put in operation, and the movable plate of the secondary will rotate in a direction opposite to that of the primary.

If the electric energy should not be sufficient to overcome the friction and inertia in starting, the plate of the secondary may be put in rotation by hand, and its motion will then be sustained by the electric action.

The explanation is as follows: When a Töpler machine is in operation, there is a strong attraction between the plates, the result of induction from the opposite electric states of the parts in proximity. This attraction, which constantly increases up to the instant of discharge, acts as a resisting force which must be overcome by the force used to rotate the plate.

Now, when the two machines are connected, this electric force is transmitted to the secondary, where, having no mechanical force to oppose it, as in the primary, it causes the rotation of the plate in the opposite direction.

Thus the mechanical force in the primary is transmitted into electric force, passes over to the secondary and reproduces mechanical force—the force applied to the primary being expended in the secondary.

The apparatus thus becomes a scientific bank, with its receiving and paying tellers. But nature is a shrewd banker, and always exacts full discounts; hence the mechanical energy paid in to the primary is discounted by friction, leakage, and heat; so that the remaining energy may not be sufficient to start the plate of the secondary into rotation without an additional payment.

The sliding electrodes in the secondary machine may be adjusted to produce the electric discharge with spark and snap, instead of the mechanical rotation of the plate; thus illustrating the transmutation of force, at will, from mechanical to electric, and from electric either back again to mechanical, or to the heat, light and sound of the electric discharge.

EXPERIMENT III.

Source of electric supply of a Töpler machine.

The earth, the machine itself, and the air are the only sources from which an electric machine can derive electricity.

With the common friction machine a connection with the earth is indispensable, and only a very limited charge can be obtained without it. Hence it is often compared to a pump, drawing electricity from the earth through a chain. Remove the chain and the supply ceases.

But with a Töpler a similar earth connection diminishes the supply; showing an escape of electricity to the earth rather than a supply from it. Indeed, perfect insulation of the generating parts is an essential feature of the machine.

To demonstrate this more perfectly, let the machine be put in operation on an insulated platform, when it will be found that there is not the slightest perceptible diminution of electric energy. It is evident, then, that the earth is not its source of supply.

A certain amount is, no doubt, obtained from the material of the machine itself; but this source would soon be exhausted by such experiments as the charging of a large Leyden battery; whereas such a battery may be charged and discharged repeatedly without diminishing the energy of the machine.

The air, then, is the only remaining source. The large amount of ozone generated by this machine is conclusive evidence of its electro-chemical action on the air, and strong presumptive evidence that the air thus acted upon has furnished the electricity whose action has changed the oxygen to ozone.

This would imply that ozone is the result of depriving air of a portion of its electricity; whereas if the electricity were derived from the earth, we must infer that its generation precedes the generation of ozone, instead of being coincident with it. But the insulation proves that the earth does not supply the electricity; so that the weight of evidence is in favor of ozone being the direct result of electric generation, rather than a result of subsequent electric action. And, if such is the case, it is strong proof that the air is the chief source of electric supply.

The generation of ozone by atmospheric electricity during thunder storms is a well-known fact; and clouds, floating miles above the earth, must obtain their electricity either from their own vapor, or the air, or both. Such clouds, at different electric potentials, insulated from the earth, acting inductively on each other, and finally producing a discharge, fulfil the same conditions as exist in the Töpler machine; and the generation of ozone is doubtless due to the same cause in both. And since the vapor of the cloud corresponds to the material of the machine, and it has been shown that the electric supply of the machine from its own material must be very limited, and since the machine operates most effectively in a dry atmosphere, and hence does not derive its electricity from vapor, we may infer that the electric action is the same in both cases, and that the air is the chief source of electric supply.

It seems evident from the movement of particles of dust and other light bodies towards the machine, that the air in which those atoms float must have a similar movement; that currents of air are constantly flowing to the machine and that this air, after being raised to the same electric potential, is repelled, and air at a lower potential flows in to take its place—a movement similar to that which takes place in the hot and cold currents round a heated stove.

It may be difficult to produce positive evidence of such currents, as they cannot be seen like currents of heated air; and as light bodies are subject to electric attraction whether floating in the air or otherwise suspended in it, so that such evidence must be chiefly inferential. And yet when it becomes cumulative from experiments too numerous to detail, it amounts almost to demonstration, and is another strong proof of the air being the chief source of electric supply.

But the initial charge is undoubtedly from the material of the machine itself, and results from the friction of the brushes on the carriers; then follows the increase by induction and the action on the air.

EXPERIMENT IV.

Electricity generated by the friction of metals.

The old division of all substances into electrics and non-electrics was the exponent of the idea then prevalent, that only certain substances, as glass, sealing-wax, and other non-conductors, comprised in a very brief list, were capable of electric excitation. While this view is no longer maintained, yet the impression on the mind of a student of any elementary treatise on electricity now in use, must be nearly the same as formerly. In all the experiments illustrating the elements of static electricity, glass, sealing-wax, ebonite, silk, wool, fur and other non-conductors, are almost exclusively employed as generators; and if a conductor is used at all, it is only in connection with a non-conductor. It is doubtful if a single instance can be found in such treatises where it is distinctly stated, and proved by experiment, that metals and other conductors are capable of generating electricity by their mutual friction. And yet this is one of the most important elements of static electricity. It is that which liberates our ideas of electricity from the narrow bounds to which they were once confined, proving that it is not a special property of certain substances, but a universal property of matter, one form of that energy which pervades and controls the universe.

The Töpler machine is the only electric apparatus specially adapted to illustrate this point. In it the initial charge is produced by the friction of metal brushes on metal carriers.

True, both carriers and brushes are attached to glass, and the glass subsequently acts by induction as a generator; but the friction is confined to the carriers and brushes alone, and, so far as the electricity is obtained from this source, the glass acts only as an insulator to prevent the escape of the electricity generated by friction, from which the initial charge is derived.

It is not even necessary that the metals should be different. My machines are constructed with brass carriers, and brushes of brass wire; and, though the carriers are nickel plated, so that the friction is that of brass brushes on a nickel surface, yet the plating is only for appearance, and carriers left unplated give equally as good results.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from page* 33.)

THE PHELPS STOCK TRANSMITTER.

The standard transmitter for the Phelps stock printer is arranged to work 10 circuits. It consists of an electro-magnetic motor driven by battery-power; a keyboard containing one bank of alternately white and black keys, for all of the characters on the type-wheels, and a system of pole-changing circuit-closers for sending the currents on the respective circuits; all of these parts being connected together by suitable gearing, so that they all move and stop synchronously. The motor transmits its motion by means of a friction connection to a horizontally placed cylinder, having 28 pins arranged around it in a spiral, and are 1-28 part of the circumference of the cylinder distant from each other. Twenty eight keys are arranged and pivoted, so that when the finger end of either is depressed, the further end is tilted up and a detent on the distal end catches against a pin on the cylinder and detains it, if the latter is revolving. Each key-detent is placed in the path of its own cylinder-pin and can catch on that pin and no other. Therefore if the first or A. key be depressed, it will catch on the first pin on the cylinder and hold the cylinder there, the motor continuing its rotation by the slipping of the friction connection with the cylinder. The latter will have made 1-28 revolutions before stopping. If the second or B. key had been depressed it would have made 2-28 revolutions, with the C. key 3-28, and with the last key a complete or 28-28 revolutions. In order to avoid the expense and the space necessary for two banks of keys, one for letters and one for figures, there are but 28 keys used, each of them being interchangeable in use for a letter, or for the figure filling the corresponding position by progression on the type-wheel. The keys are therefore engraved with two characters on each key, as follows: The characters on the upper line being those on the letter type-wheel and those on the lower line being on the figure type-wheel:

. . A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
. . 1 2 3 4 5 6 7 8 9 0 / C B . 1 2 3 4 5 6 7 8 9 0 / S

It is, therefore, evident that the operator in transmitting despatches must bear in mind which type-wheel he is using, since the keyboard itself affords him no guide as to whether he is sending letters or figures. If the first key (on which two dots are engraved one above the other), be depressed the letter-shifting pins on all of the type-wheel shafts will be brought into such a position relatively to the T. shaped shifting piece on one of the press levers in each instrument, that the pad will be shifted under the letter type-wheel and all the characters succeeding that operation will be printed from the letter type-wheel, until the second key, on which two dots are also engraved, be depressed, when the other radial pin on the type-wheel shafts strikes the T. piece. Then all succeeding characters will be printed from the figure-wheel, until the first named key be depressed again.

The operator must, therefore, practice a habit of voluntary mental blindness to the *figures* which are engraved on the same keys when he is printing *letters*, and *vice versa*. It is, however, the fact that American operators can be found who are always equal to the requirements of the most complicated and rapid mechanical devices, and this case is no exception. It is one of the rarest of occurrences for an operator, familiar with these machines, to "lose himself" on the keyboard. The result of such an error would appear in this way: If he attempted to print NEW YORK from the wrong wheel, it would appear like "pi," thus: .5 9 . / 1 4 /, a combination of characters sufficiently unintelligible to ensure a special complaint from the average subscriber.

The cylinder, driven by the motor at one end, communicates its motion at the other end by bevel-gears to a large horizontally rotating spur-wheel mounted on an upright pivot. Around the circumference of this wheel are arranged 10 pole-changers, each mounted on its own separate vertical rock-shaft. They consist of rectangular blocks of ebonite, each carrying two insulated horizontal bars, one of which is connected to the copper and the other to the zinc pole of the battery. Under the ebonite block and fastened to it, is an anchor with two pallets, gearing into the large wheel so as to rock the ebonite block backward and forward, through a small excursion in a horizontal plane, when the large wheel revolves. It should be remembered that the large wheel revolves with the cylinder and stops when the cylinder stops, and performs the same fraction of a revolution, as the cylinder does until the latter is stopped by a key, during a revolution. Two springs, one connected to the ground, and the other to the line, press alternately and in reverse correspondence, on the horizontal battery bars when the ebonite block rocks from side to side. This constitutes the pole-changing apparatus for one circuit and as many of these may be employed as is convenient. The standard transmitter has 10. When the ebonite block is rocked to the left-hand side, one pole of the battery is connected to the line and the other to earth, and when rocked in a contrary direction the reverse action takes place. Therefore, each half vibration of a pole-changer will advance the type-wheels, one letter or one figure. When the cylinder is stopped, the line and ground wires remain in contact with the battery bars, so long as the cylinder remains stationary. When the cylinder moves 1-28 of a revolution, one tooth of the large wheel passes by each of the pole-changer pallets and moves all of them once in one direction; as the cylinder continues to revolve and passes through another 1-28 of a revolution, another tooth on the large wheel passes by each of the pole-changers and rocks them all once in the opposite direction. By this means alternative positive and negative pulsations are sent over the line when the cylinder is running, and a steady current remains on the line having a polarity depending on the position of the pole-changer.

Running at the rate of 120 revolutions per minute, these machines will print an average of 21 English words per minute.

ABSTRACTS AND EXTRACTS.

COMPARATIVE TESTS OF ALUMINUM WIRE.

At the last meeting of the Philosophical Society of Glasgow, Professor Jamieson, F.R.S.E., read a short paper on this subject. He said he had obtained some specimens of nearly pure aluminum wire from the Aluminum Crown Metal Company, the same being prepared by Webster's process. On analysis, the wire gave 98.39 per cent. of aluminum, 1.24 per cent. of iron, and 0.37 per cent. of silicon, the specific gravity being 2.786. As the wire was only in short lengths, he had been necessitated to determine the electrical resistance of the metal by the "fall-of-potential" method with chemically pure copper wire as well as with a standard B.A. unit; and he had found that the aluminum had 1.96 times the resistance of the copper wire of the same gauge and length, and but little more than half the resistance of pure copper for the same length and weight. The conclusion arrived at, therefore, was that aluminum had by far the least resistance of any known metal for its weight. In the course of his investigation he had elicited a very curious fact, namely, that the introduction of a very small percentage of aluminum into copper not only raised its tensile strength immensely (the specimens shown having a breaking stress of about 45 tons per square inch), but also enormously increased its resistance. So far as his tests had gone, the specimens shown had a resistance of twenty-five times that of pure copper. He pointed out the probable uses of such wire as for example, in the construction of high resistance coils. Other qualities might be found well adapted for telephone wires, and the purer kind of aluminum, owing to the great lightness of the metal, could be used for military purposes, in which lightness of baggage was an important desideratum. He was asked to continue his tests and elicit more facts, if possible, concerning the new manufacture.—*Engineering*.

THE LONDON ELECTRIC LIGHT COMPANIES.

We learn from the *Statist* that of the 91 electric light companies started in England between the end of 1878 and the close of the year 1883, only 8 are now quoted on the Stock Exchange. Of these companies 28 were directly or indirectly offsprings of the parent Brush company. Some of the subsidiary Brush companies have been absorbed by the parent company, and others have been wound up. Of the other companies outside of the Brush very few have succeeded in establishing themselves on a sound basis. The sifting process appears to have left the Anglo-American Brush, the parent Brush company, the Hammond, an off-shoot of it, and the United Edison and Swan companies as the main possessors of the field of electric lighting. Now that the speculative craze which has so largely distinguished the progress of electric lighting in England has passed, those companies which find themselves in possession of electric appliances of real merit ought to be able to do a paying business, as the electric light has the elements of permanent growth, and under sound business management can hardly fail of success.

Very much has been made in certain quarters of this temporary departure from financial sanity, and it has been rather freely asserted that the electric light, as well as pretty much everything else in which electricity was concerned, was a fraud. But the responsibility for this craze can hardly be laid at the door of electric lighting, nor can it in justice be asked to fulfil the extravagant promises of promoters bent on fleecing too credulous investors. It is the absence of standards, which can only be given by knowledge of the subject in question, which makes such speculative crazes possible. Electricity was a particularly good field for a mania of this kind, as little or nothing was known of it by the general public, and there was consequently the largest room for the play of the imagination. In this as in all similar cases the bitten investor is not, however, entitled to any special sympathy. If he will not take the trouble to acquaint himself with the facts of the matter or secure the opinion of some expert in whom he has confidence before investing his money, he has only himself to blame for his misadventure.—*Bradstreet's*.

EFFICIENCY OF LIGHTNING RODS.

Prof. Mohn of Christiania, Norway, having been employed by the Government to investigate the efficiency of the protection afforded to buildings by lightning rods, seems to have substantially settled the much debated question, at least for that region of country. His report shows that light-houses, telegraph stations, and other exposed buildings, which were provided with conductors, did not by far suffer as much as churches, which in most cases were unprotected. It appears, in fact, that of about 100 churches reported to have been struck by lightning, only three were provided with conductors; that of these three the first had a conductor in good order, and the building was uninjured; the second had a conductor of zinc wire, which melted, and, of course, left the structure without protection; the third had a wire which was rusty where it joined the earth, and the church was burned. More than one-half the number of churches struck were totally destroyed. Mr. Preece, the English Government electrician, states that no damage has occurred since telegraph poles were earth wired.

NEW DETERMINATIONS OF ELECTRO-CHEMICAL EQUIVALENTS.

A new and very careful determination of the electro-chemical equivalent of silver has recently been made by Lord Rayleigh with a voltameter, consisting of silver plates in a nitrate of silver solution, in which its value, according to the C. G. S. System, was found to be .0118 instead of .011340, as heretofore usually given. Hence a current of 1 ampère will deposit 4.025 grammes of silver per hour.

A recent determination of the electro-chemical equivalent of copper has been made by Thomas Gray, of the University of Glasgow. He found that .000331 of a gramme of copper is deposited by the passage of 1 coulomb of electricity.

ELECTRIC LIGHT CARBONS.

A carbon for electric lighting purposes is thus prepared by M. Jacquelain so as to remove all the impurities from it. Gas carbon is subjected first to treatment with dry chlorine at a red heat for 30 hours; secondly, to treatment with hot alkali for about three hours; thirdly, to immersion in hydrofluoric acid (one to two of water) at a temperature of from 15° to 25°; and fourthly, to the action of the vapor of a high-boiling hydrocarbon.

BATTERY CARBONS.

To make plastic carbons for batteries the following recipe is recommended by M. Max Nischo Niesky: Good coke is ground and mixed with coal tar to a stiff dough and pressed into moulds made of iron and brass. After drying for a few days in a closed place it is heated in a furnace, where it is protected from the direct flames, and burned feebly at first, then strongly, the fire being gradually raised to a white heat, which is maintained for six or eight hours. The fire is then permitted to slowly go down, and when perfectly cold the carbon is taken out of the furnace.

THE FUTURE OF THE ELECTRIC LIGHT.

The London *Engineer*, in a recent issue, while admitting the greater cost of the incandescent light, says:—

As to the future of electric lighting there is no room for doubt. It will succeed. The inherent merits of the light are so great that it cannot possibly be dispensed with, and, under the most adverse circumstances, it is steadily pushing its way. * * * Electricians may take heart. Bad as their prospects are just now, they can rest assured that there is a good time coming for the light which they advocate. But fortunes will neither be made nor lost in a hurry, and this is the best guarantee that the electric light will enjoy public favor and commercial prosperity.

LITERATURE.

AMERICAN NEWSPAPERS IN 1884.

From the edition of Messrs. Geo. P. Rowell & Co.'s *American Newspaper Directory*, now in press, it appears that the newspapers and periodicals of all kinds at present issued in the United States and Canada reach a grand total of 13,402. This is a net gain of precisely 1,600 during the last twelve months, and exhibits an increase of 5,618 over the total number published just ten years since. The increase in 1874 over the total for 1873 was 493. During the past year the dailies have increased from 1,138 to 1,254; the weeklies from 9,062 to 10,028; and the monthlies from 1,091 to 1,499. The greatest increase is in the Western States. Illinois, for instance, now shows 1,000 papers in place of last year's total of 904, while Missouri issues 604 instead of the 523 reported in 1883. Other leading Western States also exhibit a great percentage of increase. The total number of papers in New York State is 1,523, against 1,399 in 1883. Canada has shared in the general increase.

ERRATA.

In the article on the Electric Light Tests at the Cincinnati Exposition, page 83, first column, of our April number, two of the formulas were misprinted. The first should read as follows:

$$C_a = \frac{V}{R_c} + \frac{V}{R_z} \text{ ampères.} \qquad (1)$$

Also the seventh formula, should be—

$$R_z = \frac{V}{C_z} \text{ ohms.} \qquad (7)$$

The location of the article on Electrolytic Vortices, page 84, under the general head of "Sketches of Electrical History," was unintentional. It should have appeared solely under its own title, having no connection with that series of sketches by the same author.

In the article entitled "A Cheap Galvanometer and Thermopile," page 56, the dimensions of the copper strips for the thermopile should be "3 inches long and $\frac{3}{8}$ inch wide."

NEW PERIODICALS.

The Canadian Electrical News.—John Horn editor, published by Hart Brothers & Co., Montreal, is a new semi-monthly periodical devoted to electrical matters in the Dominion. It is a handsome eight page journal, well filled with interesting information, and will no doubt be cordially supported by the constituency it is intended to serve. Mr. Horn has for many years taken a deep interest in electrical literature, and will give his readers the full benefit of his long experience.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Engineering (London), March 14.—The Hochhausen systems of illumination, No. III (illustr.); *Parson's* high-speed engine-driving dynamo machine (illustr). March 28.—Gramme multipolar continuous current dynamo (illustr.); the Vienna electrical exhibition, No. xx; the French ministry of posts and telegraphs (illustr).

Electrician (London), March 15.—Magnetic polarity and neutrality—*Prof. D. E. Hughes*. March 29.—Method of calculating the strength of the magnetic field in a solenoid—*W. Brooks Sayers*.

Electrical Review (London), March 29.—On the progress of electric lighting—*W. H. Preece*.

RECENT PUBLICATIONS.

Cornell, A. B. Biography of Ezra Cornell, founder of the Cornell University. New York, *A. S. Barnes & Co.*, 1884. 322 p. 8° (portrait).

Elettricita, L', e le sue applicazione: Strenna del giorn pel 1884. Milano, 1884. 219 p. 16°.

Popper, Josef. Die physikalischen grundsätze der elektrischen kraftübertragung. Wien. *A. Hartleben*, 1884. 56 p. 8°.

Resal, H. Physique mathematique; electrodynamique, capillarite, chaleur, electricite, magnetisme, elasticite. Paris, *Gauthier-Villars*, 1884. 6+376 p. illustr. 4°.

Sach, J. Die verkehrs-telegraphie der gegenwart. Wien, 1883. 12°.

Schoolbred, J. N. (See Dynamic Electricity.)

Schwarze, T. Telephon, mikrophon, und radiophon. Wien, 1883. 16°.

Societe internationale des electriciens, bulletin de la Tome 1. January. Paris, *Gauthier-Villars*, 1884. 64 p. 8°.

Swinton, A. A. C. The principles and practice of electric lighting. New York, *D. Van Nostrand*, 1884. 172 p. illustr. 12°.

Thompson, Silvanus P. Recent progress in dynamo-electric machines; a paper read before the applied chemistry and physics section of the Society of Arts. London, *W. Trounce* (*Pr.*), 1884. 30 p. illustr. 8°.

Wilke, A. Die elektrischen mess-und pracisions-instrumente. Wien., 1883. 16°.

Zoch, F. Elektrisches formelbuch. Wien., 1883. 16°.

CORRESPONDENCE.

NEW YORK AND VICINITY.

A Bad Winter for Wires.—The Metropolitan Telephone System.—Removals May 1.—The War on the "Bucket Shops."—Western Union Building Expenses.—The Extensive Growth of the Bankers' and Merchants' Telegraph Co.—The American Institute of Civil Engineers.—Electric Lighting in New York.

THE winter just past has been unusually severe upon overhead telegraph wires, although no single storm has wrought the extensive damage that has been caused by the sleet and snow of previous years. Of course the Metropolitan Telephone and Telegraph Co. was the most seriously affected by reason of its immense system of light wires. A single storm caused about 900 interruptions, while on other occasions the derangement of the service was such, that the Superintendent would be willing to see the wires placed almost anywhere, even underground, for the sake of safety, if the result was otherwise satisfactory. There are now over 4,000 subscribers in the Metropolitan system, which may interchange communications with 5,000 more in outlying cities and towns. The average number of connections per subscriber are 5 daily, although the steamship companies which are among those who use the telephone most frequently average 85 calls per day. The attainment of perfection in such an immense system is impossible, but the service is unsurpassed for efficiency. There are 32 different companies owning aerial lines in the city, rendering it very difficult to evade line troubles in stormy weather by reason of the vast number of wires.

The first of May being moving day, brings its tribulations to the telephone, district, and quotation telegraph companies, by reason of the many changes in the location of their subscribers. There have been fewer notices than usual, of changes in contemplation, and the preparatory work is well in hand. Among the removals of interest in electrical circles are the following:

The extensive factory of J. H. Bunnell & Co. will be removed from its present quarters, 112 Liberty Street, which it has outgrown, to the large building on Greenwich Street, near the Desbrosses Street Station of the 9th Avenue Elevated R.R. Three floors, each 125x60 feet, will be utilized. The present salesroom and office at 112 Liberty Street, will be retained by reason of its convenience to buyers.

The well-known firm of Pope, Edgecomb & Butler, solicitors of electrical patents, will remove from their original quarters, 32 Park Place, to the building of Brown Brothers, bankers, 59 Wall Street, second floor. This change is made for the convenience of a large number of their clients who are located in that vicinity. By the withdrawal of Mr. Butler, the firm will thereafter be known as Pope & Edgecomb.

Holmes, Booth & Haydens, manufacturers of electrical wire and brass goods, will remove from 49 Chambers Street to 25 Park Place, near the station of the Sixth Avenue Elevated R.R.

The Gold and Stock Telegraph Company, at the instigation of the Stock Exchange, is continuing its campaign against the "bucket shops," although some of the proprietors have obtained injunctions, which prevent their being deprived of quotations. To offset these the company, in its turn, obtains injunctions preventing the "bucket shops" from distributing the quotations. Meanwhile the Stock Exchange sub-committee is considering the question of making some new arrangement for the furnishing of quotations to its members, supposed to be in the interest of the Commercial Telegram Company. This company is slowly gaining ground, and is giving a very satisfactory service. It now operates two systems, one for stock quotations proper, and the other for financial news.

The new buildings of the Western Union Telegraph Company adjoining the Stock Exchange, and on 23d Street, with the pneumatic tubes up town, will cost about $1,000,000. A report was current about the first of April that bonds for that amount bearing 7 per cent. interest would be issued to cover the expense. This rumor was denied by President Green, and was perhaps premature, but since that time a plan has been decided upon for raising the required amount, which is too large to be provided for out of the ordinary revenue.

The Bankers' and Merchants' Telegraph Company has recently bought and taken possession of the lines of the Northern Mutual Company, about 200 miles in length, extending from Syracuse to Alexandria Bay. The system has now been extended within 8 months from 295 miles of poles and 1,995 miles of wire to 6,697 miles of poles and 46,347 miles of wire. Additional extensions are under contract which will give the company control of 10,000 miles of poles and 100,000 miles of wire.

The movement set on foot by Dr. Keith to establish an American Institute of Civil Engineers" has met with universal approval. The call for the initiatory meeting, April 15, was signed by over 70 of the most prominent electrical men in the city.

The bids for electric lighting in New York being in excess of the amount appropriated for that service, it is thought that it will be necessary to reduce the proposed number of lamps. At the same time application was made by Alderman Miller that Bleecker Street from Broadway to 8th Avenue, and 14th Street from 8th Avenue to the North River, and Gansevoort Market be lighted by electricity. This would be an addition and will probably not be authorized at present.

NEW YORK, April 18, 1884.

PHILADELPHIA.

The Electrical Exhibition.—Early Honors to an American Scientist.—Arrangements for the Reception of Foreign Visitors.—A Memorial Library.—Prof. Barker's Lecture.—The Postal Telegraph Co.—The Chicago Police System.—Another Telephone Suit.

THE lull inevitable in winter time in underground and electric light operations has not passed away, but a considerable "shaking up" is looked for in those lively industries during the next few weeks. All the underground companies are ready to go to work vigorously as soon as the weather and the law permit them to do so.

Meanwhile we find our chief attraction in the growing proportions of the Electrical Exhibition building in West Philadelphia. Its complete success has been assured for some months past, and the only subject of doubt now is as to what degree of fairy-like magnificence it will reach. Secretary Frelinghuysen's circular to the representatives of our Government abroad, calling the attention of foreign governments and citizens to the character, standing and profession of the Exhibition, has already borne fruit, and the applications from abroad have been so numerous that an "annex" has already been found necessary.

The interest awakened in the Exhibition is bearing fruit in the production of musty relics and interesting literary works long since forgotten. Among the latter is the London *Gentleman's Magazine* for the year 1753. Though but little over a century ago, America seemed to be very little known, if we may judge from the *Magazine's* American news. The June number contains an account of Louisiana—"a country in North America, bounded on the south by the gulph of Mexico; on the east by Carolina, an English colony, and part of Canada, and on the west by new Mexico. The north part of it is bounded by Canada. The rest extends itself to the unknown lands in the neighborhood of Hudson's Bay." Again, it tells us that "the river St. Louis is called by the natives Meaetchassippy, the literal signification of which is the Old Father of Waters. The source of the river is unknown." "The Missouri river is not yet fully discovered." Indians were reported killing "Pennsylvania traders," and French and Indians were committing depredations in New York State. Yet, even at that time American scientists were renowned throughout the civilized world, and a Philadelphian, at least by residence, and at all events an American, had taken the first step toward the electrical wonders of to-day. In the December number for that year (1753, as I said before), we read that at the meeting of the Royal Society in London "a gold medal was adjudged to Benjamin Franklin, Esq., of Philadelphia (not Maryland, as mentioned in our last magazine) for his useful discoveries in electricity. On this occasion the Earl of Macclesfield delivered a speech which greatly enhances the value of the prize and does honour to the judgment, candour and strict impartiality of the Society." And now, after a lapse of 131 years, the Franklin Institute of Philadelphia will reciprocate the "honour."

The local committee of the American Association for the Advancement of Science, is making elaborate preparations for the becoming reception of the British scientists, and it has also been decided to invite the Royal Society of Canada. The time for opening the meeting of the Association has been postponed one day—from the 3d to the 4th of September. Three grand receptions will be held—one at the Academy of Music on the 5th of September; one in the Academy of Fine Arts, and another at Haverford College—the dates of the last two receptions being as yet undetermined.

One of the lasting results of the Congress of Electricians and the Exhibition will be the "Memorial Library." Before the Exhibition opens, a collection will be made of works upon electricity in all languages, and this library will remain here. To this end requests have been sent to electricians in all parts of the world, as well as to libraries and publishers, requesting aid in this laudable purpose, which, if accomplished, will give Philadelphia the best collection of works upon electricity to be found in America.

The lecture on "How Electricity is Measured," by Prof. George F. Barker, delivered in this city on the 21st ult., was a most elaborate affair. The Professor held his audience spell-bound for nearly two hours and a half, and all his points were profusely illustrated by reflection on a screen and a great number of instruments.

The telegraph companies do not relax any of their efforts in the way of competition. Since my last letter the Postal Company has opened here with a main office at Third and Chestnut Streets, and several branch offices scattered throughout the city. They reduced the rates considerably and increased the basis of a message from 10 to 20 words, but do not seem to have had much effect on the older companies.

Contracts have been awarded for a Police Telephone and Signal Telegraph system, similar to that in use in Chicago, including ambulance wagons.

A committee of councils has reported favorably on a resolution to sue the Bankers' and Merchants' and the American Rapid Telegraph companies for the penalty ($20,000 each) due for amalgamating.

The American Bell Telephone Company and the Bell Telephone Company of Philadelphia, have commenced a suit for infringement of patent against the "Baxter Overland Telephone Company."

Mr. Jerome Carty, of this city, has sailed for Europe, where he will represent the Franklin Institute in connection with the interests of the forthcoming Exhibition. He will have offices in London and Paris.

Alfred Zahn, a German electrician who came here from New York recently, hanged himself in his work-room on the 2d inst. He was entirely unknown here and no reason can be imagined for the act. When the body was found there was $300 in cash in the pockets, and the galvanometers and other instruments and tools in the shop were worth over $1,000. He was formerly a partner in the firm of Bahr & Zahn, electrical instrument manufacturers, No. 108 Liberty Street, New York.

PHILADELPHIA, April, 15, 1884.

CHICAGO.

Defective Insulation of Electric Light Wires.—The Different Systems of Electric Lighting in Use.—The Alleged Remarkable Results Attained by Western Inventors.—Incandescent Systems.—New Insulating Materials.—An Inside Insulator Wanted.

THE subject of electric lighting in this city has been quite prominently brought before the public latterly through the action of the Council in December last, when an ordinance was passed regulating the methods of running wires, arranging plants, attachments, etc., within the city limits. This was deemed necessary from the utter want of system which has heretofore prevailed, favored as this was by the fact that in the early days of electric lighting the necessities of the case had not educated the public, nor even the light companies themselves, as to the dangers of improper installations. Experience was necessary to education, and the earlier plants were necessarily placed by inexperienced parties. It is not a matter for which any blame is attachable to anyone, but rather a misfortune which time has since shown. Taking the cue from the action of the insurance underwriters, and after consultation with them, the City Council passed an ordinance requiring a personal inspection of all plants, and a rigid adherence to certain rules governing the methods of insulation, of both wires and lamps, prescribing the size of conductors, their insulation from walls, ceilings, and ground. The results of these inspections show that the authorities were none too early in throwing these safeguards around a dangerous element of commercial and domestic use. During his visits the inspector reports finding wires insulated with paraffine coverings, sometimes only singly wound, sometimes with a braided envelope. Wires of less conductivity, by several sizes than that considered safe, smaller by several numbers than that used by any arc light company of the present day. Wires with no insulation whatever, nailed to wooden partitions, with iron staples, these latter reaching to and in contact with wire lathing, thus forming a partial ground connection. In several instances wires of as many as two or three sizes were found upon the same circuit. In addition to all this, instances were found where wires were not only naked, or but imperfectly insulated, so near together as almost to touch, and both within close proximity to iron columns, water and gas pipes, and the like. These are but samples of the faults found, yet I repeat these were all so placed, not through carelessness, but from want of experience and by uneducated employees, without the knowledge of their employers. It is far different with all later work. Education has resulted in correcting these evils, and recent plants are in much better shape. In many plants the changes which are being made, as prescribed by the ordinance, are trifling, but several plants have required to be rebuilt from end to end.

The systems represented here include the Brush, Excelsior, Weston, Thomson-Houston, and Fuller, and of home inventions we have the Vandepoele, Bain, Sperry, and the Western Electric. Among the lesser lights may be mentioned the Globe—I think—in which there is no magnet used for moving the carbons. The inventor claims that it is a lamp without resistance, and by means of clock work, at stated intervals, drops the upper carbon and immediately raises it a sufficient distance to separate the arc properly. A Chicago inventor's dynamo, running a small plant including his own lamps and a couple of a well-known variety, has, according to the patentee, a marked improvement in the method of winding the armature, which is of the ring form. The wires are placed upon it in disc-like sections, each section being built up so the whole resembles a lot of watch springs strung on a hoop, the inner and outer alternate ends being joined. Should this prove a great advance in the art of dynamo manufacture, I shall gladly embrace the occasion to give THE ELECTRICIAN an early and complete description of it.

Another sunburst in the shape of discovery broke over the electrical firmament a few days since at a test exhibition, the result of which may serve as a problem for riddle readers in electrical science. One of our Chicago inventors, by means of indicator cards, on that occasion, showed that he was enabled to run six arc lamps with less than half a horse-power. In the report of the engineer who took the diagrams, I find the following:

"The engine was of the automatic type, cylinder 10 inches diameter, 15 inches stroke, running at 148 revolutions per minute. First the engine was indicated while running the shafting only, and in doing this developed 14.45 H. P. This was considered a friction diagram. The dynamo was then started with 6 lights in circuit, and the engine again indicated, this time developing 14.88 H. P., showing forty-three one-hundredths of one H. P. consumed in driving the dynamo with its 6 lights. The dynamo was driven by a ¾ inch belt, and gave 6 lights of low candle power, though very steady. There was no provision made for measuring the candle-power of the lamps, and in my judgment they were of about 200 C. P. each, consequently employing a current of low tension as compared with other arc lights."

The gentleman who made the report from which the extract is taken was a disinterested party, and thoroughly reliable and competent, and the story told by the diagrams was read by other competent parties who confirmed his computations. Since this exhibit I have learned that several parties had previously accomplished quite similar results, notably the Brush people and a New York inventor, who ran 10 lights with one-half of one horse-power. The Brush representatives here, on one occasion ran 30 lights on a 16-light machine, and to use their own words, "the dynamo liked to have run away from us entirely." There is the conundrum as stated by good authority.

I have spoken thus far of the arc systems only. The incandescent systems are represented by the Edison, the United States, the Brush, and the Excelsior companies. The first of these has a number of large plants in various mercantile establishments, as well as in several residences. The portability of the incandescent species of light makes it peculiarly adaptable for theatrical purposes. Haverly's has the Weston arc lamps for outside, and 340 incandescent for inside lighting. These latter give throughout the auditorium a soft, mellow light, the great number conducing to a very grateful diffusion of the rays; while for stage purposes and scenic effects, traps are cut at short intervals about the stage and wings, and a bunch of half a dozen clustered lights may be attached at short notice. The same is true of rows of ground lights—a section of 10 or 15 may be placed, between acts, as readily as a piece of furniture, and lighted or extinguished instantly. The Standard Theatre has recently been lighted by the Excelsior company, which has placed the two systems, arc and incandescent, on the same circuit and dynamo. The Brush people are negotiating for a comparatively large plant of Swan lamps, to replace arc lights in the near future. In one of our principal hotels, the Palmer House, the United States Co. have a plant of Maxim lights, while nobody knows how many incandescent lamps have had the life burned out of them by experimenters in charge of arc light dynamos. The passion to invent something in electric lighting seems epidemic and wide spread; and the essays of some of these electricians who have come running across lots to the high road to electrical knowledge, are to say the least, amusing and peculiar. As an illustration of the class of scientists referred to an anecdote may be permitted. An engineer who has been running a dynamo and replacing carbons for a year or so, coolly remarked to an electrician the other day that he "knew all about electricity." "Then," said the gentleman, "get your life insured at once."

"Why?" he asked in astonishment.

"Because," was the reply, "it is the only way to preserve your life; and the world of science cannot afford to lose the only man on earth who knows all about electricity."

A new insulating material from some mysterious source, particularly applicable for covering wires, is announced as nearly ready for investigation and test. The parties who have made the mystical discovery are extremely reticent of their knowledge, but claim that experiments have proven that it possesses very valuable qualities. They assert that it can be applied to wire of any size or material with ease and rapidity, is perfectly impervious to moisture, and while it is indestructible by heat, it is flexible, and will not crack. I am promised full information in the near future, and while I have no conception of what the material is, or how it is treated, I know that the parties themselves honestly believe what they claim for their insulation. If they are right the electrical world will certainly be very greatly benefited by the discovery.

Other parties here are making extensive experimental tests of a comparatively new form of vegetable gum having some of the peculiarities of rubber, and some which belong to the gutta perchas. It is the product of one of the hundred or more varieties

of rubber producing trees called Tuno, and is brought from Honduras, where the natives have long used the milky sap of the trees for varnishing their canoes, and thus rendering them perfectly water proof. Like gutta percha, it warms readily, and is soluble in naptha, many of the oils, turpentine, alcohols, etc., and is readily vulcanized. Dissolved in alcohol, ether or naptha, it may be spread as a varnish, and bi-sulphide of carbon readily converts it into a soft vulcanite—but thus far I have seen no method of removing its sticky proclivities. Almost tasteless, it may be chewed with much satisfaction by those who are addicted to that habit, and it might be a source of large revenue for that purpose possibly, but for the fact that under that species of manipulation, to use the expression of one who has tried it, "there is no wear out to it." As a soft insulator, for tape and the like, I doubt if it has any superior, provided it is not in too close proximity to heat.

It appears to me that some neat form of insulator for inside work should displace the cumbrous "drawer knob," which seems to be the only known article for that purpose. The porcelain cleat, someone's invention for fastening large wires, is being ruled out by ordinances which require wires to be insulated from and not fastened on walls and ceilings, and this ungainly affair appears to be the only substitute to be had. Something rather more ornamental, with a neater method of fastening, so as to dispense with the binding wire, if possible, would certainly meet with a favorable reception.

CHICAGO, April 16, 1884.

BOSTON.

Telegraph Rights of Way on Railways.—No Immediate Action by the State in Underground Matters.—Lighting the Post Office.—The Boston Telegraph Co.—Long Distance Telephony.—The American Bell Telephone Co.—The New England Company's Stock.—New Quarters for the Bankers' and Merchants' Co.—The Anti-Bell Telephone Co.

SOME very interesting questions are involved in the proposition now before the Legislative Committee on Railroads, to permit telegraph companies under proper restrictions to enter upon the locations of railroads, and to construct and maintain telegraph structures thereon. There are many reasons why telegraph companies prefer to construct their lines upon railroad routes. Such lines are more direct than those by highway, and cost less to construct and repair. But on a large number of railroads special contracts have been made with certain telegraph companies, by which the railroads assume to guarantee exclusive rights to the telegraph companies. The following section of a contract between the Atchison, Topeka & Santa Fe Railroad and the Western Union Telegraph Company, may be taken as a specimen of these obligations :

"The said railroad company further agrees, so far as it has the legal power and right so to do, to give to the said telegraph company the exclusive right of way on and along the lines of the roads of the said railroad company, for the construction and use of telegraph lines for commercial and public uses and business, and that said railroad company will not, except as hereinafter provided, allow any other company or individual to build or operate a line of telegraph on or along its roads, nor transport men or materials for such company or individuals at less than the usual tariff rates; nor, except so far as it may be legally bound, stop its trains or distribute material for such parties or their employees at other than regular stations."

It is now held, in behalf of those who support the proposed order before the committee, that such exclusive contracts are contrary to the common law and to the Constitution; that a railroad is a public highway, for the public use, and empowered to use its right of way for railroad purposes only; that it cannot grant other uses to telegraph companies, and that this is a matter left for the sovereign power of the State to act upon. The Baltimore & Ohio Telegraph Company asks for the privilege sought to be conferred in the proposed order, although the other rival lines to the Western Union are on hand with their counsel. George S. Hale appears for the Western Union; Parker C. Chandler and Benj. Kimball for the Baltimore & Ohio, and M. F. Dickinson, Jr. for the Postal Telegraph and Cable Co. The various railroad corporations of the State are represented before the committee by their counsel. Very interesting testimony has been given by Mr. Bates, of the B. & O., which is in substance that which he gave before the Congressional Committee on Post Offices and Post Roads, setting forth the condition of his company, its extent and connections between the principal cities of the country, its rates, especially night and press rates, as being much lower than the Western Union, and his opinions and remarks on the subject at issue. He held the opinion that two pole lines could be built along each side of a railroad track, without any detriment, and considered it necessary to have more than one telegraph company to do business between any two cities.

J. E. Helvin, Supt. of Construction of the B. & O., declared that with a right of way of 80 feet for a railroad, three lines of telegraph on each side could be built, when the track is single, and two when it is double. When the railroad carried the materials, the cost of construction was $150 a mile cheaper than along the highway, while the liability to damage was very much less.

W. H. Fairbanks, representing the Mackay Postal Telegraph and Cable lines, stated that his company proposed to build lines from New York to Boston, coming through the principal cities, and that in his opinion two or three lines could be put on any of the New England railroads without danger.

The different railroads, through their counsel, have refused to produce their contracts with the W. U. for the inspection of the counsel of the opposition. Mr. Hale made the same expression.

The hearings have been continued from day to day. Some of the railroad people think it would be best to keep away all telegraph poles and wires except those used by the railroad.

The Legislative Committee on Mercantile Affairs has been considering the subject of placing telegraph, telephone and other electric wires underground. Mr. Hugh O'Brien, manager of the Brush Electric Light Company, appeared before it and opposed any hasty legislation in the matter, saying that in a year or two some practical action will be possible in the matter. This committee has reported it inexpedient to legislate on an order relating to the erection and use of wires used to convey electricity for light, power, or other purposes; also, on an order relative to the placing of telegraph, telephone, and electric light wires by individuals or corporations upon dwelling houses and other public buildings without the consent of the owner.

The Edison company has about completed the plant in the Post Office building in this city. This apparatus will illuminate the old part of the building, that is, the part first constructed. It was built in halves, as government buildings are sometimes. The present gas lighting system has nothing to commend itself except the illumination; the heat from the jets, and the vitiated atmosphere make life a burden to the employees.

The Boston Telegraph Company is the name of a new organization for which a certificate of incorporation was filed in the County Clerk's office at New York, April 1st. The lines of the company are to run from Boston, through Massachusetts to Hartford and Stamford, Conn., thence to New York City. The capital stock is $150,000, with the right to increase it to $350,000. The incorporators are Chauncey Belknap, Harvey L. Lupkin, and T. Kensett Wheeler.

An important telephonic item is the successful talking between Boston and New York. It is not yet a commercial line, and, if we take into account the difficulties of securing a through circuit, we must say it has been an *experimental wire*, under great difficulties. From the last heavy sleet storm onward, there has been a succession of breaks, crosses, and other difficulties to encounter, but a clear line has been obtained at long enough intervals to demonstrate the entire feasibility of talking between the two cities by means of the ordinary commercial instruments. The success is undoubtedly due to the hard rolled copper wire used as the conductor. The voice is repeated at either end in clear round tones, a *metallic* circuit being used.

The annual report of the American Bell Telephone Co. was received with much satisfaction by the stockholders and public. The business during the past year has been very large, and appears to have crystallized in a firm compact manner. By reason of renewal of contracts the main company has secured large interests in the sub-companies, and a consequent paternal care in them all, which tends to inspire a common feeling and zeal among the sub-companies.

The stock still remains at a low figure—low compared to the prices previously quoted, but the general impression is that the price has always been too high. There was so much milk in the cocoanut at first that the public seemed to think, or at least acted under the impression, that the boom would continue forever. If the principal law suits were out of the way—those which cloud the title to the invention—no doubt the stock would stand higher. There is a rumor that there will be a special dividend in July in addition to the regular 3 per cent. quarterly.

The stock of the New England Telephone Co. continues to drop. Sales at $26½ for a $100 stock are depressing for those who paid $100 and over. The apprehension of no dividends for a year explains the matter.

The Bankers' and Merchants' Telegraph Co. is fitting up elegant new quarters on the corner of Milk and Devonshire Streets, opposite the Post Office. The rooms are well located, light and airy.

"The Anti-Bell Telephone Co." is the somewhat sensational name of a corporation urging people to try the merits of an accoustic or mechanical telephone for private lines recently started in this city. There seems to be quite an interest in this sort of apparatus. A variety called the "whispering diaphragm" telephone was tried here, and reported to work successfully within a limit of five miles.

A new system of telegraphy is about to be exhibited here, which is a combination of the automatic-chemical, and Morse systems. Its peculiarity consists in the transmission of signals through any of six styluses, arranged side by side, so that the record from each appears in a different position on the tape by which its meaning is determined, and the communication read in a manner similar to that of musical notation. It is the invention of A. L. Parcelle assisted by Mr. Storm. But one line wire is required, and it is claimed that the system is easily learned, and that there is no possibility of stealing messages by tapping the wire.

BOSTON, April 18, 1884.

WASHINGTON.

Experiments in Tower Lighting.—Electric Lights on the Capitol, and Monument Too High.—Electrical Voting Machines.—No Action Probable on Government Telegraph Bills.

THE principal feature in the electric line since my last, has been the experiments made by the Brush-Swan Company in the matter of high tower lighting. As previously mentioned, it was proposed to take advantage of the unusual elevation offered by the Washington Monument and the dome of the Capitol, to test not only for the benefit of the local company, but to solve the problem, whether the arc light could be placed too high to give the best results. To make a comparison, a less number of lights were placed at an ordinary elevation, on the Smithsonian Institution, and the three groups have been lighted simultaneously from about half-past seven till considerably after midnight, each night during the month until last Saturday night. The necessity for the removal of the lights from the monument to permit the renewal of work upon it, has resulted in the discontinuance of the experiments in this direction. In fact there was no longer a necessity for them, as it had been clearly shown that there was a limit above which it was not desirable to go to obtain the best results, and that either the dome of the Capitol or the Monument were far above that limit. The high lights were distinguishable and brilliant at great distances from the city, and if their purpose had been for signals, they would have proved a great success, but for practical illumination, the lesser number of lights on the Smithsonian Institution gave decidedly the best results. The lights there have been declared, by men not interested in the enterprise, as equal or superior to those in Madison Square in New York, or to those in any other city.

400 gas lamps in the grounds surrounding the Capitol were extinguished, while the electric lights were lit, and the engineer in charge of the grounds, says, another hundred in the adjoining streets and avenues could have been dispensed with without any difficulty. During the past week a single lamp with a reflector behind it, to throw its rays directly through Pennsylvania Avenue, was placed on the roof of the building, and the result was in the highest degree satisfactory; vehicles and pedestrians were easily discernable, and even the railroad track could be seen the entire distance between the Capitol and the Treasury Department, a distance of a mile and a quarter. In a few days the lamps on the dome will be supplied with reflectors, and their light thrown directly through the ten streets or avenues that diverge from that centre. There are a number of small reservations called "circles" where eight or ten streets meet, and it appears as if these would serve for convenient points for an economical lighting of a large portion of the city, using the ordinary light for such positions as cannot be lighted in this way. President Hayes of the Brush-Swan Co., is pushing matters, and the people here, seemingly satisfied that the company mean business, are making more inquiry as to the new mode of lighting. A clause has been inserted in the District Appropriation Bill, authorizing the Commissioners to contract for other illumination than gas for the streets, provided it can be done at a cost not exceeding the current charge for gas.

Robert J. Sheehy, one of the first to enter the telegraph service, way back in the forties, is in charge of the mechanical and electrical works of the Brush-Swan Co., and has shown himself in every way qualified for the duties.

The United States Company continue to furnish a large number of private lights, and keep some 8 or 10 burning at the approaches to the capital. They are soon, I hear, to declare a dividend from their net earnings.

Two gentlemen, Mr. Crosby and Mr. Enos, have been at work to endeavor to induce one, or both, houses of Congress to adopt their respective systems of voting by the use of electricity, the object being to save time by a simultaneous record of the votes of all the members. The proposition is by no means new, whatever may be said of their peculiar devices. Practically, as every electrician will readily see, there can be no serious obstacle; but, politically, I fear they will find the difficulties insurmountable. How could Mr. B. vote without knowing how his leader, Mr. A., voted? How could a member vote who wanted to see a measure defeated or carried without his vote, unless that vote was absolutely necessary to secure that result. There are many other reasons, if not good, at least reasons why this mode of voting would not prove acceptable. One of the gentlemen, on being told that the problem was quite as often how *not* to do it, has spent some time in remodeling his machine so that it can be adapted to filibustering, and thereby obviate a formidable objection.

But little progress has been made with regard to the Postal Telegraph, and I see no reason to change my belief expressed at the beginning of the Congress, "that no bill would be passed this session." The Tariff bill has now got the "right of way" in the House. The Appropriation bills are farther behind than ever before, with prospects of more bitter controversy between the two houses on nearly every one of them, one house being economical to meanness, and the other liberal to extravagance. The calendars are loaded with bills already reported. With full four months work that *must* be done, and four times that amount that *ought* to be done. Congress will not be in a humor to spend much time on innovations, were there no adverse interest strongly opposing any step in that direction.

Washington, D. C., April 15, 1884.

PROVIDENCE.

Situation of the Multiplex Telegraph Co.—Harmony between the Baltimore & Ohio and Postal Telegraph Co's.—Sale of the Providence & Pascoag Line.—Successful Lighting by the Thomson-Houston System.—Decline in Telephone Stock.—Probable Revival of the "Ticker" Business.

THE effect of the remonstrance of Supt. Duxbury, of the Providence Telephone Company, against the Standard Multiplex Company being given a route through the city on which the wires would run parallel to those of the Telephone Company, resulted in a change of the Multiplex petition for a route where there would be no danger of induction. The Multiplex people seem to be unfortunate of late. They are not a bit nearer to getting a right of way through the city than they were two months ago. Their poles are set to the eastern boundary of Providence, and one number 6 iron wire strung for about 30 miles from Boston. I hear that the company will hereafter use No. 14 cold drawn copper wire.

In his statement before the Committee on Railroads of the Massachusetts legislature, M. F. Dickinson, Jr., the counsel for the Postal Company, solemnly denies that there will be any consolidation or sale of his company. In this connection I am led to observe that line material for the Postal Telegraph Company and for the Baltimore & Ohio Telegraph Company comes to this port billed to J. H. Helvin, Supt. of Construction for the Baltimore & Ohio, with charming unanimity, which is convincing proof that the Postal Company will never consolidate. The Baltimore & Ohio Company has recently bought the Providence & Pascoag Telegraph Company, a small one-wire line, extending from Providence 22 miles in a north-westerly direction. As a telegraph line, the property has no value. It is about 10 years old, and the competition of the telephone has greatly decreased its receipts. It was purchased on account of its possession of a right of way into Providence. There has never been any difficulty in securing rights of way in Rhode Island towns, so it cannot be said that the suburban franchise amounts to much. Furthermore, the right of way into the city possessed by the Pascoag line ends at the very point where no less than three or four lines run between there and the centre of the city. The Pascoag Company now comes in from its present terminus on Western Union poles, and has also another line running to the office of the American Rapid Telegraph Company. The B. & O. Company I hear will build from Putnam, Conn., over to Pascoag at once, and is also laying out a route to Fall River and Newport via Taunton.

The Bankers' and Merchants' Company has a line nearly or quite completed to Fall River, and is still working on its new line from Boston to New York. It has many leased wires between the two cities named above with loops at this place. The company has an attractive and well located office, and appears to be doing its share of business.

In my last letter I spoke of the contract which the Narragansett Electric Lighting Company, using the Thomson-Houston system, had obtained for furnishing 75 lamps at 55 cents a night. The new company made the initial showing on the night of the 10th inst., which was a great success. The newspapers mentioned the entire absence of the intermittent flashes to which we had become accustomed under the old system, and although it was the first night, everything worked smoothly. I am not sure that the Rhode Island Company, which is well handled and backed by large capital, will not yet make it uncomfortable for its new rival. The fact that the new concern obtained the city contract held by the Rhode Island people, is in no way a victory except in a matter of dollars and cents. The city Lamp Committee naturally accepted the terms of the lowest bidder, which in this case chanced to be the new company, and the result is heralded throughout the papers interested, as a grand triumph for the Thomson-Houston system. Another year may tell a different story.

The stock of the Providence Telephone Company, which formerly stood at $200 a share, par value $50, was for a long time a scarce article. Now at least a half-dozen brokers are advertising it in their lists, and it is dull at $175. Yet it is paying 20 per cent.

The "ticker" business bids fair to be revived. Although the Western Union Company was forced to abandon it on account of poor patronage, the Financial Telegram Company proposes to start the business in Providence if it can get subscribers, and has placed one of the instruments in the rooms of a very reputable banking firm, which has the stock for sale.

PROVIDENCE, R. I., April 17, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents. Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York City.*

EXPERIMENTS WITH PLATINUM FILAMENTS.

[8]—In the "abstracts and extracts" of your valuable paper of April last, I was reminded of some of my early experiments in incandescent lamps, through reading of 'Herr Goetz's" experiments on the "Cruto" lamp. Who Herr Goetz and Cruto are I know not, never having heard of them before, but the subject of depositing carbon and platinum wire was pretty well ventilated by me in the early boom of incandescent lighting, and as you have shown some interest in that direction perhaps my experience and observations of that time may be important.

My first experimental lamp in that precise direction I yet have. The object I had in view was to form a case for or to surround the platinum wire for the purpose of holding the metal when in a fused state. The plan for doing this was as follows: I introduced the fine platinum wire into an apparatus similar to that as described in the U. S. patent of mine of April 11, 1882, No 256,213, in which way I surrounded it with a carbonaceous atmosphere, and with sufficient current heated the wire to a white heat, and in this manner very soon had the wire fully incased in a carbon shell. It was then introduced into the glass globe, the pump applied and lamp finished.

I made several of them by this method. I found their resistance, when compared with carbon filament lamps to be very low. The light-giving body soon gave out in those I first burned, in consequence of not having a rheostat with which to regulate the supply of current. I managed, however, through the use of carbon dust, to improvise a pretty fair regulator for the supply of current, and in this way kept them alive; but at no time was I enabled to raise their incandescence equal to my carbon filament lamps. My workmen, friends and myself were very much interested upon examining the broken filaments of the destroyed lamps, some parts of the same filament would be tubular and other parts solid. We took fine hairs and strung the tubular parts as you would beads, and in place of finding platinum in the centre of the solid pieces we found a very black core surrounded by a light lead colored casing; we found all parts of the filament to be hard and brittle.

My impression at that time was that the unequal expansion between the platinum wire and carbon caused the former to strain its confines, and in this way became dissipated. Having a curiosity to look further into the subject, I took some platinum wire and packed it in the centre of carbon dust, all of which I fixed in a crucible, this I put in a hot coal furnace for some thirty minutes, after which, upon examination, I found the platinum wire to be dirty, hard and brittle like glass, and porous, and my impression is, had I left it in long enough it would have been entirely dissipated. J. H. GUEST.

Brooklyn, N. Y., April 1884.

THE RELATIONS OF ELECTRICAL AND MECHANICAL ENERGY.

[9]—It seems to me that Mr. Curtis does not quite apprehend the difficulty found by electrical students, in understanding "that doubling the current strength (in a given circuit) will much more than double the heat developed in a given time." He writes: "The only reason that a student should not understand why twice the current strength should develop four times as much heat or energy in a given time, is because he makes the mistake of thinking that energy and current strength are the same thing." Is that conclusion justified? As Mr. Curtis has pointed out, the energy (work or heat) developed in a circuit in one second, is found by multiplying the current by the electromotive force. Put into mathematical language, calling the heat developed in one second H

$$H = K C E$$

where K is a constant depending for its value upon the units employed. Is it to be wondered at then, that the student who encounters this fact for the first time should imagine that the heat developed is proportional to the current? Does not the formula indicate it? To the uninitiated it certainly does; nevertheless it is fallacious. The fallacy lies in considering the two magnitudes separately; in forgetting that in order to double the current in a given circuit we must double the electromotive force. With double current and double electromotive force we obtain four times the energy as the formula shows. But if students do make mistakes, are not such teachers as Mr. Curtis in a large measure responsible for it? To answer my own question I quote from the recent articles in your journal of which Mr. Curtis is the joint author:—

"For electricity is nothing more than one form of energy, and the sooner we recognize this fact, and consider it in analogy to other forms of force . . . "

"This distinction between force and energy . . . lies at the root of all dynamic investigations."

"For convenience we generally refer all other forms of force to foot-pounds of mechanical energy, so that we can speak of a certain amount of electrical energy as so many foot-pounds of electricity. . . . "

"For example, we might suppose, since electricity is a form of energy, that quantity of electricity would mean quantity of energy in the form of electricity—so many foot-pounds or kilogrammetres. But no, quantity of electricity (*i. e.* coulombs) . . . is not a quantity of energy."

Thus we see that electricity is energy and it is not energy; energy is force and it is not force: we can measure electricity in foot-pounds and we cannot measure it in foot-pounds.

Mr. Curtis goes into a long explanation to show that a current, or as he expresses it, current-strength, is nothing more than force—that it is a static effect of electricity. He apparently loses sight of the fact that the deflection of a galvanometer needle is an effect due to the mutual action of the current and the magnet. He tells the student that the electromotive force of a dynamo-electric machine "corresponds to the speed of rotation of its armature; therefore, when we multiply strength of current by electromotive force, it really amounts to multiplying static effect by velocity." In his discussion of Ohm's law (he does not think very highly of Dr. Ohm, by the way) he shows that he has not a true appreciation of electrical resistance; that he looks upon it as a mechanical force opposing the current. Surely the poor student deserves some commiseration. I have no doubt that Messrs. Crocker and Curtis have a fairly well defined idea of the subject they have been treating; and I fully appreciate the difficulty of presenting it to the popular mind. Scientific teaching, however, should be accurate or it is not scientific. I regard such articles as those of Messrs. Crocker and Curtis as absolutely pernicious, because they give students false ideas which can only be eradicated by much future study. The authors, in my opinion, would do well to study the "dimensions" of electrical units which they now, apparently, regard with more or less contempt. J.

Newport, R. I., April 4, 1884.

THE ELECTRIC TRANSMISSION OF WATER POWER AN AMERICAN INVENTION.

[10]—In the Autumn of 1881 Sir William Thomson delivered before the British Association, an address on the sources of energy in nature available to man for the production of mechanical effect, in which he said: "Hitherto the use of water power has been confined chiefly to isolated factories which can be conveniently placed and economically worked, in the neighborhood of natural waterfalls. But the splendid suggestion made about three years ago, by Mr. Siemens, in his presidential address to the Institution of Mechanical Engineers, that the power of Niagara might be utilized by transmitting it electrically to great distances, has given quite a fresh departure for design in respect to economy of rain power."

In February 1869, I forwarded from Oakland, in California, an application for letters-patent for a new mode of transmitting water power, to which I received, from Washington, the following reply, dated May 21, 1869:

"The alleged invention may be briefly stated to be actuating a magneto-electric machine by water power, and conveying the currents of electricity generated thereby to electro-motors situated at a distance from the source of power, for the purpose of operating them. This does not differ in principle and mode of operation from the familiar applications of electricity in which power is utilized at a distance from the place where it is developed and of which the magneto-electric telegraph of Wheatstone may be cited as an example. In this apparatus, the currents generated by means of a magneto-electric machine at the transmitting station, are made to actuate mechanism at the receiving station, and it is obvious that water power may be used for driving the magneto-electric machine. The alleged invention cannot be considered of a patentable character, being merely the application of a well-known principle."

The Examiner who wrote the above apparently did not remember that patents are not granted for principles, but for new and useful applications of principles which are generally well known.

In a letter to Mr. S. S. Fisher, then Commissioner of Patents, dated June 9, 1869, I said: "If I devise the means of utilizing a power which exists in some remote mountain gorge, and for the utilization of which no means have ever been devised or employed, it would seem self-evident that I have made a new and useful invention. If I transfer the water power of Yosemite Valley to San Francisco, or that of the Niagara River to New York, I do something for our industry, the novelty and importance of which will not be denied; and can it be that there is no protection for me within the scope of our patent laws?" I then tried to show that a telegraphic receiving apparatus can not be held to be an electro-motor merely because it produces certain motions; that it is not intended to, and can not, supply machinery with motive power, etc., and said in conclusion: "It will then be admitted that the result accomplished by what I claim as my invention differs essentially from that produced by any telegraphic apparatus. Hence the modes and means by which these different results are brought about must differ proportionately. And as it is for the new modes and means by which certain ends are attained that patents are granted, I trust it will be conceded that I am entitled to a patent."

But no patent was allowed. Perhaps I should have claimed a mechanical combination instead of a process.

Having, after an absence of nearly ten years in Europe, got the papers relating to this matter again into my hands, my present purpose is simply to show that the idea of electrically transmitting water power, even that of Niagara, to distant places, is not of British, but of American origin. AUG. PARTZ.

Philadelphia, April 19, 1884.

ELECTRICAL NEWS AND NOTES.

PLANS OF THE BANKERS' AND MERCHANTS' TELEGRAPH COMPANY.

President A. W. Dimock, of the Bankers' and Merchants' Telegraph Company, has presented to the Senate Committee on Post Office and Post Roads a statement of the position of his company, in which he says emphatically that it is an anti-monopoly enterprise, and will positively continue as such, for many of its valuable rights and contracts are conditioned upon its remaining independent of the Western Union or other competing companies. It can stand a war of rates, he avers, because its plant has been paid for in cash, and it has no water in its stock. Moreover, he asserts, it has secured a large and profitable business. The company has 5,000 miles of poles, 34,000 miles of wire, and is putting up 30,000 more miles of wire. Its system when completed will extend from the Atlantic to the Missouri River, and from the lakes to the Gulf. It is now operating 400 offices, and its operators were the only men who did not strike last summer. The company controls a telephone company, and has an interest in a stock indicator. It has made arrangements for ocean cable connections. President Dimock offered to do the Government business more efficiently and economically than it can be done by the Government.

ACTIVITY IN ELECTRICAL ENTERPRISES.

An examination of the records in the Secretary of State's office, at Albany, shows that within the last three years the number of companies incorporated under the telegraph companies' act is 135 distinct organizations, with a capital aggregating $225,000,000. This includes numerous telephone companies, some of a local character, and also schemes for the promotion of every phase of electrical contrivances for the transmission of intelligence. In no other single line of activity do the records of the Secretary of State show anything like the competition illustrated by these figures. This condition of things will be of interest in view of the discussion at Washington as to whether the Government shall go into the telegraph business.

CANADIAN TELEGRAPH LINES.

The annual report of the Minister of Public Works submitted to Parliament contains statistics showing that so far as Government management of telegraphs is concerned a very unfortunate result has been reached in Canada. The lines built have cost nearly $800,000. The expenditure last year was $55,000, while the receipts were only $27,000, showing a loss of over 50 per cent. It is true that many of these lines are in remote quarters, but even a perfect system, such as that taken over from the Western Union Company in British Columbia, shows a similar result. These lines cost $94,000; the expenditure last year was $35,000, while the revenue was only $24,000, showing a loss of $11,000. The appendix contains figures from the lines owned by the Great North-western Telegraph Company, of which Erastus Wiman, of New York, is President. The number of telegraph offices in connection with this and other private lines in Canada is 2,259, or one office to every 1,914 inhabitants, while in the United States there is only one office to every 3,700 persons. Even in Switzerland, with its dense population, there is only one office to every 2,500 persons. The number of messages sent from each office in Canada was 1,441. The report contains a letter from H. P. Dwight, the General Manager, which states that in mileage of lines and number of offices in proportion to population, Canada exceeds England by nearly four to one, and that Canadian tolls are probably the cheapest in the world, taking all things fairly into account, and will still compare favorably with the reduced rate of 6d. shortly to take effect in England. The Great North-western Telegraph Company sends 10 words 1,200 miles for 25 cents, and between all towns within 12 miles distance for 15 cents.

THE NEW YORK ELECTRICAL SOCIETY.

At the regular meeting of the New York Electrical Society, held at the Cooper Union, April 2d, Dr. N. S. Keith was elected third Vice-President, in place of E. A. Leslie, resigned. Chas. S. H. Small was elected Financial Secretary.

The subject of discussion for the evening—Electric Motors, was introduced by President Vander Weyde, who classified them: first, electro magnets attracting soft iron armatures: second, steel magnets attracting electro magnets; third, electro magnets attracting electro magnets.

Major L. M. Sabin then exhibited and described a new motor of his invention, which belongs to the first class. It was unfavorably criticised by Dr. Keith, who also made some general remarks upon the efficiency of motors. Those of the first and second, had been abandoned for the third class, resembling the Siemens and Gramme dynamos, which had proved much more efficient.

The committee on location, reported that permanent rooms had been secured for the society at the Cooper Union.

The committee on the Jones award has decided to leave the choice of subject at the discretion of the writer, who desires to compete for the prize. Papers intended for competition should be sent to the President, Room 36, Cooper Union, before the second meeting in May.

THE THOMSON-HOUSTON SYSTEM.

This system of electric lighting appears to meet with great favor wherever introduced. The successful introduction of plants in distant countries without expert assistance, appears to indicate that simplicity is one of its principal merits, while the quality of the light is very highly spoken of. The improved dynamo runs 63 2,000 c. p. lamps. It has a single 3 segment commutator and but 3 coils of wire in the armature.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The signers of the call for the organization of a national electrical society held a meeting at the rooms of the American Society of Civil Engineers, in New York City, Tuesday evening, April 15, 1884.

N. S. Keith called the meeting to order and nominated Jos P. Davis, Vice-President of the Metropolitan Tel. and Tel. Co., as Chairman. Mr. Keith was elected temporary Secretary.

T. H. Delano offered a series of resolutions as to name, objects, memberships, dues, management, committees, etc. On motion of Wm. A. Hovey, after some debate, the resolutions and the whole scheme of organization were referred to a committee of five, to be appointed by the chair, with instructions to call a meeting to hear and act upon its report. The chair afterward appointed the committee, consisting of the following named gentlemen:

W. A. Hovey, Pres. Merchants' Elec. Light Co., Boston.
N. S. Keith, Electrical Engineer.
George A. Hamilton, Electrician W. U. Telegraph Co.
Wm. H. Eckert, Gen. Supt. Met. Tel. and Tel. Co.
Geo. L. Beetle, Western Electric Co.

After a vote of thanks to the American Society of Civil Engineers, and to John Bogart, the Secretary of that society, for the use of its rooms, the meeting adjourned, subject to the call of the committee.

Applications for membership are to be addressed to N. S. Keith, Secretary, 237 Broadway, New York City.

PERSONAL MENTION.

Wm. A. Hovey, formerly of the Boston *Transcript*, and more recently President of the Merchants' Light and Power Co., at Boston, has accepted a position on the editorial staff of the *Electrical Review* in New York City.

ELECTIONS AND APPOINTMENTS.

The American Electric Light Company, of Hartford, has elected the following directors and officers: A. C Dunham, T. O. Enders, Leverett Brainard, Burdett Loomis, Henry Stanley, George S. Gillman, Charles H. Owen, H. M. French, Edward H. Goff. Officers: A. C. Dunham, President; H. M. French, Vice-President; H. M. Clark, Secretary and Treasurer; F. A. French, Superintendent.

C. J. Sheehan has resigned the managership of the Western Union office, at Providence, R. I., and accepted an appointment as assistant superintendent of the Baltimore and Ohio Telegraph Co., with headquarters at Boston. He has been succeeded by the appointment of P. J. Hurlburt, as manager, who has been employed in the Providence office since 1865.

THE TELEGRAPH.

Domestic.

The Boston bankers who lease over 20 private wires to New York, from the Western Union Company, are becoming dissatisfied with the service, and are engaging wires from the opposition companies.

The Baltimore and Ohio Telegraph Company now owns over 25,000 miles of wire, which will be increased to 40,000 during the year.

The Gold and Stock Telegraph Company will move on the 1st of May, to the new Western Union building, on Broad Street, adjoining the New York Stock Exchange.

An interesting test was made in Washington recently by electricians and an official of the coast survey to determine the speed of dots over a telegraph wire. A very intricate testing instrument was used, and it was finally estimated that an electric dot travels at the rate of 10,000 miles per second, or 9,600,000 miles per minute. This is not as great as the speed of light, which travels at the rate of nearly 12,000,000 miles per minute.

Foreign.

An optical telegraph has been successfully established between the Islands of Mauritius and Reunion, a distance of about 140 miles; observers can read the signals without difficulty, and arrangements for announcing cyclones are nearly completed.

THE TELEPHONE.

Domestic.

James R. Truax, Walter A. Willard, and Frank Moss are the corporators of the McDonough Telephone and Telegraph Company, incorporated in New York in April. The lines of the company are intended to be run all over the United States. Its capital stock is $1,000,000, divided into 10,000 shares, which are equally divided among the corporators.

The corporators of the Manhattan Overland Telephone and Telegraph Company, incorporated in New York in April, are Robert D. Buchanan, Allen T. Nye, William D. Leonard, Charles Henry Sibbald, Harvey N. Loomis, Hutchinson Ingham, and William T. P. Hollingsworth. The business of the company is mainly to be done in the Counties of New York, Kings, and Westchester. Its capital stock is $2,000,000, divided into 200,000 shares.

An experimental time system has been introduced on the telephone exchange circuits at New Haven, Conn. Its extra cost will amount to about $1,000 per year, and it will be retained if the subscribers are willing to pay for it.

ELECTRIC LIGHT AND POWER.

307 Edison electric lighting plants have been sold in the United States and Canada since May 31st, 1883, aggregating 59,173 lamps.

The following theatres are now lighted by incandescent lamps: The Municipal, Brunn, Austria; the Royal theatres at Munchen and Stuttgart, Germany; the National, Prague; the Manzoni and La Scala, Milan, Italy; the Bijou, Boston; Harry Hill's, New York.

Under the new contracts for lighting New York City, the United States Company will illuminate the following additional territory: East Broadway to Grand Street, Gansevoort Market Square 8th Avenue, from Bleecker Street to 14th Street, Bleecker Street, from the Bowery to 8th Avenue. The Brush Company will light 14th Street from East River to Hudson Street; 23d and 42d Streets, from the East River to 8th Avenue; 59th Street, from 3d to 9th Avenues; 7th Avenue, from 14th Street to 59th Street; 5th Avenue, from 34th Street to 59th Street, and Broadway, from 34th Street to 59th Street. This is also in addition to the old contract.

The electric light is now used in four churches in Montreal.

The sum of $25,000 has been appropriated by Congress for electric lighting at the capitol.

The New York & Brooklyn Electric Light Company have the contract for lighting the new Mutual Life Building in New York on the incandescent system. Their plant will consist of eight dynamos.

The Eastern Imperial Electric Light Company's certificate of incorporation has been filed. It has a capital stock of $500,000, divided into 5,000 shares of $100 each. The incorporators, who are also the trustees for the first year, are Eleazer B. Loring, Wm. F. Pepper and George C. Wilde.

The Louisiana Electric Light and Power Company has been incorporated in New Orleans with a capital of $300,000, by Burris D. Wood, M. J. Hart, Moses Schwartz, Charles S. Rice, George A. Chiapella, John Fitzpatrick, A. Jardet, Simon E. Marx and James D. Edwards.

The Edison Electric Company at Brockton is trying the experiment of out-door lighting, by placing clusters of three 32-candle power lights on a couple of street corners. The lights are suspended on wires about 30 feet from the ground. It is thus intended to demonstrate that street lighting by this system is possible.

The Thomson-Houston Electric Co., Boston, has received the contract for furnishing 100 street lights to the city of Syracuse, after a lively competition with a rival company.

Electric lighting on the Pacific Coast is taking a new start. At Sacramento, two or three different companies have been exhibiting their lights. The Thomson-Houston Electric Co. has forwarded to that place, from Lynn, Mass., apparatus for a permanent plant of 125 arc lights, and expects soon to largely increase it.

The Arnoux-Hochhausen Electric Co. has recently made a very successful exhibition of its electric lighting system at Lincoln, Nebraska, where the Lincoln Electric Light Co. is now preparing to illuminate the city.

The United States Electric Lighting Company has recently erected a very fine plant for lighting the extensive retail dry-goods establishment of Mabley & Co., at Detroit, Michigan. It comprises 42 Weston arc lamps and 300 Maxim incandescent lamps. The dynamos are driven by Westinghouse engines in the basement of the building.

Messrs. D. Crawford & Co., of St. Louis, have lighted their dry-goods store with an isolated plant of 50 Weston arc lights.

The municipal authorities of Charleston, S. C., have given a contract to the United States Illuminating Co. of that place for supplying 100 arc lights for lighting about 20 miles of streets in the residence part of the city. The Weston system will be used.

The contract for lighting the U. S. Custom House and Post-Office building at St. Louis, has been awarded to the United States Electric Lighting Company. The plant will consist of 30 arc lights of the Weston system and 750 Maxim incandescent lights.

THE RAILWAY SERVICE.

The Boston & Providence Company has made a contract with the Union Switch & Signal Company to put up block signals on its road from the Boston & Albany crossing in Boston to the junction with the Dedham Branch at Forest Hill, a distance of about five miles. In connection with the block signals the interlocking signals and switches of the Union Company will be introduced on this section of the road, and the various highway crossings will be carefully protected. The system is to be gradually extended over the whole of the road from Boston to Providence.

To prevent the dropping of fine iron chips from the wheels of the New York Elevated Railroad cars into the eyes of pedestrians below, it is suggested that magnets be attached over the brakes or shoes. This has been done with excellent results in flouring mills, for ridding the grain of pieces of wire used in binding the sheaves.

SUBTERRANEAN LINES.

The New York State underground bill has passed the Senate, but it is thought will be defeated in the House.

Preparations are being made to place 50 miles of the Chicago fire alarm wires underground.

SUBMARINE CABLES.

The Telegraph Construction and Maintenance Company (limited) has entered into a contract recently with the Brazilian Submarine Telegraph Company, to duplicate its cable for the whole length, and the work is now in progress. The ships were to sail during March to lay the first portion between Madeira and St. Vincent, and the other section will follow in course.

The post-master general of New South Wales has proposed a very extensive addition to the Australian cable system, via New Caledonia, Fiji and Honolulu. The contemplated length is about 6,858 knots, to cost £2,000,000.

MANUFACTURING AND TRADE NOTES.

Domestic.

Bridgeport has a new joint stock corporation—The Electrical Insulating Manufacturing Company—with a capital of $25,000. The new company will manufacture and sell electrical machines and apparatus.

The Jarvis Engineering Company of Boston, has sold the second Armington & Sims engine to the Bridgeport Electric Light Company. It has also an order for the third Armington & Sims engine for the Hartford Electric Light Company. It is to furnish the engines for the new Cambridge (Mass.) Electric Light Company.

The Cambria (Pa.) Iron Company and the Gautier Steel Department now have 89 electric lights and 34 telephones. A new electric engine was recently set up at the rolling mill. Mr. I. W. Watterman, the electrician, and five assistants, are kept busy.

The Lake Superior copper companies' pool has concluded a sale of about 12,000,000 pounds for English export. The price is understood to have been 14 cents. The market price for lake ingot in New York, is 14¾. The price at which the American manufacturers purchased their supply for the first half of the year 1884, of the copper companies' pool, was 15 cents. A pool is now forming for the last half of the year, and there is talk of making the price 14 cents.

Platinum wire has been drawn by H. F. Read, of Brooklyn, so fine as to be invisible to the naked eye. It is to be used for the cross wires in telescopes.

Foreign.

Wm. Denny Bros., Dumbarton, Scotland, are to add an electrical department to their ship building establishment.

FINANCIAL.

NEW YORK, April 19, 1884.

There has been a further decline of telegraph and regular telephone stocks during the past month. Western Union has sold at 66½ against 82¾ a year ago. American Bell Telephone stock has sold at 158, and there is more or less depression in the whole line of local telephone securities. Our quotations are from the Electric, Manufacturing, and Miscellaneous Stock Exchange, with the exception of the active telegraph stocks, which are listed at the New York Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Speaking	110 00	125 00	New York	—	85 00
Currier-Tele. Bell	3 00	—	New York & N. J.	—	80 00
Columbia & Pan	24 50	25 00	N. Y. & Penn	50 00	80 00
Continental	15 00	—	Overland	8 50	17 00
Dolbear	5 00	10 00	Peoples	10 00	12 00
Erie	28 00	35 00	Do. N. E.	1 50	—
Globe	—	9 75	Shaw	20 00	—
Hudson Riv.	60 00	90 00	Southern Bell	95 00	125 00
Inter-Cont.	95	1 25	Southern N. E.	—	175 00
Mexican	2 50	3 25	Tropical	2 00	2 50
Mexican Central	—	3 00	W. I. Tel. & Telph.	1 25	2 00
Molecular	5 50	10 00			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	50 00	65 00	Manhattan Telegraph	10 00	85 00
Commercial Tel. Co	—	70 00	Mexican	125 00	147 00
Harlem Dist. Tel. Co.	—	5 50	Postal	7 25	7 50
Bankers' & Merchants' 1st m. bonds	—	85 00	do. bonds	57 00	57 50

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	2 00	4 00	Edison Isolated	55 00	90 00
Brush	50 00	80 00	Edison European	3 00	15 00
Brush Ill.	45 00	70 00	Excelsior	20 00	—
Daft	40 00	60 00	Swan	—	40 00
Edison	—	120 00	U. S. Ill. Co.	—	90 00
Edison Ill.	55 00	75 00			

It is reported that $1,000,000 Western Union 7 per cent. bonds have been taken by the Equitable Assurance Society at 113. These are a portion of a loan authorized in 1874.

Montreal Telegraph stock has declined since March 14, from 124½ to 115. Anticipated competition from the Canadian Pacific Railway lines is said to have been the cause.

The Tropical Telephone Co. has sold its plant at Trinidad for about $20,000, and is perfecting other negotiations in South America which are expected to improve its condition materially.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

United States Supreme Court.—*Cook, Appellant* v. *The Sandusky Tool Co.* Waite, C. J., held that if an invention which was made and sold at such a date as to anticipate a patent, is the same invention as that claimed in the patent, the patent is void. If it is not an anticipation it is not an infringement. *The Pennsylvania Railroad Co., Appellant* v. *The Locomotive Engine Safety Truck Co.* This is an appeal from a decree against it upon a bill in equity for the infringement of a patent of Alba T. Smith. Gray, J., delivered the opinion of the court to the effect that the application of an old process or machine to a similar or analogous subject, with no change in the manner of applying it, and no result substantially distinct in its nature, will not sustain a patent, even if the new form of result has not before been contemplated. The decree of the Circuit Court was reversed, and the patent of Smith is declared void.

United States Circuit Courts.—District of Rhode Island. *Morgan, et. al.* v. *Rogers.* Colt, J., held that a trade mark may be conveyed with the property with which it is associated, and for it to pass under a bill of sale, it is not necessary that it be specifically mentioned. District of California.—*The Giant Powder Co.* v. *The Safety Nitro Powder Co.* Sawyer, C. J., held that where a patent is inoperative so far as not to cover all that the party is entitled to, it is inoperative within the meaning of the statute relating to reissues. The questions relating to the right to reissue are for the Patent Office to determine. A reissue, identical in terms with the original patent, may be valid. A patent may be reissued in divisions. Certain technical rules of practice are discussed in this decision. Western District of Pennsylvania.—*Loyd* v. *Miller, et. al.* Acheson, J., Letters Patent No. 135,050, Puddling Furnaces, were construed and sustained, but held not to be infringed by the defendants. *Keller, et. al.* v. *Stolzenbach, et. al.* Acheson, J., held that in order to constitute a prior judgment or decree rendered against a plaintiff a bar, it must appear that the point in issue was judicially determined after a hearing and upon consideration of its merits. It was also held in this case, that, when two persons were in partnership and the one invented and patented a machine, while the firm bore the expense of securing the patent and conducting experimental tests, but the outlay was more than repaid to the firm by the benefits arising from the invention, no implied license arises to the other member of the firm to make, use and vend the patented machine after the dissolution of the partnership.

United States Circuit Courts.—In the Southern District of New York. *Reay, Executrix* v. *Raynor, et. al.* Reissue Letters Patent No. 2,520, were granted upon surrender of original patent No. 39,702, for improvements in Envelope Machines. A bill was brought upon the original patent, without referring to the reissue, to restrain alleged infringement. After the expiration of the patent, the bill was amended substituting the reissue for the original patent as the basis of the action. The defendants moved that the bill be dismissed because the patent had expired before the amended bill was filed. Wheeler, J., held that the amendment made the bill as it should have been at first. It was also held that a broadened claim in a reissue taken out after a delay of more than three years would seem to be invalid; but that this claim would not necessarily render valid the other claims of the original, reproduced in the reissue. Other minor points were passed upon. *Truss* v. *Shuter.* Wallace, J., held that Letters Patent No. 95,894 to H. W. George are anticipated by Letters Patent No. 60,082 to A. B. Ely. Subject-matter—Box Toe for Boots and Shoes.

United States Patent Office.—*Ex parte Demming.* Commissioner Butterworth held that even if an inventor is a pioneer in his line, he is not entitled to a claim which will cover every means for effecting the exact purpose which his invention is designed to accomplish, although he may cover colorable variations of his invention. The claims should set forth specifically and definitely the actual invention covered by the patent. *Ex parte Derby*; Rock Drills. On May 29, 1883, a patent was granted to G. McC. Derby. 32 days later Derby filed an application claiming subject-matter, which was described in the patent granted, but which was specifically disclaimed in that patent with a notice of the reservation of the right, and a declaration of the purpose, to claim the same in a subsequent application. Commissioner Butterworth held that, in view of the fact that applicant specifically set forth in the patent the invention which he proposed to claim subsequently, and that he filed the subsequent application without unreasonable delay, he was entitled to a patent therefor. Also held that when an invention is shown but not claimed in a patent and no reservation is made, the appropriate remedy is a reissue. *Ex parte Upton*; Lightning Conductors. That an interference may be declared, it is not necessary that the claims should conflict in terms, nor that the claim in the one case should apply just to the matter or device in the other. If the claim of one party will include that of the other, there is an interference in fact. The Patent Office should determine who is entitled to the broad claim. Neither the spirit of the law nor public policy sanctions the granting of patents with specific claims while generic claims are pending.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From March 18 to April 8, 1884 (inclusive).

Alarms and Signals:—*Combined Fire and Police Alarm*, J. C. Henry, March 18, 295,249. *Fire Alarm*, J. Hill, March 25, 295,759; same, 295,760. *Combined Door Plate and Mail Receiver*, R. G. Page and W. J. Wey, March 25, 295,581 *Thermostat*, M. D. Porter, April 1, 296,058.

Clocks :—*Strike System for Secondary*, W. H. Sawyer, March 18, 295,287. *Alarm for Spring Clocks*, E. Jungerman, March 25, 295,873. *Clock Synchronizing Apparatus*, G. G. Wagner, April 1, 296,256.

Commutators :—*Switch-board*, F. Blake, March 18, 295,223; T. N. Vail, April 1, 296,253. *Automatic Switch*, T. A. Connolly, March 18, 295,356. *Switch*, C. S. Shivler, March 18, 295,445. *Commutator for Electric Generators*, H. M. Stevens, March 18, 295,206.

Conductors, Insulators, Supports and Systems :—*Conductor*, R. C. Stone, March 18, 295,207. *Manufacture of*, A. A. Cowles, March 18, 295,232; T. Shaw, April 1, 296,074. *Insulator for*, W. H. Davis, April 1, 296,146. *Artificial Pavement and Conduit for Wires*, W. Berry and P. Stuart, March 18, 295,334. *Tip for Conductors*, G. Doolittle, March 18, 295,371. *Coupling for Wires*, G. L. Kitson, March 25, 295,559. *Sidewalk, Curb and Surface Case for Wires*, R. Wylie, March 25, 295,710. *Manufacture of Compound Electric Wire*, J. J. Williamson, April 1, 295,966. *Conductor and Connecting Device therefor*, J. Kruesi, April 1, 296,185. *Binding Post for Conductors*, A. G. Goodbody, April 1, 296,160. *Insulated Conductor*, T. Miner, April 1, 296,294. *Telegraph Poles*, C. F. Brott, April 1, 295,905. *Apparatus for Distributing Time Signals*, Frank Waldo, April 8, 296,653. *Insulator for Line Wire of Mechanical Telephones*, J. F. Gilliland, April 8, 296,330. *Means for Supporting and Insulating Wires*, J. W. Tringham, April 8, 296,485. *Bracket for Insulating Support*, D. S. Haines and S. D. Lake, April 8, 296,558. *Insulating Support*, same, 296,988.

Dynamo Machines and Motors :—*Dynamo*, T. L. Dennis, March 18, 295,368; E. J. Houston and E. Thomson, April 8, 296,569. *Armature Coil for*, J. J. McTighe, March 25, 295,789. *Apparatus for Regulating and Distributing Currents from*, W. Hochhausen, March 25, 295,552. *Magneto and Dynamo Machine*, F. G. Frick, March 25, 295,534. *Electro Dynamic Motor*, F. J. Sprague, March 18, 295,454. *Driving Gear for Dynamo*, J. W. Boothby, March 25, 295,614.

Galvanic Batteries :—C. Pabst, March 25, 295,671; H. Thame, April 8, 296,365. *Voltaic File*, A. Schroeder, April 8, 296,464. *Sealed Galvanic Battery Cell*, W. T. McGinnis, March 25, 295,574. *Electrode or Element*, E. T. Starr, March 25, 295,889.

Ignition :—*Igniting Device for Gas Engines*, H. S. Maxim, April 8, 296,341.

Lamps :—*Manufacture of Incandescing*, W. Holzer, March 18, 295,398. *Double Carbon Arc*, E. Thomson, March 25, 295,830. *Arc*, T. L. Dennis, March 18, 295,367; W. Morava, March 25, 295,604. *Automatic Cut-out for*, C. L. Buckingham and H. C. Townsend, April 1, 296,125. *Portable Battery and Lamp*, C. G. Gumpel, April 8, 296,331. *Swinging Bracket for Lamp*, J. Ritchie, April 8, 296,355.

Metallurgy :—*Magnetic Ore Separator*, F. V. Rouleau, April 1, 296,008. *Electrotype and Stereotype Casting Pan*, C. B. Cottrell, April 1, 296,277. *Same, Casting Mould*, same, 296,278. *Process and Apparatus for Reducing Metals*, A. J. Rogers, April 8, 296,357.

Miscellaneous :—*Lightning Arrester*, C. W. McDaniel, March 18, 295,207; J. Griffin, April 8, 296,407. *Toy Railway*, M. Bacon, March 18, 295,473. *Electric Implement*, A. H. Kinder, March 25, 295,652. *Helix and Method of Winding*, F. Bain, April 8, 296,380. *Machine for Carding Buttons*, L. Gillon, April 8, 296,401. *Hot Air Furnace Regulator*, F. M. Sparrow, March 25, 295,686. *Electro-magnetic Valve and Connection*, H. Flad, April 8, 296,540. *Apparatus for Collecting and Removing Waste from Spinning Machines*, W. A. Delmage, April 1, 296,148.

Railway Appliances :—*Signaling Apparatus for Railroads*, F. L. Pope, March 18, 295,427. *Car Brake*, H. S. Park, April 1, 296,211, 296,212; April 8, 296,349. *Same, System*, A. L. Duwelius, April 8, 296,319. *Air Brake*, H. Flad, April 8, 296,540. *Connector in Pipe Couplings for*, same, April 8, 296,547.

Storage Batteries :—*Secondary Battery Plate*, E. T. Starr, March 18, 295,455. *Secondary Battery and Method of Constructing Electrodes therefor*, E. T. Starr, March 18, 295,456. *Secondary Battery*, A. Haid, April 1, 296,164.

Telephone Systems and Apparatus :—*Telephone Box*, A. G. Davis, March 18, 295,365. *Telephone Support*, G. W. Fish, March 25, 295,531. *Telephone*, F. B. Cook and F. F. Graves, April 1, 293,933; J. A. Maloney, April 8, 296,420. *Transmitter*, D. Drawbaugh, March 25, 295,741, 295,742; C. A. Randall, March 25, 295,805, 295,806; J. A. Maloney, April 8, 296,421, 296,593; S. Chadwick, April 8, 296,076. *Telephonic Receiver*, C. A. Randall, March 25, 295,804, 295,807. *Individual Signal Apparatus*, T. D. Lockwood, April 8, 296,588. *Signaling Apparatus*, April 1, 295,913. *Mechanical Telephone*, H. & E. Seligman, April 1, 296,230.

Telegraphs :—*Automatic and Fac-Simile*, J. Absterdam, March 18, 295,219. *Printing*, A. F. Johnson, March 25, 295,644. *System*, C. G. Burke, March 25, 295,855. *Automatic*, R. Anderson, April 8, 296,376. *Morse Register and Perforator*, L. C. Springer, April 8, 296,541.

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THE ELECTRICIAN
AND
ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

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NEW YORK, JUNE, 1884.

THE UNDERGROUND LAW AND ITS EFFECTS.

THERE will probably always be a large proportion of the community who believe that the passage of a law by Congress, or a State legislature, is in itself a remedy for any possible public evil which may exist. The enforcement of the act may, from its very nature be impracticable, but let there be a clamor for certain legislation, through the agency of the press, and eventually the statute becomes a part of the law of the land. This is the case with the underground telegraph movement. Certain simple-minded people appear to have become imbued with the idea that in order to place electrical wires underground, it was only necessary to dig a trench, lay them in it, and fill it up, where they would harmlessly remain out of sight, at least until this generation passed away. All statements and arguments made by interested parties, have been sneered at as mere subterfuges indulged in for the purpose of avoiding the expense which would be incurred by the adoption of a subterranean system. A city journal which has been one of the most ardent supporters of this raid, has by some means been converted to the opinion that, after all, it will probably be necessary to provide sub-ways for the purpose, and then the question arises, shall they be undertaken by private corporations or the board of public works. Again the problem is presented in the following words, which is a fair sample of the manner in which this important matter is treated by the press. "Give the companies two years to bury their wires. How it is to be done is their business."

It cannot be expected that these gentlemen are open to conviction. They voluntarily assume the responsibility of regulating the affairs of the nation, as well as of the corporation and individual. The model editor is equally competent, either to advise the farmer when to wean lambs, or instruct the Secretary of State how to manage Bismarck. Naturally they are equally well versed in all the intricacies of electrical engineering in its various branches. If education is chiefly valuable in teaching us the density of our ignorance, as Dr. Johnson defined it, these enthusiasts have not profited by their training. The tiresome argument that all wires are placed underground in Europe, merely proves that these gentlemen have never crossed the ocean, or that if they have, the wires were unnoticed, because there was no inducement for devoting their attention to them. The solution of this problem is merely a question of time and expense. No person who is familiar with the resources of modern engineering will deny that eventually at least a large proportion of the electrical wires must go underground. In New York city, however, where there are over thirty different companies whose wires must be provided for, the merest tyro should see that unless some comprehensive plan is adopted, the continual burrowing, and consequent interruption to traffic in the streets, will be simply unbearable. It is also ignorantly assumed that most of these companies are rolling in wealth, and it is intimated that this will be a good way for the public to square accounts with them. It is well known in electrical circles that some of the most useful of them have struggled years to attain a position where they could honestly be said to earn expenses, much less pay dividends upon invested capital. If there are people who innocently believe that all of these companies will bury their wires, in anticipation of an onslaught by the local authorities on November 2d, 1885, they would doubtless be surprised to see how calmly the situation is viewed by those who are deeply interested in the present systems. As an instance of the futile efforts of our law-makers in preventing an evil practice, the following extract from an editorial in the New York *Times*, furnishes an instructive example:

"For many years there has been on the statute-book of the United States a law that has subjected any bank, the officers of which have falsely certified checks, to the appointment of a receiver and the loss of its charter. There has not been a day for at least ten years that a half-dozen banks of this city, some of them the most active and possessing the most influence, could not have been, as by the terms of the law they should have been, closed up. Yet they have gone on untouched and unchecked."

This is but one instance out of hundreds, but its importance makes it conspicuous, especially at the present time. Right in the face of this adverse legislation, an electric light company just starting in a city which will come under the provisions of this act, will run its wires on poles exactly as it would have done two years ago.

The city authorities of Chicago fixed upon the first day of May, 1883, as the date when all wires should be buried, but when the time arrived, it was discovered that the mountain had not moved, and it was understood at the time that, had its wires been interfered with, the Western Union Telegraph Company would have severed its connections with that city. No material progress has been made since that time in placing the wires underground, but eventually it will probably be done. Instead of being an honest movement in the interests of the public, this legislation in New York State is being engineered by certain parties who have obtained underground privileges in New York city, and are now attempting to coerce existing

companies into a position where they will be obliged to hire from them their rights of way, or conductors. Had it not been for the existence of erroneous ideas regarding the progress of underground telegraphy in Europe, probably the Daly bill would never have been passed. The following extract from remarks by Mr. Preece, the eminent English electrical engineer, showing the actual state of affairs, deserves particular attention:

"There was then going on what he had characterized as a meaningless crusade against overhead wires. Vestries and other small corporations in outlying districts were endeavoring to force the government to put the wires underground, and the newspapers were bringing forward the fact that even in Germany and France the wires were so placed. It was not sufficiently known that Germany and France were only doing what had been done in England a quarter of a century ago. The wires were then placed underground; all the main wires between London, Birmingham, Liverpool, Manchester, Leeds, and all the wires to the cables on the south coast, were underground; but after sufficient experience of their use it was found necessary to take them up again; and he should not be in the least degree surprised to find the same result taking place, sooner or later, in Germany and France. It had been found that wires overhead had many times the efficiency of wires underground, and it was absurd to try and force electricians to do an act that was commercially wrong and practically foolish, for the imaginary reason that overhead wires were supposed to be dangerous."

In all of these cases the wires referred to were for ordinary telegraph purposes. The treatment of the various house-to-house, and telephone systems is a still more difficult matter. The Western Union Telegraph Company began putting its wires underground several years ago, and other commercial telegraph lines will follow its lead in due time for their own protection, as the infrequency of their stations, and the character of the Morse system renders the problem comparatively simple. Considering all the factors of the case we will venture the prediction that on the first day of November, 1885, there will be more wires overhead in this city than there are to-day.

COMPETING TELEPHONE EXCHANGES.

The first fruits of an opposition telephone system have been brought forth in Philadelphia, where a new exchange company in its efforts to relieve the public from the thraldom of a monopoly, is meeting the usual obstacles provided in such cases. Its customers are being warned by letters from parties representing the Bell patents, that proceedings will be brought against them for using instruments which are said to infringe upon the rights of the owners of said patents. It was to be expected that the company at fault would assume charge of the suits brought against its patrons, which they publicly agree to do. The occasion is also availed of by the officers of the new company to denounce such warfare as "undignified" and "disreputable." It is intimated that in undertaking the exchange business, it is the intention to furnish superior instruments, and, as usual, to perform the service at reduced rates. It is difficult to see how any particular advantage is to be secured by subscribing to an embryo system of this character. The nature of an exchange service is such that its value is enhanced by the greatest number of subscribers, and it seems absurd to suppose that any person for a possibly slight reduction in price, will forego the manifest advantages arising from the greater number of persons with whom he can communicate. There is also little reason for supposing that the exchange service will be greatly improved, whatever may be the superiority of the telephone, excepting, perhaps, for the reason that the number of subscribers is limited, and the business simplified accordingly. The running expenses of a telephone exchange system are not as light as would appear from a superficial examination, while the chances of damage from storms or fires are such that ample provision should be made for extraordinary outlays, which are by no means to be ignored. In fact the occasional development of unforeseen emergencies, which can only be determined by experience, has in many cases caused the rates to be raised to their present standard, in order to render the business sufficiently profitable to warrant its continuance. If there is any business in which a monopoly is justifiable, that of a telephone exchange appears to be clearly entitled to it, and the establishment of competitors would be fully as likely to bring additional burdens upon the public for the reason that the exigencies of commercial intercourse would compel many subscribers to patronize every system.

THE SENATE COMMITTEE ON THE GOVERNMENT TELEGRAPH.

The majority of the Senate Committee on Post-offices and Post-roads, in their report prepared by Senator Hill, certainly do not evince any symptoms of having been influenced by the arguments presented by the Western Union Telegraph Company. In an analysis of the bill which will be reported favorably, it appears that the rates for telegraphing are to be generally reduced and equalized, and special provisions made for the transmission of general and commercial news for associations and the press. The rates will not be as low as was hoped for by many earnest advocates of a government telegraph, yet as it will be a competing system, rather than a substitute for those which already exist, the public will not be compelled to patronize it, and consequently it must stand on its merits, and secure business by the superiority of its service, as the government tariff will no doubt be adopted by the companies then in the field. The committee asserts that under the constitution, the government has a right to engage in the telegraph business, and that no company has just cause for objecting to such competition, for the reason that the present systems have been built up, subject to a possible curtailment of their revenues in the manner proposed. It is probable that the adoption of this bill, will have a healthy effect upon the transaction of telegraph business, by the establishment of a uniform schedule of rates, and by the extension of the system to points which have heretofore had little prospect of enjoying telegraph facilities. While it may not be all that enthusiasts have hoped for, there appears to be no danger of its making the situation of affairs any worse, and the officers of the post-office department will become gradually more familiar with their new charge, without compelling the public to suffer neglect during the period of their apprenticeship.

BRINGING OUT THE RESERVES.

It is undoubtedly the case that the main strength of the present onslaught against the Bell telephone patents, is derived from the subtle influence exercised by that mysterious personage known as Drawbaugh. Secluded from the world, in his rural retreat at Eberley's Mills, he pursued his researches,—secretly perfecting one of the greatest inventions of the age, but in the innocence of his heart allowing the prize to slip from his grasp for the time being, only to be rescued by a noble band of philanthropists, whose mission on earth appears to be the protection of the public from greedy monopolists, and the bolstering up of needy inventors by the aid of wealth entrusted to them by confiding capitalists. So long as there existed in the mind of the public but one Drawbaugh, it was felt that the aggressive movement founded upon his individuality, was possessed of an element of strength which could be secured by no other syndicate. In an evil hour, however, it would appear that in their anxiety to hasten the issue, certain ill advised participators in the scheme, have brought forth another Drawbaugh, and the original Daniel necessarily declines in importance by this overissue. If a second Drawbaugh, who is likewise a producer of illegitimate telephones may be produced in this surreptitious manner, why not a third or a fourth? In fact the various telephone companies, which are striving to occupy the promised land, may each obtain possession of a Drawbaugh, although it cannot be supposed that in this watered condition of the stock, the immature descendants will equal in value, the original wizard of Yellow Breeches creek. It is also extremely doubtful if there exists in the hamlet of Eberley's Mills a sufficient number of individuals to furnish that extraordinary delegation of witnesses which will be required to properly support the misty claims of additional Drawbaughs. At this late period, with assured victory almost within the grasp, it is sad that the halo of romance which enveloped that remarkable genius should be thus ruthlessly torn aside. In vain may the managers of this movement assert that theirs is the great, the original, the only. That is an old and well-known device of the base imitator, whose existence in commercial circles has long been known. This new departure is doubtless based upon the assumption that if one Drawbaugh is good, two should be of double the value. While this reasoning is correct in finance, it by no means follows that it is equally true in computing the value of antiques, the ownership for which is eagerly sought because of their rarity. This undue inflation will certainly diminish the influence heretofore exerted by the concealed inventor, and should it not be checked will result in permanent injury to the cause. It is already too late to recover his lost prestige,—the spell is broken.

A MERCANTILE TRADES' UNION.

A novel association has recently been organized in New York city and incorporated under the title of the Traders' and Travelers' Union (Co-operative) with a capital of $200,000. Its ostensible object is to enable its members to obtain favorable transportation and telegraph rates, and for the purpose of protecting them from various actual and imaginary oppressions. The particular grievance which these gentlemen entertain against the telegraph companies, is what they are pleased to characterize as the unjust discrimination between through messages and those sent to intermediate points. Some of the largest mercantile firms in the country are represented in this association, and it would be interesting to know if they are entirely exempt from similar alleged evil practices. One of the best established principles of trade is that which recognizes a difference between the wholesale and retail prices of goods. A telegraph company can better afford a lower rate to a point where its business amounts to a thousand messages a day, than to an intermediate station handling only a hundred. It is, of course, well known that rates are reduced by competition at the more important centres, while the entire revenue is maintained at a profitable figure by a relatively higher tariff to smaller towns and cities. The merchant in his line of business, pursues a similar course; and it appears to be a very natural thing to do. There are no doubt a vast number of matters which require regulation; and many in which the masses are more interested than in the price of telegrams or the rates of freight. The firms which have united in this movement are reputed to be wealthy, and no doubt reap a much larger profit in proportion to the labor and capital they represent, than do any of the corporations against which they are about to open warfare. Their proposed plan of procedure has not yet been announced, but it will be interesting to watch the growth of the new movement. What is commonly known as the "business" part of the community comprises men of such various views that a large array of respectable names may be collected to endorse almost any scheme which the ingenuity of man can devise.

ELECTRICAL SECURITIES AND THE PANIC.

Although the shares of the Western Union Telegraph Company are the only electrical securities which may be considered well known and active, they were not the most conspicuous in their depression during the recent panic. The stock of the Bankers' and Merchants' Telegraph Company was precipitated from 119 to 45, caused by its being forced upon a market in which more substantial securities were being slaughtered through the pressing necessities of their holders. This abnormal excitement has diverted attention from traffic in the stock of more obscure companies, and taken in conjunction with the apprehension of difficulties with the telephone patents, excessive competition amongst the electric light companies and the prospect of expensive subterranean construction it appears probable that there will be little activity, excepting in strictly telegraph stocks for some time to come. In the telegraphic field there will certainly be room for speculation, as the active competition of the large companies must eventually result in fluctuating revenues, compromises, and deals of various descriptions. These will be taken due advantage of by those who are inside the mystic circles, or the recipients of those familiar Greek gifts known as "points," by means of which many an innocent lamb has been led to the slaughter.

ARTICLES.

ON THE ELECTRIC LIGHT TESTS AT THE CINCINNATI EXPOSITION.

BY F. L. POPE.

(Continued from Page 84.)

THE dynamo exhibited at Cincinnati by the United States Electric Lighting Co. was No. 1,651 of the type known as the Weston 200 light incandescent machine. Its general appearance is well shown in the accompanying engravings, figures 4 and 5. The following particulars of its construction may be of interest:

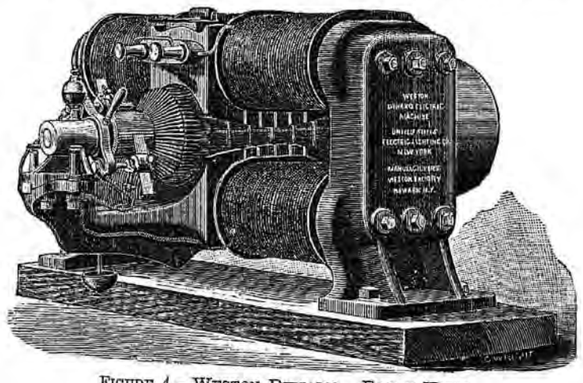


FIGURE 4.—WESTON DYNAMO. FRONT VIEW.

Diameter of armature,	9 in.
Length " "	16.5 "
Diameter " " wire,	00.240 "
Approximate length of armature wire,	240 ft.
Weight of wire on armature,	465 lbs.
Weight of armature,	202 "
Mean normal speed of armature conductor per minute,	2300 ft.
Number of commutator sections,	48.
Area of section of field magnet,	54.26 sq. in.
Diameter of wire on " "	0.092 in.
Length of wire on " "	18.934 ft.
Weight of wire on " "	493 lbs.
Total weight of dynamo in running order,	2,701 "

Careful measurements have been made, both under my own supervision and independently by others, of the resistances of the armature and field circuits of this dynamo. The actual resistance of the armature is so small that some difficulty was experienced in arriving at a satisfactory result. The following determinations were made by observing the fall of potential along a conductor, of which the armature formed a part, by means of a Thomson reflecting galvanometer of high resistance. The mean value for the resistance of the armature, including brushes and connections was found by this method to be 0.014 ohms at 23.5° C. After running a considerable time and becoming well heated, the resistance of the armature measured 0.018 ohms, and that of the field 24.7 ohms, which values have been adopted in the following computations, although there is reason to suppose that this figure for the armature resistance is somewhat too high.

Taking the figures given in the report (Table I) for the Weston incandescent dynamo, and computing the rate of work as before, by formulas (4), (5) and (6) we get the following results, which for convenience of reference have been arranged in the form of a table:

No. of Experiment.	RESISTANCE. (ohms).			CURRENT. (ampères).			Potential at Terminals.	RATE OF WORK. (horse-power).				H. P. Consumed.	EFFICIENCY	
	External.	Field.	Armature.	External.	Field.	Armature.		External.	Field.	Armature.	Total.		Electrical.	Commercial.
	Rx.	Rf.	Ra.	Cx.	Cf.	Ca.	V.	Wx.	Wf.	Wa	W.			
1		24.7	0.19	168.1	2.80	170.9	99.2	15.16	0.29	0.70	16.12	18.55	86.9	81.1
2		24.7	0.19	145.7	2.48	148.1	90.0	11.70	0.19	0.53	12.42	12.80	96.3	91.4
3		24.7	0.19	157.4	2.63	160.0	95.0	13.70	0.23	0.62	14.55	15.50	93.9	88.1

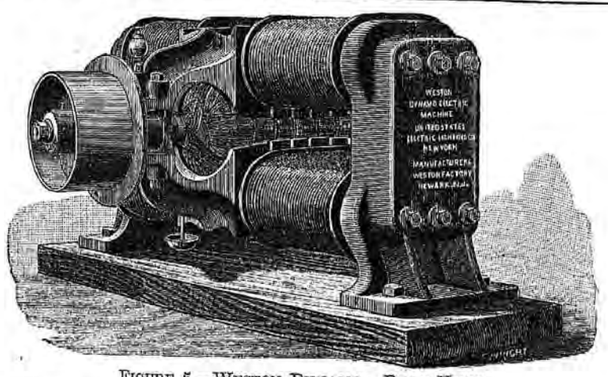


FIGURE 5.—WESTON DYNAMO. REAR VIEW.

An examination of this table shows a remarkable discrepancy between the apparent results of the three tests, and as it does not seem probable that there could have been any very great difference in the conditions under which the different trials were made, except, perhaps, in respect to the speed of the armature, as the number of lamps in circuit (200) remained the same, it is difficult to account for the great lack of agreement in the percentage of efficiency.

In experiment No. 2 of the above table, for example, the mechanical h.p. by the dynamometer is given as 12.80 and the gross electrical h.p. is 12.42, showing a loss in conversion of 0.38 h.p. due to friction, etc., which is probably not far from the truth. But in this test the speed of the armature was obviously very low, and the potential appears also to have been about 10 volts below that at which the Maxim lamps are designed to be run. In experiment No. 1, the potential is nearly as high as it should be, but the difference between the h.p. by dynamometer, and the gross electrical h.p. is 2.43 h.p., and if we allow 0.38 h.p. for friction and other losses in conversion as in experiment No. 2, we have no less than 2.05 h.p. entirely unaccounted for. A similar computation shows that 0.95 h.p. is likewise missing in experiment No. 3.

The discrepancies which have been pointed out are too great to be susceptible of satisfactory explanation upon the theory of instrumental errors, either in the electrical or in the dynamometrical measurements, and, moreover, as we have seen, the percentage of efficiency given for the Weston machine (except in the case of experiment No. 2) is too low, while, on the other hand, that given for the Edison machine is too high. A careful study of the results given in Table I, will, however, serve to indicate the probable origin of these errors. It will be observed that in the three tests of the Weston machine, the percentage of efficiency falls as the strength of current increases. The less the current the greater the efficiency. The current of the Edison machine, being of higher potential and of much less volume than that of the Weston gives a considerably higher apparent efficiency. In the accompanying diagram, figure 6, I have plotted out these results as taken from

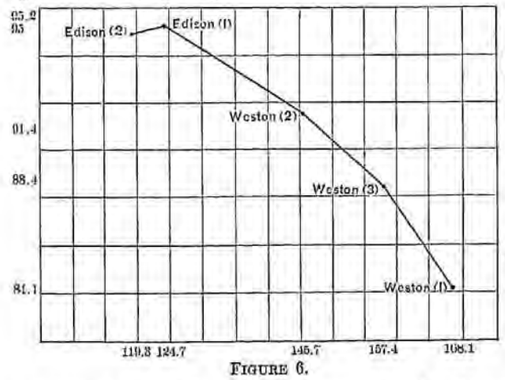


FIGURE 6.

the table, the vertical divisions representing the strength of current in ampères, and the horizontal divisions the percentage of commercial efficiency. The results—with the exception of the second Edison test, which varies a little—fall into a regular curve, showing that the falling off in efficiency bears a direct relation to the increase in the strength of current. This effect is undoubtedly mainly due to a progressive variation in the ratio of the respective resistances of the galvanometer and its shunt, when heated by the passage of the current. It is quite apparent that this variation does not favor the system in which the stronger current is used, as stated in the report, but precisely the contrary. The value of the shunt multiplier accepted by the jury, viz., 4.9, is a purely arbitrary one, and is based upon the assumption that the temperature of the shunt was higher than that of the galvanometer. The diagram, figure 6, shows that this assumption was an erroneous one, as might perhaps have been expected, for the reason that the galvanometer leads were thickly wrapped with a coating of silk, thus greatly obstructing the radiation of heat, while the shunt was covered with a thinner coating of cotton.

The computations already made show that the assumed value of the shunt must have corresponded closely with its true value at the time of making the second test of the Weston machine, in which the commercial efficiency of the latter was found to be 91.4 per cent., but that its actual multiplying power rapidly diminished as the strength of current increased, and as rapidly increased when the strength of current diminished. This source of error would seem to be sufficient to account for the apparent excess of converted energy in the Edison machine, as well as for the apparent deficiency of the same in the Weston machine, the latter, by reason of the greater strength of current which it transmitted through the galvanometer and shunt, being placed at a material disadvantage in the comparison.

The Maxim lamps have a mean resistance when hot of 75 ohms, and are designed to be run at a normal potential of 70 volts, but this figure does not appear to have been reached in any of the tests, while on the contrary, the Edison lamps, which are stated to be designed to run at a potential of 110 volts, were in fact run during the two tests given in Table I at 124.9 and 122.8 volts, more than 10 per cent. above their normal standard.

It is stated by Sidney E. Paine[1] that the Edison lamp, of the type used in manufactories, when at 16 candles, has a resistance of 120 ohms, and the type used in central stations a resistance of 140 ohms. If we allow 0.05 ohms for the resistance of the leading wires, 200 lamps of the "manufactory type" in the external circuit would give a resistance of 0.65 ohms, and of the "central station type" 0.75 ohms, which, when run at the lowest potential given in the table (122.8 volts), would give a current respectively of 188.9 ampères and 163.7 ampères, while the rate of electrical work in the external circuit would be 31.09 h.p. which is far more than the amount delivered to the machine.

But if we compute the resistance of the lamps from that of the external circuit, by applying the equation $R_x = \frac{V}{C_x}$ to the figures of the two Edison tests, we find the values of R_x to be 1.00 and 1.03 ohms respectively; deducting 0.05 ohms for the resistance of the leading wires, and multiplying by the number of lamps (200) gives us 190 and 196 as the mean resistances per lamp. As we have already seen, the strength of current given is too high, hence the actual resistance of the lamps cannot be as great as these results indicate.

There is, however, a class of 10-candle lamps made by the Edison company, and especially designed for use in village lighting and in certain kinds of isolated lighting plants, which has a resistance when hot of about 180 ohms. This corresponds with the resistance of the Edison lamp used in the photometric tests (see Table III) as computed by dividing the means of the electromotive forces by the means of the resistances in the table, which gives 180.9 ohms as the mean resistance of the lamp used in that test.

It is certain that the resistance of the lamps actually used must have been at least as high as 180 ohms, and the results indicate that they were 10-candle lamps designed to give that illumination at a potential of about 110 volts, but that they were driven to a higher degree of incandescence by an abnormal increase of potential. This would materially increase the apparent efficiency of the lamps, but at the expense of their life. This possibility is pointed out in the report, showing that the jury were not ignorant of its practical importance.

Owing to the variable error in the shunt multiplier which has been referred to, it is scarcely possible to conjecture the real percentage of efficiency of the Edison machine from the figures given, although if the actual h.p. consumed by the friction of the armature and brushes had been measured, it might have been reached with a fair degree of probable accuracy by the aid of Mr. Howell's figures (page

1. Bulletin No. 21, Edison Elect. Light Co., p. 10-11.

92 ante). For example, if we take from Table I the mean potential V = 123.8 volts, and the resistance of the external circuit (200 lamps at 180 ohms each) plus the resistance of leading wires assumed at 0.05, making a total of 0.95, and take Mr. Howell's figures for the resistances of the dynamo, we shall have

R_a = 0.95	C_x = 130.2	W_x = 21.81 h.p.
R_f = 17.00	C_f = 7.28	W_f = 1.21 h.p.
R_a = 0.032	C_a = 137.48	W_a = 0.81 h.p.

Total electrical rate of work W = 23.83 h.p., which is certainly low enough.

If we allow 0.50 h.p. for friction, which is at least not too high, the commercial efficiency of the machine will be

$$\frac{21.81}{24.33} = 89.65 \text{ per cent.}$$

A similar computation for the Weston machine, based on the values in Table III, and the first test in Tables I and V, together with the measurements heretofore given, results as follows: Potential V = 69.2 volts; resistance of external circuit (200 lamps at 71.97 ohms each) plus resistance of leading wires assumed at 0.05, total, 0.41 ohms.

R_x = 0.41	C_x = 168.7	W_x = 15.65
R_f = 24.70	C_f = 2.80	W_f = 0.26
R_a = 0.018	C_a = 171.60	W_a = 0.71

Total electrical rate of work W = 16.62 h.p.; adding 0.50 h.p. for loss by friction, etc., as before, the commercial efficiency of the machine would be $\frac{15.65}{17.12}$ = 91.45 per cent., or 1.8 per cent. higher than that of the Edison machine.

The principal element of uncertainty in the above computations is the actual loss by friction of the armature and brushes, which has been assumed at 0.50 h.p. for each machine. This assumption is quite unfavorable to the Weston dynamo on account of the great disparity in the sizes and weights of the respective machines and their armatures, as shown by the following comparison:

	Total Weight.	Weight of Armature.
Edison K. machine[2]....	8,392 lbs.	698 lbs.
Weston (1,651).....	2,791 "	202 "

The above computations will serve to show the inaccuracy and inconsistency of some of the results put forth by the jury, although they cannot fairly, in the absence of accurate measurements, be taken to show the relative efficiency of the two competing dynamos. They do indicate that both machines have a very high percentage of commercial efficiency, and that they in fact stand so near abreast of each other in this respect, that a comparatively small error in measurement may easily place one at a disadvantage as compared with the other.

THE PHOTOMETRIC TESTS.

It has already been shown by deduction from the results given in Table III, that the Edison lamps tested at Cincinnati must have had an approximate resistance of 180.9 ohms. This class of Edison lamps is stated to have an illuminating power of 10 candles with a potential of 110 volts. These same lamps, however, are said in the report to have been spoken of as 16-candle lamps by the representatives of the Edison company, and I am informed that they were so labeled. It will be observed that this resistance is much higher than that of the regular Edison 16-candle lamps, which is stated by Mr. Paine to be from 120 to 140 ohms. According to Table III, therefore, a comparison was actually made by the jury *between a 10-candle Edison lamp run at a mean of* 115.1 *volts, nearly 5 per cent. above its normal potential*, and a 16-*candle Maxim lamp run at a mean of* 92.7, *more than* 10 *per cent. below its normal potential.* It is not surprising, therefore, to be told that a comparison made under conditions so obviously unfair, should have resulted in favor of the Edison lamp, in the proportion of 1.25 to 1.00. The only remarkable circumstance is that the disparity is no greater. Of course it is to some extent a matter of conjecture what the results of a fair test would have been, but it is perhaps possible to approximate it from accessable data.

If the standard 16-candle Edison lamp of 140 ohms resistance had been used, with a potential of 110 volts, the rate of work in the lamps would have been 86.42 watts when producing a 16-candle light. A standard 16-candle Maxim lamp is designed to have a resistance of about 75 ohms, but taking the somewhat less efficient one tested at Cincinnati, whose mean resistance computed from Table III is 71.97 ohms, and running it at the normal potential of 70 volts, the same amount of light (16 candles) would be produced by the expenditure of 68.07 watts. That is to say, the production of the same amount of light would require 26.9 per cent. more power with the Edison lamp than with the Maxim, thus almost exactly reversing the figures given by the jury for the respective lamps. With a dynamo having an efficiency of 90 per cent., this would give 9.86 lamps per h.p. for the Maxim lamp as against 7.77 for the Edison.

This statement will serve to show how easily a comparison of two incandescent lamps with each other, without reference to any fixed standard, may be made to favor a lamp of comparatively low efficiency at the expense of a better one. All that is necessary is to run one lamp above its normal illuminating power and the other below it.

The manner in which the photometric comparison of the arc lamps was made by the jury is also open to criticism. In order to determine the intensity of the light projected at an angle of depression 45° below the horizontal, the lamp is said to have been placed in an inclined position. As the feeding mechanism of an arc lamp is actuated by gravity and is necessarily adjusted with considerable delicacy, the placing of the lamp in an inclined position could hardly fail to interfere with its proper action, hence a variation in the angle at which the lamp was held might introduce a considerable error. In the comparison between the Thomson-Houston and the Weston lamps the efficiency of the lamps when in a normal vertical position (as shown by the quotient of the mean of luminous intensity divided by the mean of energy expended in the lamp), was in the proportion of 27.8 for the Thomson-Houston to 37.4 for the Weston, but when inclined as above stated it became 194.6 for the Thomson-Houston to 86.8 for the Weston.

It is not probable that so great a difference would have been found in the latter case if both lamps had remained vertically suspended, and the illumination had been measured by more suitable methods. It is true that a proper measurement of the light produced by an arc lamp, especially of the class actuated by continuous currents, is a matter of considerable difficulty. If the light projected in a horizontal direction only is measured, the results will vary enormously as the location of the arc is on one side or thé other of the axial line of the carbons. It has been found by experiment that the maximum amount of light is emitted at an angle of depression of about 40°. A much better method of measuring the intensity of these inclined rays would have been to make use of a plane mirror mounted so that it might be made to revolve around the arc at a uniform distance from it, and which could be set at such an angle that the downwardly inclined rays would be reflected horizontally at a known angle, say 90 degrees, while the direct rays were cut off by a screen. A comparison would only need to be made once for all between the intensity of the light reflected from the mirror and that proceeding directly from the arc, and the difference allowed for in the subsequent measurements.

The electrical measurements of these lamps were made by the jury with the aid of a shunt of 17 to 1, by which any errors would necessarily be multiplied by 18. That errors were made is manifest from instances in the table where the current remains constant while the E. M. F. rises

2. Hospitalier, *Form. Pratique*, 1884, p. 925.

and falls. In at least one case an increase in the E. M. F. is accompanied by an actual decrease in the current.

There are other points in this report which merit attention, but this paper has already reached such a length that I must refrain from discussing them. In pointing out what I believe to be some of the sins of omission and commission on the part of the exposition jury, my object has mainly been to call the attention of the electrical public to the importance of employing competent, impartial and trustworthy jurors to conduct important competitive tests of this character, so that the final determinations will withstand the most rigid analysis. It hardly needs to be said that the electricians of the United States cannot afford to have any competitive tests of this character made at the coming International Electrical Exhibition, unless the work is done in a manner which will command the confidence, and successfully withstand the criticism of the ablest physicists of the world.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

No. XII.—ELECTRIC SPARK IGNITION.—*Concluded.*

PART IV—ELECTRIC TORPEDO AND ARTILLERY PRACTICE.

When the explosive "floating magazine" employed by Lambelli at the siege of Antwerp in 1585,[1] and revived in the form of a "submarine magazine" by David Bushnell in 1775,[2] was finally named in all its forms, by Robert Fulton in 1801, "the torpedo" from the electrical fish of that name[3] which strikes its blow from under the water, he little imagined that its development from the bomb with which he contrived first to destroy a vessel in 1801[4], to the effective weapon of war Bushnell predicted it to become, would, as time has shown, be largely dependent upon the antecedent development of electrical exploding.

The idea of firing torpedoes by electricity, suggested, but discarded by Fulton in 1813,[5] was enthusiastically advanced by Col. Colt of revolver fame,[6] who having first devised a suitable subaqueous conducting cable[7] experimentally destroyed three vessels at anchor in 1841 by torpedoes thus exploded, and on the 18th of October in the following year blew to pieces by an electric torpedo a vessel in motion on the Potomac River, he at the moment being in Alexandria, five miles away.[8]

But those who early advocated the torpedo were overwhelmed with ridicule and contempt,[9] especially by naval officers, by whom at the beginning of the civil war in America, rumors that the confederates were resorting to its use were met with disdain. Appreciating, however, in this promising and inexpensive weapon their only hope of protection against a powerful navy, the confederates legitimatized the torpedo, and so successfully demonstrated its possibilities that it soon affected our navy with mistrust.

Shore firing torpedoes anchored upon the bottom, contact torpedoes made of lighter cases and held upon spars a few feet below the surface of the water, and floating torpedoes made of buoyant cases were soon encountered in several Southern rivers, and the spectacle of a powerful man-of-war on blockade duty at night, with all steam up, cables ready to slip, officers on watch, the small boats and a pair of specially appointed tugs on patrol around her, all to guard her against a possible deadly foe in the shape of a drifting contact torpedo, or a little submarine boat containing two or three men and a few pounds of powder, was a consequence of their proceeding.[10]

Subsequently, the fate of a large United States steamer, the Commodore Jones, which while actually dredging for torpedoes in the midst of a fleet of gun-boats, on the James River in 1861, was suddenly lifted so high out of the water that the banks of the river could be seen under her, and then completely shattered to pieces by a torpedo containing 1750 pounds of powder exploded by electricity from the shore, proved that such precautions were not injudicious.[11]

Before the close of the civil war the naval authorities who had regarded the torpedo with indifference urged and effected its adoption by the United States government. The lectures on electricity and the torpedo, established at Chatham in 1867, on H. M. S. "Excellent," the association of Mr. Moses G. Farmer and other able electricians, with the U. S. school of offensive torpedo warfare, established July 29th, 1869, and now regularly maintained at Newport, R. I., the frequent use of electrical torpedoes in several recent foreign wars, and the elaborate series of experiments in electrical exploding which have been conducted by the U. S. school of defensive torpedo warfare at Willets Point, L. I., sufficiently attest that the now recognized art of submarine warfare, if not submarine exploding in general, has become largely an electrical art.

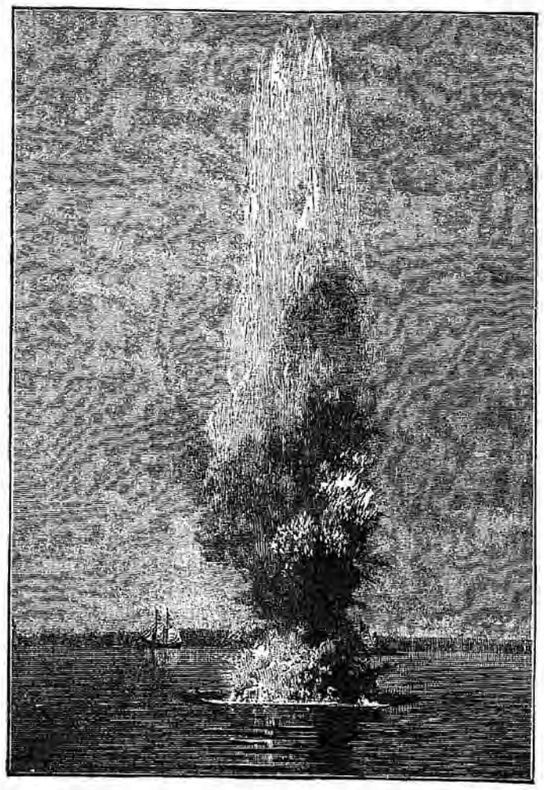
Beyond the obvious and anticipated advantages there is for this a reason which the progress of electrical exploding has itself disclosed. It has been found that subaqueous cartridges may be discharged in two ways viz: by inflammation, or by detonation. In the first way, the charge is simply ignited as by the application of a flame at one point, and it is claimed, with many disadvantages, most important of which is the probability that by the combustion of one part of the charge the case will be prematurely burst open and the remainder of the explosive material blown away without being *effectively* consumed. This may be overcome in part by igniting the charge simultaneously in several places, and only by electrical fuzes can this be accomplished. In the second way, called ignition by detonation, a small cartridge, charged with a quick burning and powerful explosive, in quantity sufficient to burst its own envelope, but not sufficient to burst the large case, is fired in the midst of the principal charge, every particle of which is supposed by the concussion to be sympathetically and simultaneously ignited. The feasibility of igniting the detonating material within an absolutely closed case having no vent is one of the chief advantages of electrical ignition.

The explosion of an electrical torpedo is an interesting study, and one which the modern development of instantaneous photography has greatly facilitated. The accompanying illustration, from one of the remarkable photographs taken by Mr. C. A. Van Sothen of the Willets Point station,[12] shows that a column of water mixed with some mud and stones is projected upward, and the basin shaped depression surrounding its base shows how the surrounding water rushes into the space it vacates. By the area of the basin and the height of the column, determined by the photograph, the power of a torpedo may be approximately estimated, and that of the torpedo which destroyed the Commodore Jones may be inferred by comparison with the effect shown in the figure, which was produced by the explosion, on June 12th 1882, of a comparatively small torpedo which contained but 276 pounds of mortar powder, yet projected a column of water 180 feet in height.

There are two distinct systems of defensive electrical torpedo practice,[13] in both of which the explosion is controlled by an operator on shore. In the first of these the firing of the torpedo, effected by a contact key, is

1. Sleeman, Torpedoes and Torpedo Warfare, Portsmouth 1880, p. 1.
2. Ibid, p. 2.
3. Barnes J. S. Submarine Warfare, N. Y. 1869, p. 17 Clark's Naval History of the U. S., 2 vols., sec ed. 1814, vol 1 p. 63-64.
4. French Commissioners' experiments.
5. Fulton R., Letter to Wm. Brent Jr., of Aquia, Va. (Barnes Loc. cit.)
6. Col. Colt's Biog. Rev. Dr. Barnard Armsmeare, p. 270. (Barnes Loc. cit. p. 53.)
7. Of copper wire covered with asphalt and beeswax. (Barnes. Ibid, p. 56.)
8. *Fraser's Magazine.* Vol. 5, N. S. April 1872, p. 467.
9. Barnes Loc. Cit. p. 62.
10. Ibid, p. 126.
11. Ibid, p. 126. Also, *Fraser's Magazine*, vol. cit. p. 467. For an illustration of this incident see, *Harper's Weekly*, May 28, 1864, p. 348 of the vol.
12. Printed from the negative by Mr. Van Sothen expressly for this sketch.
13. F. A. Abel, C. B. "Electricity Applied to Explosive Purposes," A Lecture before the Inst. C. E., London *Electrical Review*, May 5, 1883, vol. xii., p 367.

wholly dependent upon the judgment of the operator. A desirable feature of this system is that the condition of the torpedo may be examined by testing its fuze, and



TORPEDO EXPLOSION, JUNE 12TH, 1882.

another is that it may be sunken so deeply in a channel as to leave it unobstructed for all but hostile vessels. Its disadvantageous features are two. At night, or during foggy weather, it is inoperative, and even in fair weather the most expert and vigilant operators at the observing and exploding stations find it difficult to determine when the vessel to be attacked is properly situated with respect to the torpedo. To locate the vessel several methods of observation have been contrived, and are described in various works on torpedo practice, but none are free from serious objection.

In the second system, which is most promising, and may be combined with the first, the torpedo is a self-acting mine, exploded either by the hostile vessel striking a circuit closer upon it, whereby circuit is completed through the shore battery and the fuze, or striking a floating or otherwise arranged, detached circuit closer, whereby the mine, moored at some depth below, is at once fired, or a signal given to the operator on shore. Torpedoes arranged in accordance with this system are effective at all times, and especially so in clear weather, while by simply disconnecting the exploding battery they may be rendered harmless at pleasure; but an especially advantageous feature of the system is, that upon the approach of hostile shore parties preceding the advance of vessels upon a river, the operator can close the circuit, conceal the battery and retire, leaving the system still operative.

Since it is only the matter of electrical ignition which may be considered here, no further reference to the remarkable Fish torpedo boat, which may be sent from the shore, moved in any direction to attack a vessel, and exploded if occasion offers, or retrieved at pleasure by electrical devices, is necessary, except that in this, as in all torpedo practice, the selection of the fuze is governed by the conditions described under electrical blasting. The third class or platinum wire fuze is chiefly used, but the spark fuze properly employed, might, if necessary, effect the results which have been obtained, equally well.

By modification in form several of the fuzes described,[14] such as Abel's,[15] have been adapted for the firing of artillery, and advantageously used for the firing of guns "upon proof" at Woolwich. In naval practice every detail for their application to the firing of broadsides has been carefully elaborated, but since their use in this way was first instituted, fourteen years ago, no military or naval emergency has as yet afforded a test of their efficacy in actual service.

By the electrical fuze the ancient practice of firing cannon time-signals has been successfully extended to other than garrison towns. The operation of a time gun, by electrical means, from a distance, appears to have been first accomplished in Edinburgh, where since 1861, a cannon has been fired by a mechanical device actuated by a clock, the time of which is controlled electrically by the mean-time clock of the Royal Observatory on Carlton Hill. Shortly after the establishment of the Edinburgh electrical time gun, others were installed at Newcastle, Sunderland, Shields, Glasgow and Greenock, and are fired in various ways, either directly from the observatory at Edinburgh, or from shorter distances. At present there are also time guns at West Hartlepool, Swansea, Tynemouth, Kendal and Aldershot, which are fired electrically, either directly from London, or by local batteries thrown into circuit by relays controlled from St. Martin's-le-Grand.[16]

A highly novel, and now famous, application of artillery which would be impracticable without the aid of the electric fuze, was first attempted by Mr. Patrick S. Gilmore, the celebrated band-master, when on March 4th, 1864, at a great festival held in New Orleans, to celebrate the inauguration of Governor Hahn, he introduced 50 cannon as accessory to a chorus of 10,000 public school children, and a band of 500 musicians. This attractive application of the electric spark, the success of which in the first instance was largely due to Col. Bulkley, the electrician then in charge, has since been successfully repeated in 1870 at Boston, in connection with the Peace Jubilee, and in 1882 and 1883 at Manhattan Beach. Mr. H. Julius Smith, to whom the effectively prompt ignition of the cannon in the latter instances was due, secured it by discarding the vent fuze and firing the cartridge by a detonating fuze buried within it," to which the current was conveyed by conductors leading through the muzzle of the gun.

BURKE'S SYSTEM OF TELEGRAPHY.

NOTWITHSTANDING the remarkable activity displayed in the field of electrical invention during the past few years, comparatively little attention has been directed to the improvement of telegraphic systems, which could successfully be adapted to communication by long submarine cables. Very few inventors are sufficiently familiar with the results already attained to warrant them in devoting their time to this branch, while the opportunities offered for practical experimenting are very meagre.

The system invented by Charles G. Burke, and patented March 25, 1884, while not confined to cable telegraphy, seems admirably adapted for such work, and is certainly of sufficient interest as an entirely new departure in that direction, to entitle it to a prominent position as a most ingenious conception in the field of electrical devices.

14. This sketch, Part III, ELECTRICIAN, N. Y., Feb. 1884, p. 31.
15. Noad. Students' Text-Book of Electricity, London, 1807, p. 393.
16. F. A. Abel, C. B., Loc. cit.
17. Of the third class fired by a battery and key.

The Burke system is based upon a division of the alphabet, into two groups, which may respectively be designated as left and right hand groups; these groups are each

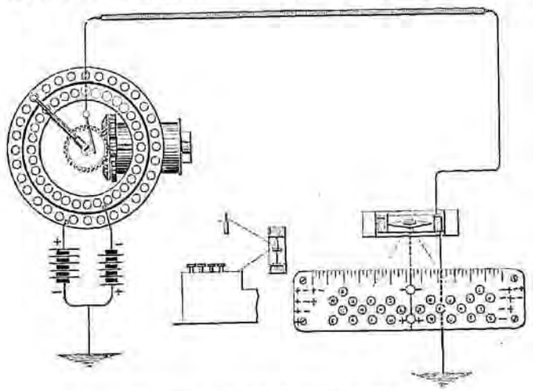


DIAGRAM OF THE BURKE SYSTEM.

arranged in four divisions and each division into four positions. The groups are recognized by a correspondence of deflection in the galvanometer needle; the divisions of the groups by the number of such deflections, and the letters in the division by a period of time from the designation of the division and agreeing in the number of its units with the numerical position of the letter in such division. For submarine cable purposes, alternate positive and negative impulses are found most effective, and consequently in this system it is so arranged that consecutive impulses of like polarity are never required in the elements which constitute a complete signal.

As an illustration of the method of operation it may be assumed that the alphabet is arranged as follows:

Left hand group.	Right hand group.
1 2 3 4	1 2 3 4
1—e; a; i; o.	1—s; t; u; n
2—c; h; p; l.	2—b; y; r; d
3—w; m; f; g.	3—k; j; q; v
4—x.	4—z

In this case the left hand group is designated by a deflection of the galvanometer needle to the left, and the right hand group by a corresponding deflection to the right. If for instance the first division of the left hand group was to be designated, then a current is sent to line that will cause a deflection of the needle to the left; if the second division of such group was intended, it would require two motions of the needle, and as it is essential to avoid successions of similar polarity, the primal motion always determines the side, so that the second motion may be in the opposite direction, and, consequently, the result of a change of polarity. As there are four letters in each of the three first divisions of the two groups, the time required to designate them is divided into four units of equal duration, and to designate any particular letter, a number of units of time corresponding with the relative numerical position of the letter must be required.

For instance, in the foregoing table it will be seen that the letter "p" is the third letter in the second division of the left hand group. To designate "p" would, therefore, require two electrical impulses: the first deflecting the needle to the left, the second to the right, and then a pause for three units of time. The time measurement may be readily determined by the use of a metronome arranged to beat in consonance with the transmitting apparatus; but as there is at most only four units or periods to be recognized a little practice will render mechanical aid quite unnecessary.

The arrangement of the letters is intended to be in accordance with the frequency of their usage in the prevailing language, and they are so placed that those most in use will require the least number of electric impulses for their indication.

It will be observed that the pulsations employed for indicating the divisions are each composed either of a single current or of a series of currents of alternating polarity. Such a combination of currents effectually prevents any detrimental results which have heretofore been encountered from a static condition of the main line or cable.

It is well known that the effect of a current of opposite polarity succeeding any given current is to neutralize the static discharge which otherwise succeeds the interruption of the preceding current. The time which lapses between the indication of any two successive groups of letters is sufficient to allow the static discharge of the last current employed to take place before the next succeeding group is indicated.

In connection with his system, Mr. Burke has designed a transmitting and receiving device which greatly facilitates its operation, and which enables persons of ordinary intelligence to become proficient operators.

The transmitter is a series of keys arranged in circular form, each key corresponding with a letter of the alphabet, and which, when depressed by the operator, will automatically send to line the necessary electric impulses to affect the galvanometer, so as to designate the group and division in which the letter is, and, at the same time, measure off at the conclusion of the group and division signal, a period of time corresponding with the position of the letter. This is effected in the following manner: The key board consists of two metallic rings insulated from each other, and connected respectively with the sources of electric energy of dissimilar polarity. Through the two rings and radially from the centre, are bored a series of holes at regular distances from each other, through which pass connecting metallic pins, and which may be thrown into the pathway of a circuit closing arm rotating beneath them. These pins are so arranged that only one can be in contact with the rotating arm at one time, so that no matter how many may be depressed they must always be operated upon in regular and pre-determined succession. The operator is thus enabled to depress as many keys as may be desired in advance of the rotating arm, and they will be taken in their regular order, their various combinations of impulses and time measurements sent to line, and the key restored to its normal position for further operation. By an indicator above the key board, which travels in the same line with the circuit closing arm, the operator can always tell what keys he may use, and as he has not to wait for the making of the contacts of the keys he has depressed, he can follow the indicator in its round and avail himself of any key beyond which it has passed, so that there is no loss of time. As an illustration of the arrangement of the keys we will take the letter "p." Referring to the table it will be seen that that letter is in the second division of the left hand group, and is the third letter in the division. To designate this letter two electric impulses must be given, and three units of time. The key which corresponds with this letter must, therefore, combine, first, a pin to give a positive impulse, followed by a pin to give a negative impulse, and then a blank space equal to the time of three impulses, and then another pin to give a closing impulse to complete the signal. The top of the key which is circular, extends over all the pins necessary to complete the signal, but is not attached to either of them, so that whilst by its depression all the pins beneath it are simultaneously thrown into the pathway of the circuit closing arm, they are returned under the key head only in the order of their operation, the return of the key top being effected by a means independent of the circuit closing arm. It will be seen that the transmission involves no skill on the part of the operator beyond a facility to keep up with the indicator, and that the signals must be mathematically correct in their transmission, and very plain and distinct to the receiver.

To aid the receiver the inventor has designed a type-printing device, the keys of which are arranged to correspond with the arrangement of the alphabet, so that the signals when received will positively indicate the letter intended. Taking again for instance the letter "p," the receiving operator will first recognize that the galvanometer is deflected to the left, he knows, therefore, that it is the left hand side of his key board which is intended, then comes a second signal which means the second division of the left hand side, then a pause of three beats and a final closing signal, so he has but to depress the third key in the second division of his left hand group and the transmitted letter "p" is printed.

Where a ray of light is employed in connection with the galvanometer it may be readily arranged to have its zero in the centre of the receiving key board; but as no certain degree of deflection is required, a scale is unnecessary, and the operator has simply to observe the direction of the first movement and the total number of distinct signals.

It will be observed that this system involves no change of circuits or increase of battery, and that the same delicate instruments now employed to receive are retained, but it must be apparent to any one who appreciates the conditions incidental to long submarine cables, that it meets all such conditions with the very means best adapted to overcome the obstacles which they present to facility and rapidity of transmission, and must greatly increase the capacity of cables for telegraphic work.

If it is desired to employ electric currents of different strengths for furnishing indicating signals, the same system of divisions is applied, the positive current being replaced by currents of a given strength, and the negative currents by currents of a greater or of less strength. The currents of different strengths may be of the same or of opposite polarity, as desired. Likewise the substitution of currents of different durations may also be effected by assigning a current of a given duration in place of a positive current, and a current of another and distinctive duration in place of a negative current, wherever those currents occur in the system first described.

This system, apparently, opens a new and wide field for inquiry, and must be especially valuable for telegraphic purposes wherever a minimum of battery use, and a maximum of line discharge are requisite, or desirable; it ought also to make the transmission and reception of telegraphic messages much more simple than under the present system, since the codes which are possible by it will be to a marked degree self-teaching and easily comprehended.

As in most new inventions of this character, actual practice will doubtless develop defects which must be eradicated, or suggest improvements that will render the system still more desirable. The principle, however, appears to be novel, and it may possibly be adapted to other uses which have not as yet received consideration.

A NEW MECHANICAL TELEPHONE.

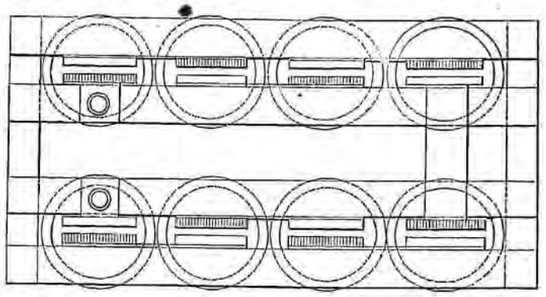
Although the electrical telephone is very extensively used, in social as well as business circles, the price of rental is sufficient to prohibit it from occupying a subordinate, but very extensive field where such an instrument, while a great convenience, is not an absolute necessity. The acoustic or mechanical telephone has been found to be admirably adapted for use in various localities, and its apparent commercial value, has attracted the attention of several inventors, who have sought to render it more efficient. A recent improvement in this class of telephones, consists in making use of a diaphragm formed of thin splints of wood, interwoven in a manner similar to basket work, two or more layers of which are firmly cemented together. One of the principal advantages of this arrangement of the material arises from the fact that it is entirely unaffected by atmospheric changes. Actual tests made with this instrument prove that it is in every way satisfactory for telephonic communication on short lines. A patent for this improvement has recently been allowed to Mr. A. A. Knudson, the well-known electrical and mechanical expert, who is skilfully assisted in his experimental researches by Mr. T. G. Ellsworth. These instruments, in actual use upon lines, have been placed upon exhibition in the office of Mr. John P. Sunderland, Mechanics' Bank Building, Brooklyn, and also at 61½ Broad Street, Boston. Local companies are being formed in various cities to introduce them.

A CHEAP BI-CHROMATE BATTERY.

A. M. BULLARD.

A cheap and efficient bi-chromate battery for experimenting may be made as follows:

Obtain 8 fruit jars [Mason's No. 2 are the most convenient size] and a box large enough to hold them in two rows, four in a row. Eight amalgamated zincs and eight carbons each 6x2x¼ in., should next be procured and a hole should be drilled and countersunk in each ½ in. below the middle of one of the short ends. A frame to hold the zincs and carbons is now to be made.



Four pieces of any hard wood 14x1x1 in., and two pieces 7x1x1 will form this. Fasten the plates alternately upon the longer sticks according to the accompanying diagram, and connect with strips of sheet copper ¾ in. wide, placed between the plates and the frame, the same screw passing through both plate and copper band. Clamp down the strips from the first and last plates by suitable binding-posts. Some contrivance must be used to raise the frame and elements out of the liquid when not in use. The well-known windlass will do, or they may be raised by hand.

ABSTRACTS AND EXTRACTS.

THE SKRIVANOW POCKET BATTERY.

The element is constructed of sheet zinc and silver chloride wrapped in parchment paper, immersed in a solution of 75 parts of caustic potash in 100 of water. The whole is placed in a small trough of gutta-percha, which can be closed hermetically. The conductors and external contacts are of silver. Such an element, when complete, weighs about 100 grms. Its electromotive force is 1.45 to 1.50 volt, and it yields for an hour a current of 1 ampère.

CENTRAL AMERICAN TELEGRAPHS.

All the lines in Central America were built by and are the property of the Government, and are worked for their account, the employees receiving salaries varying from $20 to $50 per month in way offices. In the capitals higher salaries rule, but are not of a nature to induce foreign talent to seek them. In Guatemala, Salvador, Honduras and Nicaragua the system is Morse pure and simple, with only such additions as the Spanish language has demanded in the alphabet. These additions were made by Mr. McNider.—*Canadian Electrical News.*

THE BENNETT-MACKAY CABLE.

The *Pall Mall Gazette* of London, gives the following information regarding the construction of this cable:

The "copper centre." of the deep-sea part of the cable is formed of 13 wires—12 wires of small size coiled around one wire $\frac{1}{10}$ of an inch in thickness. The conductor thus created is $\frac{3}{10}$ of an inch in diameter. This work of binding the copper wires together is performed by a small "stranding machine," which grasps the principal wire as it is driven through an orifice, and fastens the 12 minor wires around it. All the interstices are afterward filled up with a solution of gutta-percha. There are ten of these stranding machines at work upon this cable, and these can together turn out 60 miles of copper centre in a day of 24 hours. Breakages of wire are rare. The copper used, of course, is of the best quality. It comes principally from Lake Superior. Messrs. Siemens generally buy the copper in wire form. They are now using it at the rate of 50 tons per week. There is more weight of copper in the cable now being manufactured than in any other cable previously turned out.

HOW ELECTRICITY IS MEASURED.

FROM PROF. BARKER'S LECTURE.

Special instruments are used to measure all of these powers—the electrometer for tension force, the galvanometer for strength of current, standard coils for resistance, calorimeter for heat, and for chemical effects a voltameter.

To measure the electricity used in an electrolier, such as was suspended over the rostrum, and containing fourteen jets, several meters are to be had. A picture was thrown on the screen of one which consists of a bottle of liquid, in which a deposit of zinc is made according to the amount of electricity used. This is used in New York city, and this bottle is examined every month.

Another bottle is connected with it, to be looked at every year. This acts as a check on the other. In order to prevent the liquids from freezing an electric lamp is placed beneath the bottles, and over the lamp is fastened a bar of joined iron and brass, with the brass on the lower side. When the temperature decreases, the brass and iron are affected unequally, and, in this way, a wire connecting with the current is touched and the lamp lighted automatically.—*The Electrical Era.*

UTILIZING WASTE.

It is the value of the residual products that have enabled the gas companies to bid defiance to the competition of any other light.—*Electrician.*

If we are not mistaken, the gas that has shown the most indifference to the "competition of any other light" is water gas.—Will our contemporary please tell us what are the "residual products" in its manufacture?—*Water Gas Journal.*

We do not propose to cross swords with our esteemed contemporary upon the "gas" question, as we do not pretend to be experts in that line. While willing to admit that there are no residual products from "water gas," the latter has gained no foothold in Great Britain, and it is there that coal gas is cheapest, and, consequently, the field for profitable electric lighting least encouraging. However cheap water gas may be, consumers in New York city are deriving little benefit from its introduction.

LITERATURE.

NEW PERIODICALS.

The Electrical Era.—George M. Wallace, Manager; The Electrical Era Publishing Co., Limited, Philadelphia, Pa., appeared on May 1. It purports to be a weekly journal devoted to the development of the science of electricity. It contains a considerable amount of interesting matter, but is marred by an unusual amount of typographical errors. It aims to be fearless, independent and impartial.

REVIEWS.

Berley's Electrical Directory and Advertiser: The Electrician's "Vade Mecum," 1883-84. 3d Edition, revised and enlarged. Cumming & Brinkerhoff, 219 East 18th St., New York.

This familiar work, which has now become an indispensable hand-book to all who are in any manner connected with electrical affairs, appears in a very complete form, and is not only valuable as a directory of all trades and industries which are in the slightest degree identified with the business, but, by reason of its tables and statistics, has become a very handy book of reference. In every busy establishment, questions are continually arising which may at once be settled by a glance at this directory. Its compilation has involved considerable labor, and it could hardly be expected that the classification of its contents should be perfect, or free from errors. As a guide to purchasers, however, it would be more satisfactory if a distinction was made between manufacturers and mere agents or dealers. As an instance, under the head of earthenware manufacturers for electrical purposes, there is but a single name, and this one an agent, while there are a dozen or more potteries in this city and vicinity which do not appear, although published in the previous edition. A well known manufacturer of steam engines is not given under that head, but is classed as a mechanical engineer. Other names appear prominently under various heads which are not generally recognized by the trade as parties of special experience, as might be supposed by the casual searcher for reliable information. As the book was printed in England, typographical errors in the American department might naturally be expected, but had proper care been exercised in the preparation of the copy, they might not have been so conspicuous a feature. It is for the reason that we appreciate the importance of reliable information, that attention is directed to these minor defects which may be eradicated in future editions.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Engineering (London), April 18.—Electric light on shipboard; continued (illustr).

Electrician (London), April 5.—Description of an electrical launch—*A. F. Yarrow.* April 12.—New standard unit of light—*F. v. Hefner Alteneck.* Lightning conductors on the Meisens system. The heating effects of electric currents—*W. H. Preece.* May 3.—The induction of currents in cores—*Oliver Heaviside.* The cost of transmission by electricity.

Engineer (London), April 25 and May 2.—H. M. S. cable ship "Monarch" (illustr).

RECENT PUBLICATIONS.

Ayrton, W. E., and Perry, J. Winding electro magnets. New York, *Spon,* 1884, illustr. 8°.

Baltet, C. Traité de la culture fruitère commerciale et bourgeoise. Paris, 1884. 10+640 p., portrait. 350 figs. 12°.

Bardet, G. Traité élémentaire et pratique d'électricité médicale. Paris, *Dien,* 1884. 10+645 p. 294 figs. 8°.

Billmanson, A. Elektriciteten och dess tekniska användning. del 1. Elektricitetslära. Stockholm, 1884. 232 p. 8°.

Bericht über die internationale elektrische ausstellung, Wien, 1883. Unter mitwirkung hervorragender fachmänner herausgegeben vom Niederosterreichischen gewerbe-vereine. Redacteur F. Klein, Lief. 1. Wien. 80 p., illustr. 8°.

Ditte, A. Traité élémentaire de chimie fondée sur les principes de la thermochimie, avec emploi des données calorimétriques. Paris, *Dunod,* 1884. 20+297 p. 138 figs. 12°.

Daniell, A. A text-book of the principles of physics. London, *Macmillan,* 1884. 20+653 p., illustr. 8°.

Fahie, J. J. A history of electric telegraphy to the year 1837. New York, *E. & F. N. Spon,* 1884. 19+542 p., illustr. 8°.

Gomez y Pallete, J. Historia y progresos de la electricidad. Conferencias del centro del ejército y de la armada, 24 de Noviembre de 1883. Madrid, *impr. de Pacheco,* 1884. 48 p. 8°.

Preece, W. H. On electrical conductors. London. Inst. of Civil Engineers, 1883. 67 p. 8°.

Plante, Gaston. Recherches sur l'électricité, de 1859 à 1879. Paris, *La lumière électrique,* 1883. 5+322 p. 8°.

Serpieri, A. Das elektrische potential oder grundzüge der elektrostatik. Die neuere theorie der elektrischen erscheinungen. Uebersetzt von R. v. Reichenbach. Wien, 1884. 250 p., illustr. 8°.

Wallentin, J. G. Die generatoren hochgespannter elektricität mit vorwiegender berücksichtigung der elektrisirmaschinen im engeren sinne. Wien 1884. 202 p., illustr. 8°.

Welch, E. J. C. Tables of relative weights of copper conductors for conveying electrical currents from 1 up to 5,000 ampères.—Table of the relative weights and size of insulated copper conductors for conveying electrical currents of from 1 to 2,741 ampères, showing the electromotive force absorbed by the conductors; also the nearest corresponding imperial B. W. G., size of solid copper wire, or strand for the purpose. New York, *Spon,* 1884.

CORRESPONDENCE.

NEW YORK AND VICINITY.

The Telegraphic Interest in the Wall Street Flurry.—Electric Light Affairs in New Jersey and Brooklyn.—Midnight Pole Planting.—Final Disappearance of Printing Telegraph Property.—Underground Legislation.

APART from the financiers who are directly interested in the effects of a panic, there is probably no portion of the community who are so thoroughly awakened as the telegraphers, who have an important duty to perform during such exciting scenes as have recently directed the attention of the whole country toward Wall Street and the Stock Exchange. George E. Spencer was the cashier of the now notorious firm of Grant and Ward, whose downfall, precipitated the recent financial squall. Mr. Spencer learned telegraphing at Pittsfield, Mass., became manager of the American Telegraph office at Albany, private secretary to Sup't Prescott, then operator for Jay Cooke & Co., where he was located when the failure of that house led the panic of 1873. From there he went into the First National Bank, and eventually became intimate with Mr. Ward, being frequently the guest of that erratic financier at his villa in Stamford, Conn. Both A. W. Dimock and his brother Arthur V. are enthusiastic amateur telegraphers, the latter having a Morse line connected with his residence in Elizabeth, N. J. These gentlemen composed the firm of A. W. Dimock & Co., and until the recent break in the market have successfully maintained the price of the stock of the Bankers' and Merchants' Telegraph Company of which the senior partner is president, as he also is of the Commercial Telegram Company. It is not believed that the extension of the facilities of these companies will be retarded by this suspension, for the reason that their available resources in other quarters are unimpaired. Such connections however, usually weaken confidence, and it is impossible to judge what the final result may be.

The firm of Hotchkiss and Burnham which was forced to suspend, at least temporarily, is composed of H. L. Hotchkiss one of the organizers, and for several years treasurer of the Gold and Stock Telegraph Company, and J. W. Burnham, formerly manager of the Western Union office at the Fifth Avenue Hotel. No discredit is attached to their failure, and their honorable conduct during the crisis will probably bring them new customers when they resume business.

The Mutual District Telegraph Company found itself temporarily embarrassed by the suspension of the Metropolitan Bank where its account was kept. Fortunately, the resumption of payments by the bank on the following day removed what promised to be a serious difficulty. The Union Electric Manufacturing Company in addition to its other misfortunes had its available funds on deposit in the Marine Bank, and it has no immediate prospect of getting hold of them.

Considerable indignation has been aroused in Newark, N. J., over the proposition of the gas companies, to reduce the prices of their product to the citizens as well as the city, provided they are protected in their monopoly for a period of ten years, which is the term the proposed contract is to run. As Newark may be called the home of the Weston system of lighting, the United States company will no doubt jealously guard the interests of the people in its efforts to obtain a firm foothold for the electric light.

Our great sister city of Brooklyn, after many months of agitation in its official circles, has finally decided to permit the establishment of two electric lighting systems. The privileges have been granted to the Kings County, and to the Citizens Electric Lighting Companies. The former will use the Fuller system, at least in part, while the latter, representing the firm of Pope, Sewall & Co, of New York, will furnish the Thomson-Houston lamps and dynamos. Each company is required to provide the city with four lamps of 2000 c. p., free of charge, and also one for each 30 private consumers supplied. Additional lamps required by the city will be charged for at a rate not exceeding 70 cents per night for 2000 c. p., and 15 cents per light for 16 c. p. The companies also agree not to charge private consumers over 75 cents per night for arc lamps and 15 cents for incandescent.

The Baltimore and Ohio Telegraph Company has aroused the indignation of the press by invading the streets of New York city by night, and erecting huge poles to astonish the sleeping citizens when they went abroad by daylight. Such doings naturally arouse suspicion, but the policemen on duty, after investigation, find that everything is authorized by the proper officials, and after the wires are once strung, the removal of a line, either by legal or illegal process, is not an enviable undertaking.

It is a curious fact that an ordinary commercial system of telegraphs, extending all over the country, may be established, and become a formidable competitor for business, before it is possible to start an auxiliary, in the shape of an opposition quotation system, in this city. Attempts in this direction were made both by the Atlantic and Pacific, and American Union companies, but the instruments had not yet been put in operation, when consolidations were effected, and the relics of these enterprises, representing, perhaps, $60,000 in cash, were recently broken up, and have passed out of existence as printing telegraph instruments, never having earned a dollar.

The officials of the various electrical companies in New York do not evince any special anxiety regarding the result of the passage of the Daly underground bill, even if it is signed by the governor and becomes a law. Good authorities pronounce it unconstitutional for at least two reasons. First, that it is retroactive in its provisions for the removal of structures lawfully erected in good faith; second, that in some cases, notably the arc light companies, it is a virtual confiscation or destruction of property, in which money would not have been invested had such legislation been anticipated. Immediately after the bill had passed the Assembly, petitions urging the governor to sign it were actively circulated in this city, probably by the agents of some underground scheme, who watch the interests of the public with such tender solicitude.

NEW YORK, May 30, 1884.

PHILADELPHIA.

Unusual Activity in Line Construction.—Property Owners Tired of Roof Raiding.—Paying for Housetop Privileges.—Ground Breaking Ceremony of a Subterranean Company.—Action of the Council's Committee.—Satisfactory Progress of Electrical Exhibition Matters.—Extension of Opposition Telephone Lines.—A Gas Explosion in an Electrical Conduit.

THERE can be no doubt as to the activity of electrical matters in this city. Go where one will, he is almost certain to see gangs of men with all the tools and material necessary for the repair or construction of wires for various electrical purposes. A dozen years ago, such an influx of men in this particular line of business would have caused considerable comment, but electricity having become such an indispensable agent, and being so universally used in our every day affairs, it no longer excites wonder.

In certain portions of the city, where the wires, crossing and recrossing business houses, have become very plentiful, owners or occupants of such buildings are beginning to consider them somewhat of a nuisance. They complain of a constant stream of linemen raiding their premises, whenever the wires get in a tangle, and it was only a few days ago that the officers of the Pennsylvania Mutual Life Insurance Company cut all the wires of the Baxter Telephone Company running over their roof at No. 925 Chestnut St. There have been other cases of a similar nature within a short time, and unless the wires are put underground very soon, the cutting of conductors running over housetops, bids fair to become a very frequent occurrence. The Telegraph companies, well aware of the fact that they have no rights to trespass on people's property, are paying for the use of roofs on which to run their wires.

The Philadelphia Sectional Electric Underground Company, taking advantage of the fair weather, has commenced its spring work of laying conduits. It began operations at the corner of 9th and Chestnut Streets, and promises by the middle of May to have completed its system eastward, to the Delaware river, a distance of about one mile. The work was opened with considerable ceremony and attracted a large crowd. President W. H. Johnstone, General Manager George McGowan, Treasurer Sabine and other persons interested in the company were present. The Treasurer broke ground himself, with a declaration that work would thereafter be pushed until conduits were laid in every street where the business interests of the city demanded them. A despatch was read from Chicago giving the information that the Baltimore and Ohio, Bankers' and Merchants' and Postal Telegraph companies had bowed to the inevitable, and accepted the system, and would go underground.

Chicago has the advantage of this city in having seven miles of these conduits already in operation and more are being rapidly laid. The local company here promises all in its power to give Philadelphia equal service at the earliest possible moment.

Council's Committee on Police and Fire Alarm Telegraph, met a few days ago for the first time since its appointment. The ordinance granting permission to the Philadelphia Sectional Electric Underground Company to construct, maintain and operate in certain streets, a line of wire, or other conduits, and to lay wire for the transmission of electricity to furnish light, power and sound, was ordered to be reported to councils with a favorable recommendation.

An ordinance granting to the Citizens' Telephone Company the same privileges as have already been given to the Clay Company, was presented and referred to a sub-committee. The sub-committee will call a meeting soon, and hear arguments in the case.

The ordinance extending the term to September 1884, for the Philadelphia Sectional Underground Conduit Company to lay its pipes was also favorably reported.

The Electrical Exhibition building is taking shape very rapidly. The contract calls for the completion of the building not later than June 15th, and from present appearances it will, no doubt, be completed on that day, if not before. Applications for space continue to come in from all quarters of the globe, and inquiries as to arrangements and conveniences arrive in great numbers. Colonel Bance and Dr. D. Wahl, with their assistants, find their time constantly employed answering, adjusting and preparing the preliminaries for the undertaking.

Among those who have already applied for space are the Edison Company, the United States Electric Light Company of New York, and the Brush Company of this city, which has requested for its own exhibits no less space than 1,800 square feet. The latter company will show specimens of dynamo machines, incandescent and arc lights, storage batteries, a motor and an electric railroad.

President Tatham, of the Franklin Institute, suggested at a recent meeting of the committee that the tower of the exhibition building, facing 32d Street and Lancaster Ave., be raised a further height of 30 or 40 feet, and that the Lighthouse Board should furnish a revolving light. The effect would be very fine, as the light could be seen from almost all parts of the city, and a considerable distance into the country. The suggestion will probably be carried out.

The proposed collection of works on electrical science, is being successfully made, although the applications have only been out about 15 days. Already from 30 to 40 domestic publishers have promised their hearty co-operation. Applications have also been made in connection with many pieces of apparatus of historical value, and it is expected that this branch of the exhibition will be well represented.

The delegation sent by the Committee on Exhibits of the International Electrical Exhibition to New York and Boston, has returned after a very satisfactory visit. They saw several of the prominent electrical inventors and manufacturers of those cities, and received fresh promises of their co-operation.

The Clay Commercial Telephone Company is actively engaged in running wires throughout the city, notwithstanding that the American Bell Telephone Company and the Bell Telephone Company of Philadelphia, threaten suit for infringement. The former company is now ready to receive and make contracts for telephonic service by private lines and by exchanges. The Central Exchange, at Third and Chestnut Streets, is being rapidly pushed to completion and will very soon be ready to render exchange service. Exchanges will be established in other sections of the city as rapidly as demanded.

Permission has been granted to the Reading and Pottsville Telegraph Company to lay a pneumatic tube from its office to that of the Reading Railroad Company.

A special committee was recently appointed by councils, to ascertain if the various telephone companies which had been granted privileges by the city had lived up to their agreements. The ordinance changing the name of the Police and Fire Alarm Department to "Electrical Department," was ordered favorably reported, as was also the petition of the Citizens' Local Telephone Company to place wires on city poles, for which privilege it will place free service in all the departments, police stations, and fire houses.

A sharp explosion, which hurled a heavy iron man-hole cover from the electrical conduit at Fifth and Chestnut Streets, thirty feet into the air, occurred the other afternoon. It is supposed that gas collected in the conduit from some leaking pipe near it. The explosion was caused by a lighted match thrown upon the man-hole by a workman digging in the trench opposite the Custom House. He was knocked down and somewhat singed by the sudden explosion and blast of flame. His first exclamation upon getting to his feet was: "where's me pipe?"

The Brush Electric Light Company is engaged in laying an underground cable on Delaware Avenue, between Vine and South Streets to connect the lamps furnished by the company for the Girard estate. The distance covered is about one mile.

The Baltimore and Ohio Telegraph Company is said to be doing a fine business to all points where it has offices. It has opened an office in the new post office building here at 9th and Chestnut, and as this is a central location, there should be no difficulty in obtaining all the business that can be conveniently handled.

PHILADELPHIA, May 14, 1884.

CHICAGO.

An Electric Street Car.—Photography by the Rays of the Electric Light.—New Quarters of the Central Union Telephone Co.—Improved Construction of Electric Light Lines.

A CHICAGO inventor is about ready to test a street car motor, which is rapidly approaching completion, and of the success of which he feels perfectly assured. This gentleman, by the way, is possessor of some hundreds of thousands of dollars, the proceeds of former inventions, and the prosperity which has attended his previous efforts, no doubt buoys him up in this last crowning glory of his fertile brain. If the "Innovator"—the name of this new motor—proves a success, there are many who have gone through it from an electrical standpoint, who will be grievously disappointed. Argument is a useless weapon with which to combat prophesy—one can only wait, and—disbelieve. Probably the inventor never saw Froment's engine, which is almost identical with the "Innovator," if turned down sidewise.

The Chicago Photographers' Association held a meeting a few evenings since, at the rooms of the Vanderpoele Electric Light Company, the object of which was to show to the uninitiated some practical experiments in the use of electric light, for both taking negatives and printing therefrom. The attendance was quite large, and after listening to a paper on the subject, by G. H. Sherman, of Elgin, the reader proceeded to show practically what he had outlined. His method of handling the light is simple, yet apparently quite satisfactory, as far as I can judge. The method has been in daily use for nearly a year in his studio, and is both practical and successful. The light, arranged for both vertical and horizontal adjustments, hangs in front of, and quite near, a concave reflector of white muslin, which throws the rays back upon a screen between the light and the sitter, who is thus in a "side light." This screen is also of white muslin, but in its centre, a hole, 2x3 feet, is cut, and this open space is patched by a piece of blue mosquito netting, or gauze. In the centre of this again is placed a thickness—sometimes 2—of tissue paper about a foot square. On the opposite side of the sitter is another white screen reflector, having a plain surface. In some cases a looking-glass is utilized, to still further dissipate and equalize the light rays, the whole resulting in very perfectly softening the light, and breaking the abruptness of the shadows. An ordinary, neutral tint background completes the arrangement.

The venerable president of the Vanderpoele company was announced as the first victim, and was followed by sundry lesser lights, each execution requiring about 20 seconds, the criticisms of the experts present being favorable in all cases. While all this was taking place, another photographer—Gentile—was manipulating, what to the profane seemed a tin bake oven, in another corner of the room, the occasional sizzling of the inclosed lamp going far to aid the culinary illusion. There, prints were made from sundry negatives with good results, and soon, in a third room, a detail of experts were busy developing the good looking portraits just taken. In a fourth room, a series of experiments illustrating the current manifestations in various gases—Crooke and Geissler tubes—were shown, so that, take it all in all, the seance was quite interesting, and to very many of the society, highly instructive. The various processes were continued until quite a late hour.

Do not think for a moment that this application is a new thing here. Many of our photographers have been using it for a long time, and there are several engravers and stereotype establishments where it has been in daily use for some years—but the photographers' society, like many another society of specialists, is sometimes driven to a corner for material for a monthly meeting.

During the evening a sort of triune compact was formed between a photographer, a chemist, and an electrical student, who will jointly endeavor to evolve from their combined knowledge and ingenuity, some better method of sifting out the non-chemical, and more perfectly utilizing the chemical rays. They have a theory. In all this prospective development, we are reminded of Voltaire's definition: "Theory is a mouse, which passed through nine holes in safety, but was stopped by the tenth." The truism contained in this excerpt is applicable to other branches of our calling, as well as to electric light results.

The Central Union Telephone Company has left its old home in the Western Union Building, and is in the usual condition of people who have "just moved in," in the new Pullman Building. The new quarters are five stories from the ground, and are roomy, pleasant and convenient. Its former neighbor, the Chicago company, will soon join it on the same floor. The entire force of employés are highly gratified with the change. The whole building is wired for Edison lamps, and when completed will contain 2,037 of them. The engine which is to furnish power is an Armington & Sims, 14½x13, rated at 200 h. p., and will be run at 254 revolutions. In the first instance but one dynamo will be placed, with a capacity for 400 lights. This, it is reasonably presumed, will be sufficient for the needs of the long daylight days. After awhile a second will be added, and if found necessary, perhaps a third.

Considerable strife is now manifest among the electric light companies—contrary to the usages of former days—in endeavoring to outdo each other in the excellence of their work. This is one of the beneficial effects of the inspection ordinance to which I have heretofore referred. They have all, without exception, cheerfully submitted to the ordinance with a good grace, and aided the inspector in his work to the extent of their ability. Prof. Barrett, the city electrician, expresses himself as surprised in the ready acquiescence of both companies and consumers to the requirements of the law.

CHICAGO, May 18, 1884.

BOSTON.

The Numerous Telephone Companies Which Aspire to Power.—An Electrically Lighted Coasting Craft.—City Authorities Still Granting Pole Privileges.—The Electrical Development and Manufacturing Company.

WHILE looking over the volumes of electrical patents, the other day, those thick books which show forth the fecundity of the glorious American inventor, and the absorbent power of the still more glorious American patent solicitor, I was struck with the number of telephone companies, who at present seem to be gathering a patent here and there; now a transmitter, now a receiver, and then a central office, and one or two of those funny little things called individual bell patents—all the while seeming to be guided by a purpose to have a bouquet of patents which would answer the purposes of a little stock company, when that giant Bell company should lose its grip.

The first company in the business was the Bell company, which licensed to the Bell company of New England. The latter soon appears to have absorbed its parent in a most untillial way, and emerged as the National Bell Telephone Co., which, when the waves of water dashed high, swelled up to the name of the American Bell Telephone Co., and the latter spread its tentacles into every nook and cranny of the land. As a great rival claimant the name of the Western Union Telegraph Co., as a telephone promoter. is familiar, controlling the inventions of Edison and Phelps. Then we hear of the Harmonic Telegraph Co., bearing aloft the name of Gray as the only and true. Next in our mind is the Gold and Stock Telegraph Co., having the telephonic names of Dolbear, Short and Fitch to conjure with. And last in this list appears the American Speaking Telephone Co., which acted as the reservoir for the preceding aspirants until the time should come when he whose right it was should appear.

Of the tribes who now are without sustenance and who are in eager search for the garments to be divided by lot, is the People's Telephone Co., which first secured the patents of Tisdale and Klemm, and then found in the sleepy hollow of Yellow Breeches creek Rip Van Winkle Drawbaugh, who should be awarded a place with the celebrated Seven Sleepers. This is the man who climbed a *Hill* with the aid of *Jacob's* staff. Then we observe, dimly, the Eaton Telephone Co., which now sleeps quietly.

The Molecular Telephone Co. presents an imposing array of patents, granted to Lockwood, Bartlett and Waite, in various combinations of the names. The Overland Telephone Co. is founded on patents granted to Dr. Baxter, who is giving the American Bell Co. anything but a saint's rest. The People's Telephone and Telegraph Co. secured the patents of G. M. Hopkins.

The Dirigo Telephone Co., of Maine, is wrestling with patents issued to Beedy. Then appears the Dolbear Electric Telephone Co., which has made a gallant fight under Prof. Dolbear's inventions. The Clay Telephone Co. is making a determined show in Philadelphia, with Henry Clay's patents. The Shaw Telephonic Co. of America, has the courage of its convictions, with G. E. Shaw as a patentee.

The Atlantic and Pacific Telephone Co. thinks that Gillet's patents will be heard from one side of the Atlantic to the other, shortly. Here we see J. H. Robertson, with his little cluster of patents, and friends to back him. The Secret Telephone Co. has the patents of J. H. Rogers, who so easily chops up one's words, sends them dismembered for miles, and finally unites them as they were originally, without break or fracture. Not content with doing that, the same J. H. Rogers must seek other fields, or rather tubes, for he discloses to us the American Electro-Gas Telephonic Co., of New Jersey, and invites us to talk through our gas pipes, and make them give forth sound as well as light.

The United States Telephone Manufacturing Co. has a full hand and feels flush, with the numerous patents issued to Coy and Buell.

These are the principal companies to which the American public will be invited to turn with expectant hope, "when the clouds roll by," and time would fail us to speak of the mechanical telephones, the "lovers' whisperers," and the inventions of Watson, Gilliland, Kellogg, Scribner, etc., etc., for telephonic apparatus, or of the hopes and struggles of minor inventors, and of the select syndicates all over the land, who have had in grooming "little Bells and Edisons" with which to dream of electric empires and Arabian Nights' revelings. Telephonic research has not been "a true fissure vein," as the festive mining circular reads, to all who have struck a lode, pockets have been depleted rather than filled, in many cases. How frequently a friend is heard to say, "You see that man over there, the one with the moody brow? Well, I'm told he actually was the inventor of the telephone," or the dynamo, Colorado beetle, or something that has proved an immense success; and as long as he lives has a small circle to whom he retails how near he came to immortality—if he could have had *one* more spoke in his wheel he would have been all right.

It is singular to observe how the Bell people have strode forward, keeping to the simple, first principles, as embodied in their apparatus, winning victories through thick and thin, overcoming difficulties and obstacles. A strong hand and steady head has almost seen the end from the beginning, and struck out for it. Nothing appears to avail against it.

An odd electric light installation has been brought out. The Bernstein Electric Light Co. has fitted its system on a coasting sailing vessel, using the steam power applied to the hoisting apparatus. About 50 lamps are in the system, including signal lights in the rigging. This is the most unique application of electric lighting yet made public.

The House has passed to be engrossed a bill to fine all electrical companies $500 if they put wires on buildings without consent of their owners. An order has been passed by the Board of Aldermen authorizing the Committee on Lamps to contract with the several gas light companies for furnishing gas for the public lamps in their respective districts for the term of three years, and also to contract with any responsible electric lighting company or companies for furnishing the city with electric lights. It continues to authorize the erection of poles, the Baltimore & Ohio Telegraph Co. obtaining important concessions for their pole lines, as also the telephone companies.

The Electrical Development and Manufacturing Co. has established a laboratory and factory at 197 to 205 Congress Street, occupying two floors, each 50 by 125 feet square, in the building of the American Electric and Illuminating Co. It is proposed to exploit electrical inventions of all kinds and keep in stock all the standard classes of telegraph, telephone and electric light supplies. The officers and directors include the names of some of the prominent electric light, telegraph and telephone people of the community.

BOSTON, May 17, 1884.

WASHINGTON.

Slim Prospect of the Passage of any Government Telegraph Scheme.—Experimental Subterranean System of the Telephone Exchange.—Fine Effect of the Lights on the Capitol Dome.—Successful Progress of the U. S. Electric Light Co.

"SHALL we have a government telegraph system?" is a question which was answered in the negative in this correspondence early in the present session of Congress. Several bills have been introduced, much testimony taken, and arguments *ad libitum* heard by the committees, and the outcome has been the introduction of a bill in each house, providing practically for contracting with some company for the transmission of telegrams at certain fixed rates.

It is possible that these bills may be taken up in one or both houses and considerable eloquence wasted on them, yet there is but the slightest chance of their passage. The bills are by no means satisfactory to the advocates of a government telegraph, and it is not likely the Western Union company, which is looked upon as the potent influence against a government system, will press a measure like either of the pending bills, which may be considered as a shunt circuit, to break the force of the governmental proposition, and which seems to have diverted most of the current. Those favoring the government control of the telegraph, do not credit the Postal company with the extremest good faith, and claim to see the Western Union company behind it. Should the bill come up for discussion in the house, it will be strongly opposed by Messrs. Anderson and Sumner (Cal.). The latter is an ex-telegraph operator, and has been in correspondence with a large number of his former co-laborers, as to the inside workings of the Western Union company.

The subject of underground wires continues to embarrass the District Commissioners. With their eyes fixed on an ultimate removal of all overhead lines, they have been repeatedly forced by various considerations to temporarily relax their efforts in this direction; but they continue to gain ground, and feel confident of ultimate success.

The Chesapeake and Potomac Telephone Company, from whose exchange the wires run as thickly as the threads of a spider's web, have inaugurated a system, by which it is proposed to bury the wires to such a distance from the exchange, as they can be run in any considerable number, and for the present diverge from the termini, through alleys and over back buildings, to the single points in communication. The first experiment is now being tried, and consists of a wooden box, about 8 inches square, placed at the bottom of a trench, 2 feet deep. After a layer of tar in the bottom of the box, two kinds of cables are then laid in, *i. e.* the Phillips' and that of the Western Electric Company. The former carries 100 and the latter 50 wires. Having laid and covered these cables with tar, advantage is taken of the remaining space in the box, and some 50 or 100 wires of every description and every variety of covering, and even naked wires are laid, with a view of having a more satisfactory test and perhaps developing some new data on the subject. The distance which it is proposed to carry these experimental wires is about 3,000 feet and the cost is estimated at $10 per foot.

The Waring cables laid last season for the police, fire-alarm systems and the departmental circuits, continue to work well, and will be much extended during the present season.

The Brush-Swan Electric Light Co., whose experiments have been frequently noted, inaugurated another one on Saturday night. The fourteen 4,000 C. P. lights, which have been attached to the tholus on the capitol dome, were dropped about 20 feet, and a reflector, 23 inches in diameter, placed behind each. They were then adjusted so as to throw their rays through the various streets and avenues radiating from the capitol, over the open spaces around the building, and upon the public buildings and reservations. The result was quite effective. Newspapers could be read at a distance of a mile from the lights on the streets thus lighted. Some minor defects were found in the initial test which will be remedied and the experiment repeated in a day or two. While these experiments are being made, the company is going on with its plant, and will soon be in a position to supply almost unlimited demands for lights of any description. The Smithsonian Institution and National Museum have been supplied with lights of both classes, and they are gratuitously lighted by the company whenever required. On the occasion of the recent exhibition by the Fish Commission a brilliant illumination was given.

The United States Electric Light Co. has settled down to regular business and puts up its lights only when ordered, at the regular rate of charges. The half-dozen or more exhibition lights at the approaches to the capitol are exceptions to this rule. The company has something over 100 arc lights burning nightly, and has been able to declare a dividend of 6 per cent., payable July 1st.

WASHINGTON, May 19, 1884.

PROVIDENCE.

The Multiplex Line not yet in the City.—Report of the Providence Telephone Company—Satisfactory Service of the Thomson-Houston Electric Light.

THE Standard Multiplex Telegraph Company continues to be unfortunate in its efforts to enter this city. At a recent meeting of the City Council Committee on Ordinances which holds the fate of the Multiplex matter, the petitioners were given leave to withdraw, the chairman reporting that while the company had, as he supposed, an excellent system, yet its interference with telephone and other telegraph lines was so marked, that the committee could not grant the right of way asked. The company's representative made the mistake of announcing that his was merely an experimental line. This caused the committee to suggest that the experiments could as easily be carried on outside the city limits as in our midst, and the members did not think it wise to further encumber our streets with poles for the conducting of an untried system. The movement has been engineered by Councilman Smith, a friend of Mr. Goodwin, who is General Manager of the company. Now the Providence *Evening Press* newspaper has taken up the cudgel in behalf of the Multiplex company, and vigorously demands its admission. As the present committee will hold over until next January, it is not believed that the new champion will help matters along.

At the annual meeting of the Providence Telephone Company, held a few days since, it was shown that the net earnings for the past year were $46,036. 30, or about 23 per cent. on the present capital stock. In February, a dividend of 5 per cent. was declared and paid, and, allowing for the expenses of the present month, the Treasurer thinks the accumulated earnings will be sufficient to warrant a like amount as dividend this month.

The gross earnings during the year were $121,699 15; expenses, $75,662 85; net earnings, $46,036 30.

The report of the General Manager and Superintendent, J. W. Duxbury, was presented and showed the number of subscribers on May 13, 1884 to have been 2,812, an increase of 409 from the previous year, when it was 2,403. There were at the time of the report 50 unfilled applications, and they continue to come in daily, and the indications are that as many telephones will be put in this year as in any during the history of the company. There were 214 instruments taken out during the year, owing to failure in business, death, removal and refusal to pay. Sixty-four of the above were summer connections, which will probably be replaced this season.

The company has now in use nearly 1,000 miles of wire. The Finance Committee reported that the General Assembly had granted an amendment to the charter of the company, allowing it to increase its capital stock to $300,000.

The Thomson-Houston electric light is giving universal satisfaction and it is fair to say that the prospects of the Narragansett Electric Light Company are most flattering. The light is steady and seldom if ever fails.

PROVIDENCE, R. I., May 16, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, 115 *Nassau Street, New York city.*

ELECTRIC LIGHT COMPANIES IN ENGLAND.

[11]—In your issue of May, I find an error, which has doubtless been made by the *Statist*, which you quote as authority for the state of affairs in England, in the electric lighting business.

Firstly, I note that you say 91 companies have been started. I doubt the correctness of this, but during the excitement of 1882 when companies were floated to the extent of $85,000,000, I fancy many of these were for the continent, and some for foreign countries, but very few of these were even quoted on the Stock Exchange. The Brush, Hammond, Swan, Weston and Pilsen, have but little market value. The Brush parent and its children were all more or less quoted, but most of the purchasers got the children instead of the old man; all these companies named and many others were gotten up for stock jobbing purposes. The largest electric light concerns were never put into limited companies. These concerns have a good established business, and did not want to let the outside public gamble with it; most of the latter have all the orders they can fill for some months to come, their systems have been thoroughly tested and they sell at a fair remunerative profit. They do not form lighting companies but sell their plants. Having just returned from Europe, where I have been connected with electric lighting, I can speak from experience. The parent Brush company has large works, but I hardly think they are doing a paying business. The Edison has consolidated with the Swan people, and this may be of considerable benefit to both concerns. The Hammond company have the Faranti machine; Siemens Bros. have their own dynamo and lamp: Lumley & Co., who have the patents of Levey & Lumley, for arc and incandescent lighting; Woodhouse & Rawson are makers of incandescent lamps, and purchase any good dynamo, suited for the work to be done: R. E. Crompton & Co., make dynamos and lamps, which are the best arc lamps in the market; there are some few smaller firms who do a little work, but these named are the firms who get all the large contracts. At the prices they charge, large consumers of gas can save money by the employment of electric lights; taking into consideration the C. P. given, and the price of gas, which varies from 35c to $1.25 per 1,000 ft., altogether, the future for electric lighting in England looks bright. The English concerns give more attention to incandescent than to arc lighting, although there are some very fine arc installations, notably at Nine Elms Station, the station of the London & S. W. R. R. Most of the large railway station have arc lights. There is a circuit of arc lights at Brixton (one of the suburbs of London) with 60 2000 C. P. lamps and they are very steady and make a fine show. In incandescent lighting there are many plants in all parts of England. Perhaps no other country can boast of so many expert electricians. Although electric lighting first assumed its form in the U. S., I think without a doubt that the English are far ahead of us, and I attribute this to the fact that there are so many in that country who are skilled engineers, and have thoroughly studied the science of electricity.

L.

300 W. 42d St., N. Y., May 14, 1884.

NEW PROCESS OF PRINTING MAGNETIC CURVES.

[12]—While making some experiments in magnetism several months ago, I made use of a method of preserving the diagrams of "magnetic lines of force" obtained by the use of iron filings, which was new to me at that time, and which is extremely simple and effective. The process is as follows: The figures are formed by the filings in the usual manner, but on a *sheet of prepared blue print paper*, which is exposed to the sunlight as soon as the figures are formed. After a few moments exposure, the paper is washed in clear water and the diagram appears as you see it on the specimen I enclose. If care is taken to have the light strike the paper as nearly normal as possible, the print obtained will be very sharp and clear. Hoping that this may prove of interest to some one investigating the subject of Magnetism, I am yours respectfully,

A. D. STEVENS.

Worcester, Mass., April 22, 1884.

[The specimen of printing by the above process is very fine, and it should be practiced by those who are interested in preserving a record of such experiments.—ED.]

AN EFFICIENT ELECTRO-MAGNET.

[13.]—In your issue for this month, I find an article on electro-magnets, in which mention is made of a peculiar form, concerning which I am in search of information. I refer to the method of utilizing the external magnetizing effects of the helix, such as is used in the "Altandi" magnet, spoken of by this writer. I am anxious to get written matter or information, in any form, respecting electro-magnets of this construction. I should be very much indebted to you, if you would let me know where I might find anything on this subject. J. W. ROGERS, JR.

New Haven, Ct., May 10, 1884.

[We do not know where any published information in respect to this form of electro-magnet is to be found, except in Mr. Sprague's paper. It is a very efficient arrangement, especially when great attractive force rather than rapidity of action is desired. It was first invented by Moses G. Farmer, then of Salem, Mass., nearly 30 years ago, and was used by him in various electrical apparatus. It is now used by G. Westinghouse, Jr., in his electro-pneumatic railroad signal and switch apparatus, which is being introduced on many of the leading railroads of the United States.—EDITOR.]

QUESTIONS AND ANSWERS.

[21.] **Battery and Instructions for Electroplating.**—J. A. D., 203 E. 53d St., New York, asks:—"1. Which form of battery combining economy and durability is the best for use in electrotyping, electroplating and general experimenting? 2. Also the best for electrotyping if a different battery is required? 3. Refer me to a good work on electrotyping, not too high in price." Ans. 1 and 2.—Either the Smee or Daniell battery are suitable for electroplating or electrotyping. Both are economical, and are adapted for most experimental purposes, but in many cases, many more cells would be required. 3. "Electro-Metallurgy, Practically Treated," Alex. Watt, price, $1 or, "Electroplating and Electrotyping," J. W. Urquhart, each forming a separate illustrated volume. Price $2.

[22.]—**Elementary Book of Experiments.**—W. Y., Auburn, N. Y., inquires for the best book giving directions for minor experiments for young students. Ans.—"Elementary Experiments in Magnetism and Electricity," J. Overend. Price 40 cents.

[23.]—**Sheet Zinc for Batteries.**—A. M. B., inquires if ordinary commercial sheet zinc is suitable for use in a bi-chromate battery if amalgamated? Ans.—It is too thin for practical use, and would last but a short time. By amalgamation it would become so brittle as to necessitate careful handling.

[24.]—**Electro-motive Force of Fuller Dynamo.**—W. F. C., Kansas City, Mo.:—The electro-motive force of a 10-light dynamo, Fuller Electrical Co., is 450 volts and the current 9.2 amperes.

[25.]—**Pocket Battery for Induction Coil.**—J. C. asks for information regarding some convenient form of pocket battery of sufficient power to operate an induction coil. Ans. There are two sizes of pocket medical batteries with coil complete, which may be obtained of any large dealer in electrical supplies. The battery is not arranged separately in pocket form, but might be readily fitted with a case.

[26.]—E. F. C., Arkwright, N. Y., asks the following questions:—"1. Is the repulsive force exerted between like poles of 2 magnets as great as the attractive force between their unlike poles? 2. How does the running expense of small steam engines (1 or 2 H. P.) compare with that of the best electric motors, of the same power, run by primary batteries? 3. How many cells of bi-chromate battery—each cell containing two zinc plates, 10 x 12—in connection with a well-constructed motor, would be required to produce 1 H. P.? 4. I understand that storage batteries, as now constructed, are not durable. What is the cause of failure?" Ans. 1. The attractive force between the unlike poles of two magnets is considerably greater than the repulsive force between the like poles of equal strength. This result is a necessary consequence of the mutual inductive action between the poles. When two unlike poles are brought into proximity, each tends to increase the power of the other, by developing opposite magnetism, thus increasing their mutual attraction; but in the case of two like poles, placed in the same relation, each tends to induce or develop a magnetism in the other opposite to that which it originally possessed, by which the two opposing magnetic poles are partially demagnetized and their repulsive power weakened. Professors Ayrton and Perry, who have carefully investigated the theory of electric motors, say: "We cannot lay too much stress on the importance of this fact—a motor must work mainly by attractive, and not by repulsive forces. The magnetic fields due to the field magnet and armature must help one another, and not oppose one another, as in the case of a dynamo." 2. The running expenses of a small steam engine of 1 or 2 H. P. is about 4 cents per H. P. per hour. According to the experiments of Hospitalier, a current capable of developing 1 H. P. per hour for 5 hours, was produced by the consumption of 1.493 kgs of zinc, 2.4 kgs of bi-chromate of potash and 7.2 kgs of sulphuric acid. In English weights this would be, per hour:

0.658 lbs.	zinc,	@	.08 cts.	.053
1.056 "	bi-chromate of potash	@	.14 "	.148
3.160 "	sulphuric acid	@	.0125 "	.039
	Total			$0.250

To this it is necessary to add at least 50 per cent., as the best motors yet made cannot be depended upon to utilize more than two-thirds of the current energy in the circuit. This would make the cost of the electric motor 37 cents, as against 4 cents per H. P. per hour for the steam engine. A motor of less efficiency would increase the proportionate cost. 3. With a well-constructed motor, 1 H. P. would require from 30 to 40 cells of the size mentioned, depending somewhat upon the density of the bi-chromate solution and the distance between the plates. 4. The causes of failure in the storage battery are as yet but partially understood. Local action is one of the difficulties, and disintegration of the lead plates, doubtless due to such action, is liable to take place after the battery has been in use a few months. Many experimenters are at work upon the subject, and much light will doubtless be thrown upon it within a year or two.

[27.]—G. L. Parkdale, Ont., makes the following inquiries:—"1. Where can I obtain practical directions for making current and potential galvanometers? 2. What is the exact length of 1 ohm resistance of No. 38 German silver wire. 3. What is the reason that the Gramme ring is more efficient than the Pacinotti armature? It appears to me that the latter should be the best, as it has projections or poles which pass close to the poles of the field magnets, while the Gramme ring is separated from the field magnets a considerable distance, in consequence of the wire with which it is wound. 4. If it is the *wire* on the ring which produces the current, what is the use of the iron core? 5. If a current of a certain E. M. F. passes through a circuit of low resistance, will there be any fall of potential if the resistance be greatly increased; or does the resistance affect current strength only? 6. In what country is electrical science farthest advanced?" Ans. 1. So far as we know, no such directions have been published. The manufacture of adjustments of these instruments, so as to be of any practicable utility, requires the very nicest workmanship, and is quite beyond the resources of most amateurs. 2. A length of 1.277 inches of German silver wire, having a diameter of .004 in., will give a resistance of 1 ohm at 60° Fah. This is the usual diameter of No. 38 wire; but the wire is liable to vary somewhat, both in gauge and specific resistance. 3. We do not believe that the Gramme ring is more efficient than Pacinotti's armature, and think you are right in your opinion. 4. The use of the wire is to concentrate and intensify the magnetic field through which the wire moves. 5. The fall of potential in a given length of conductor is always in proportion to the resistance, and is affected at the same, and to the same extent, as current strength. 6. In Great Britain, most probably, although many special departments are much farther advanced in the United States.

ELECTRICAL NEWS AND NOTES.

REDUCTION IN TELEGRAPH RATES.

The various telegraph companies have made considerable changes in rates during the past month. In pursuance of its policy of making the tariff list uniform, reductions of from 15 to 30 per cent. have been made in the charges for messages sent to and from Southern points. For instance, rates that have heretofore been 75 cents are now 60 cents, and rates that were formerly 60 cents are now 50 cents. The highest rate now on the Western Union list is $1.07, which is the charge for a message of 10 words sent from ocean to ocean. A 15 cent night rate now prevails on all the telegraph lines. The Western Union Company limits its messages to ten words, with one cent for each additional word; the Bankers' and Merchants' to 15 words, and the Postal to 20 words. The low night rates prevail over the entire Baltimore and Ohio and Postal systems, and over the entire Bankers' and Merchants' system, except the Southern telegraph lines. The Western Union's low rate covers competitive points alone, about 280 in number, between Boston and Kansas City, and as far south as Richmond.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

In response to a call by the committee on organization, a meeting of the Institute was held on May 13th at 127 East 23d Street, about fifty members being present. The meeting was called to order by Mr. Jos. P. Davis. After reading the minutes of the former meeting, the committee appointed to draw up and submit rules presented their report.

These rules were adopted substantially as reported with the exception of some changes regulating the election of new members. The rules as adopted provide for a president, 6 vice presidents, 12 managers, a treasurer and a secretary. These officers, together, constitute a council whose duties include that of passing upon candidates for membership. A candidate who has been approved by a majority of the council is then voted upon by the members of the Society and may be elected by a majority vote. These votes are secured by letter and canvassed by the council.

The initiation fee is $5, and the annual dues are $10 for the associate members. A body of honorary members is provided for who are exempt from all dues.

After the adoption of the rules, the meeting proceeded to ballot for permanent officers. The "scrutineers" who were appointed to conduct the balloting, reported that it had resulted in the election of the following officers: *President*, Norvin Green; *Vice Presidents*, A. Graham Bell, Charles T. Cross, Thomas A. Edison, Geo. A. Hamilton, Chas. H. Haskins, Frank L. Pope; *Managers*, Charles F. Brush, William H. Eckert, Stephen D. Field, Elisha Gray, Edwin J. Houston, C. L. Hillings, Frank W. Jones, George B. Prescott, W. W. Smith, W. P. Trowbridge, Theodore N. Vail, Edward Weston; *Treasurer*, Rowland R. Hazard; *Secretary*, Nathaniel S. Keith.

A letter from Mr. C. J. Kintner, Principal Examiner in the electrical department of the United States Patent Office, was read to the Society, in which attention was directed to the hampered condition of the office and the urgent need of increased facilities for examining the numerous applications for patents which are now being filed.

The statements made by Mr. Kintner were supplemented by a brief and well directed speech from Mr. Frankland Jannus of Washington, and a resolution offered by Prof. Trowbridge expressing the will of the Society against any legislative act tending to restrict the protection now granted to the inventor, and in favor of the passage of Senator Platt's bill or its equivalent, was passed without opposition. A motion made by Mr. Bowen, of Chicago, that a committee be appointed by the chair to lay the matter before Congress was unanimously passed.

The meeting was then adjourned subject to the call of the council.

EDISON AT WORCESTER.

An Edison electrical exhibition occupied two evenings, May 1 and 2, at Mechanic's Hall, Worcester. The Edison company was represented by Major S. B. Eaton, T. A. Edison and his confidential associate, E. H. Johnson. The platform was also illuminated by incandescent lamps of various patterns. A very attractive feature of the exhibition was a floral pyramid about 6 feet in diameter, illuminated by lamps of various colors, arranged in 6 different circuits, each of which opened and closed once during every revolution, the pyramid being turned by an electric motor. A sewing machine and turning lathe driven by electrical energy were also shown. The audience was further entertained by a lecture given by Mr. Johnson, covering the whole subject of the derivation of light and power from coal through the agency of electricity.

DELAY IN LAYING THE NEW CABLE.

The steamer Faraday, with the American section of the Commercial cable on board, was expected to arrive at Rockport, Mass., about May 14, unforeseen events, however, had delayed her progress considerably. Immediately on her arrival at Dover Bay, Nova Scotia, on the following Tuesday, she laid about 80 miles of the transoceanic line. Then, having buoyed the sea end, she returned to port, laid the heavy shore end of the American section, and had paid out about 31 miles of deep-sea cable when Mr. Brittle, chief of the electricians on board, received a message ordering him to pick up all that had been laid to within six miles of shore. This was successfully done, though only with the exercise of much care. The company had, at the last moment, determined to take a more southerly course than that first laid out, to avoid the fishing grounds. This involved the use of over 40 miles more of cable. The Faraday started anew and had paid out about 158 miles, then cut the cable and buoyed the sea end just off Cape Sable, and proceeded back to Canso to take the additional cable needed. She left Canso, May 12, at 6 o'clock p. m., and Wednesday morning picked up the cable where she left it, spliced the ends, and the same day was reported steaming toward Cape Ann. She has since put back to Halifax to take in coal, and sailed from that port for Cape Ann on the evening of May 19, where she will take up the end of the cable buoyed off the harbor and proceed with the work.

ELECTRO-PNEUMATIC SIGNALS ON THE PENNSYLVANIA RAILROAD.

An extensive arrangement of interlocked switches and signals will shortly be put in operation at Wilkinsburg, Pa. The signals, switches, etc., are constructed by the Union Switch and Signal Co., and are shifted by pistons acted on by compressed air, the admission of which is controlled by valves moved by electricity. The signal operator has, consequently, no hard labor to perform, but simply moves miniature levers in a small locking frame, which are simply electrical switches, and by means of the current, operates the valves of the pistons which are actuated upon by compressed air. A boiler and an air pump are placed at each end of a long air main, extending from Wilkinsburg to Torrens, and branch pipes supply air for working the various signals and switches between those points. The interlocking arrangements are combined with the track circuit system in such a way, that a switch cannot be shifted until the last wheel of the train has passed completely beyond the switch.

THE BALTIMORE AND OHIO RAILROAD TELEGRAPH.

Chief Justice Waite has filed his decision, in the long pending suit of the Western Union Telegraph Company vs. the Baltimore and Ohio Railroad Company, involving the ownership of the telegraph lines along the route of the latter between Baltimore and Wheeling and Parkersburg, in West Virginia. The Western Union under the decision secures the value of one wire. The Baltimore and Ohio Railroad has had possession of the line since 1877.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At the Minneapolis meeting in 1883, of Section D, devoted to mechanical science, it was resolved that a circular of invitation should be prepared, requesting persons interested in that branch to join the Association. A meeting of the section is called for September 3-10 at Philadelphia, when it is hoped that a large number will avail themselves of the opportunity to become identified with the society. Prospective members, or persons desiring further information regarding the meeting, with a view to the preparation of papers to be read before the section, may obtain proper blanks and circulars by addressing the Secretary, Prof. J. Burkitt Webb, Cornell University, Ithaca, N. Y.

ELECTIONS AND APPOINTMENTS.

At a recent meeting of the Directors of the Postal Telegraph and Cable Company the number of the board was increased from 13 to 16, and the following gentlemen were elected to fill the positions so created: Joseph S. Stout, of the firm of Stout and Co., bankers; Emery M. Van Tassell, a prominent grain merchant, and Francis F. Robins, of the firm of Robins & Robinson, bankers.

The stockholders of the District Telegraph Company, a corporation formed under the laws of New York, but doing messenger business in Boston, has elected the following directors: Thomas G. Eckert, Charles A. Tinker, W. C. Humstone, R. H. Rochester and A. R. Brewer, of New York, and F. L. Ames and Thomas Roche, of Boston. A meeting of the directors was subsequently held, at which Thomas G. Eckert was elected President, Thomas Roche, Vice-President, and R. H. Rochester, Secretary and Treasurer.

The annual election of Directors of the Edison Electric Light Company, of Europe, Limited, May 7, resulted in the choice of Thomas A. Edison, James H. Banker, S. B. Eaton, R. L. Cutting and F. W. Foote.

At a meeting of the stockholders of the Bankers' and Merchants' Telegraph Company, of Baltimore City, held at Baltimore, May 17, Anthony W. Dimock, of New York, Robert Turner, Francis P. Stevens, J. G. Case, Bentley S. Bibb, G. S. Mott and William A. Dunn were elected Directors for the ensuing year. The following officers were unanimously elected: President—Anthony W. Dimock; Vice-President—Robert Turner; Secretary and Treasurer—J. G. Case; General Superintendent—G. S. Mott; Attorney—Francis P. Stevens.

THE TELEGRAPH.

Domestic.

In order to exterminate "bucket shops" the Chicago Board of Trade has assumed control of the publication of market reports, instead of allowing the different telegraph companies to make such use of them as they please.

The annual convention of the Railway Telegraph Superintendents' Association will be held at Philadelphia in September, instead of Boston. The change in place of meeting has been made to enable the members to attend the Electrical Exhibition.

Foreign.

The Great Northwestern Telegraph Co. employs about 50 men as messengers in Montreal. They are paid 2 cents for each telegram delivered and the same amount for replies.

THE TELEPHONE.

The Pittsburg *Commercial Gazette* is authority for the statement that the Bell Telephone Company offered the Western Union Telegraph Company $10,000 to discontinue the use of the Gray duplex between Pittsburg and the West on account of its annoyance to telephone subscribers.

The Baxter Overland Telephone and Telegraph Co. was organized at Utica, N. Y., May 2, with a capital of $200,000, divided into 8,000 shares, and has applied to the common council of that city for permission to run its wires.

The certificate of incorporation of the Fuller Universal Telephone Company was filed in the County Clerk's office, May 5. Its capital stock is $5,000,000, divided into shares of $100, and its incorporators are I. Ensign Fuller, Conrad N. Jordan, Elijah B. Martingdale, William D. Snow, E Burton Hart, George H. Kendall, William W. Post, William Jeffreys, and John M. Moore.

It is said that Wellington, O., has more telephones in use, in proportion to the inhabitants, than any other place in the world, being one subscriber to every fifteen of the inhabitants, and the rate is the same as to all the principal cities under the management of the Central Union Company.

ELECTRIC LIGHT AND POWER.

Domestic.

The Brush-Swan Light Company, Norfolk, Va., has ordered the third tubular boiler set with the Jarvis patent furnace, and will use the Sheffield grate bars to burn screenings for fuel.

The Jarvis Engineering Company, Boston, has received orders to fit up a complete steam plant for the Jenney Electric Light Company, Brockton, Mass. It will furnish 2 30-horse power Armington & Sims engines. The boiler will be set with the Jarvis patent furnace and use Sheffield grate bars to burn screenings for fuel. It will use the Deane steam pump with the Korting injector as auxiliary feed, also use the National feed-water heater to utilize the exhaust steam. It is the intention to add a third engine later

The Edison company is putting in a new and extensive plant for lighting the type-setting and press floors of the Government printing office, Washington. This is an addition to the plant in the *Record* office, which has been in operation for some time.

The Edison electric light was started in Piqua, Ohio, April 8. It is supplied with a 90 horse-power Armington & Sims engine, running at 290 revolutions per minute, and a Babcock & Wilcox boiler.

The Miller company of Canton, O., have just supplied their works with Brush electric lights and are running day and night.

The contract for lighting the streets of San Francisco is about to be let by the Board of Supervisors. The competing bidders are the San Francisco Gaslight Company and the California Electric Light Company.

The Minnesota Brush Electric Co. are introducing storage batteries and incandescent lights at Minneapolis. It has 200 arc lamps in use, and what is said to be the highest tower of the kind in the world. The West Hotel, which is the great hotel of the Northwest, is lighted by the Brush-Swan system. The company is running 7 dynamos by water power from St. Anthony Falls. A new station, 40x200, is being erected at the foot of 3d Avenue, North.

The electric light wires at Elgin, Ill., were cross connected by a piece of telegraph wire on the evening of April 29, thus short circuiting the dynamo, and burning out one lamp. Much damage would have ensued had not the power been suddenly shut off. A hundred dollars reward is offered by Mr. Bowen for information regarding the perpetrator of the act.

The United States Electric Lighting and Power Co. has been organized at Portland, Oregon, with a capital of $100,000, half of which is paid up. The present plant which is now being erected consists of 3 Weston 50-light dynamos and 150 arc lamps, driven direct by 3 Westinghouse engines. The company expects to start the Maxim incandescent plant this fall, and also establish lighting plants in Seattle and Spokan Falls, W. T.

Foreign.

The Trinity Board is making a test of the relative efficiency of electricity, gas, and oil for lighthouse purposes. The experiments are expected to continue for several months.

A very successful installation of the Maxim incandescent light has been made on the Cunard steamship, Gallia.

The electric light is becoming the favorite means of lighting sugar refineries in Germany. Its absolute safety from fire recommends it for this special use, independently of the expense, which is found not to exceed that of gas.

The Edison company has 92 lamps of 10 candles each in the Holburn Viaduct, London, for which it receives the price of the gas displaced; but the business houses in the vicinity, which use 745 lights, have to pay higher figures.

The plan of using the enormous water power of the Alps for working electric railways in Switzerland appears to have taken a definite shape, the idea being to connect the towns of St. Moritz and Pontresnia by an electric railway 4¾ miles long, the motive power to be supplied by the mountain streams; the line, in case the plan proves a success, to be extended a considerable distance.

An electric bouquet was presented to the Crown Princess of Austria, a short time ago, at Vienna, which consisted of a group of snowy globes, inside of each of which was an incandescent lamp, fed from small storage batteries in the vase. The capacity of the battery was found sufficient to maintain a brilliant illumination for three days.

The city of Brussels means to try the experiment of using electricity to drive its street cars in good earnest. One line—that of the Rue de la Loi—is to be equipped with motors, and separate accounts are to be kept, in order to ascertain definitely the cost of running, as compared with the use of horses. The test is to last for one entire year, and then, should the result warrant it, electricity will be employed exclusively on the street railways of Brussels.

The first journeys were recently made on the electric railway at Brighton, England, which, with the sanction of the town council, has been extended at the edge of the beach, starting opposite the entrance to the aquarium, and running eastward beyond the chain pier. There is a single ornamental car, which will hold about a dozen persons, and the speed is limited to six or eight miles an hour, though a much higher rate can be attained. The experiment was entirely successful.

Shanghai has the electric light, but the local company does not keep to its agreements, and the "heathen Chinee" is making it unpleasant for the officers. To be sure the company has a contract, but the simple-minded pagans who gave it, claim the right to take it away unless the work is properly done.

MISCELLANEOUS.

A time-lock devised by Henry F. Newbury, Brooklyn, N Y., has an electric motor connected with it in such a way that in case the time mechanism is injured or stops, the lock may be unlocked by the motor in about the same time that would be required by the time-lock.

Among the bills introduced at Albany, but which will be held over until next session, is the Thomas bill assessing telegraph, telephone and electric light poles in the towns of New York State.

M. de Fonvielle has suggested the following method of detecting infernal machines: All luggage to be placed on wooden tables supported by iron feet, but not nailed to them. A microphone to be placed on each of the tables, when any ticking or other noise proceeding from the luggage would at once become audible.

SUBTERRANEAN LINES.

It is thought that owing to a defect in the title of the Daly underground bill, Governor Cleveland will refuse to sign it, although it has passed both branches of the New York State Legislature.

SUBMARINE CABLES.

The United States and West India Cable Company, to maintain telegraphic communication between New York city, the Coast of Florida, and the West India Islands, has been incorporated by James C. Jewett, Joseph Emerich, N. B. Perretz, Herman Kobbé and Nicholas Brandt.

The cable between Key West and Havana is broken, and messages between those two points are passed over by steamer about once per day.

MANUFACTURING AND TRADE NOTES.

Valuable deposits of manganese are reported as having been discovered in Arkansas. About 100 mining claims have been located, and 4,000 tons already shipped.

A recent day's shipments from the wire mill of the Gautier steel department of the Cambria Iron Company at Johnstown, Pa., were particularly heavy and amounted to about 22,000 miles. It weighed nearly 2,000,000 pounds, and required 60 cars to contain it. All this was one day's shipments, and it probably stands unparalleled in the wire business in this or any other country. This wire was worth, at current prices, about $125,000.—*Iron Age.*

The copper market is quiet and dull. The efforts which are being made to form a pool for the purchase of a large quantity from the Lake companies for the season's delivery appears to hang fire. The proposed price of 14c is not considered low enough to offer sufficient inducements to buy largely.

The Armington & Sims Engine Company, of Providence, have recently shipped 20 engines for electric lighting purposes of various sizes ranging from 20 to 125 h.p.

Messrs. Courtenay & Trull, manufacturers of the "gelatinized fibre," have consolidated with the Vulcanized Fibre Company, of Wilmington, Del. There is great similarity in the goods manufactured by these two concerns, and the consolidation seems to be a wise move. Their product has developed a great variety of uses, and the demand for it is becoming very large.

FINANCIAL.

NEW YORK, May 21, 1884.

The decline in telegraph stocks referred to last month, has been still more noticeable since that time in the case of shares dealt in at the Stock Exchange, on account of the panic, which forced Western Union below 80, and Bankers' and Merchants' to 45. In the present unsettled state of financial affairs, miscellaneous electrical securities are comparatively neglected and prices are nominal. Our quotations are from the New York Stock Exchange and the Electric, Manufacturing, and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Speaking	110 00	125 00	New York	—	85 00
Currier-Tele. Bell	3 00	—	New York & N. J.	—	80 00
Colombia & Pan	24 50	25 00	N. Y. & Penn	50 00	80 00
Continental	15 00	—	Overland	10 00	12 00
Dolbear	5 00	10 00	Peoples	8 00	—
Globe	4 00	6 00	do. N. E.	1 00	10 00
Hudson Riv.	00 00	00 00	Southern Bell	95 00	125 00
Inter-Cont.	95	1 25	Southern N. E.	—	175 00
Mexican Central	—	2 50	Tropical	2 00	2 50
Molecular	7 00	13 00	W. I. Tel. & Telph.	1 50	1 60

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	50 00	55 00	Manhattan Telegraph	10 00	85 00
Bankers' & Merchants'	40 50	—	Mexican	125 00	147 00
Commercial Tel. Co, prfd	—	100 00	Postal	5 00	5 50
Com'l Tel. Co., common	—	95 00	do. bonds	40 00	50 00
Harlem Dist. Tel. Co.	2 00	2 50	Western Union	55 00	55 12½
Bankers' & Merchants' 1st m. bonds	75 00	85 00			

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	2 00	4 00	Edison Isolated	—	90 00
Baxter	22 00	22 50	Edison European	8 00	15 00
Brush	50 00	80 00	Excelsior	20 00	—
Brush Ill	45 00	70 00	Swan	15 00	40 00
Daft	—	90 00	U. S.	75 00	95 00
Edison	50 00	100 00	do. Ill. Co.	—	90 00
Edison Ill.	55 00	75 00			

The St. Louis Thomson-Houston Electric Light Company has increased its capital stock from $25,000 to $50,000.

The quarterly dividend of the Erie Telephone Company, $48,000, was mailed to 1,224 stockholders.

Judge Simonton, of the Harrisburg Court, filed an opinion, on April 30, in the cases of the State of Pennsylvania against the Western Union Telegraph Company, appeals from tax assessments made on the capital stock of the telegraph company for the years 1879 and 1881. The court gives judgment against the company in the first case for $18,481, and in the second for $44,045. The company offered to settle the cases some time ago for $50,000, but, as the Commonwealth claimed $147,200, the offer was refused.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 50 Wall Street, New York city.*

LEGAL NOTES.

United States Supreme Court.—*The Burrow-Giles Lithographing Co. v. Sarony.* This case relates to the law of copyrights. The plaintiff, a lithographer, was defendant in a suit commenced by a court at law in which Sarony, the present defendant, was plaintiff, the latter having charged the present plaintiff with violating his copyright of a photograph, the title of which is "Oscar Wilde, No. 18." Mr. Justice Miller held that the notice of copyright which the statute requires should be given to the public, is sufficiently given by the words "Copyright, 1882, by N. Sarony," found on each photograph. Also, that an author in the sense in which the term is used in the Constitution is "he to whom anything owns its origin; originator; maker." There is no doubt but that the Constitution is broad enough to authorize an act covering copyright of photographs so far as they are representations of original intellectual conceptions of the author, and the photograph in question is an original work of art and the product of intellectual invention, and that the arranging and disposing of light and shade, suggesting and evoking the desired expression was due to the original mental conception of the present defendant, and that, therefore, the photograph is an original work of art and proper subject for copyright. *Black, et. al. v. Thorne, et. al.* Mr. Justice Field delivered the opinion of the Court to the effect that it does not necessarily follow that, because a party may have made an improvement in a machine and patented it, another using the improvement will be mulcted in more than nominal damages for the infringement. The inventor may exact a license fee. *Garretson v. Clark, et. al.* Field, J., held that when a patent is for an improvement and not for an entirely new machine, the patentee must show in what particulars his improvement has added to the usefulness of the machine and show the benefits derived therefrom, otherwise he is not entitled to more than nominal damages; he must give evidence tending to separate or apportion defendant's profits and the patentee's between the patented and unpatented features, or he must show that the profits and damages are to be calculated upon the whole machine for the reason that the entire value is due to the patented feature.

United States Circuit Court—District of California.—*Cahn v. Wong Town On.* Sawyer, J., held that although a device, comprising several patentable elements, has been patented as a whole, the patentee will not be prevented from afterwards securing a patent for a combination of any number of the elements less than the whole, provided he applies for it before the lesser combination has been two years in public use. District of New Jersey.—*Doyle v. Spaulding, et. al.; Illingworth v. The same.* Nixon, D. J., held that the use, or knowledge of the use of an invention in a foreign country by persons residing in this country, will not defeat a patent which has been granted to a *bona fide* patentee who at the time was ignorant of the existence of the invention or its use abroad. District of Vermont.—*Vermont Farm Machine Co., et. al. v. Marble, Commissioner of Patents.* Wheeler, J., held that in the case of *Campbell v. James*, that his decision must be construed to forbid the obtaining of an invention by a party who has already obtained the same invention, and not merely to describe it in a former patent. *Vermont Farm Machine Co. v. Marble, Commissioner of Patents.* Wheeler, J., held that where the Commissioner of Patents accepts service, he, by such acceptance of service, consented to be found in the District Court, and his act is binding upon his successor. Eastern District of Pennsylvania.—*Prentiss v. Ellsworth, the Late Commissioner of Patents.* Randall, J., held in this case that where there are two interfering patents, the Circuit Court of the District whereof the defendant is an inhabitant or where he may be found, is the court "having cognizance," and that where an original application for a patent has been refused and remedy is sought in equity, and the process is to be served on the Commissioner of Patents, then the Circuit Court of the District of Columbia should entertain the suit, a court outside of the District of Columbia having no authority to issue a writ of mandamus to an officer of the United States, commanding him to do a ministerial act. Northern District of New York.—*Swift v. Jenks, et. al.* In a motion for preliminary injunction. Coxe, J., held that the omission of an inventor to claim a combination or device, apparent upon the face of his patent, amounts to a dedication of such combination to uses of the public, also that an injunction should not issue when it would work great harm to one party without benefit to the other, especially where adequate protection can be had without it. Western District of Pennsylvania.—*Bradley, et. al. v. Dull, et. al.* Acheson, J., referring to the decision rendered by Judge Lowell in the *Shaw Relief Valve Co. v. The City of New Bedford*, held that an assignment of a patent by an administrator is valid under the act of July 8, 1870. Also, that an element which may be serviceable under certain conditions, but is not indispensable, and is not mentioned in the claim, is not to be held an element of the patented combination.

Supreme Court of the District of Columbia—*Marvin v. Lillie.* This is a case decided May 31st, 1867. Olin, J., held that it is contrary to the spirit and letter of the law to grant a new patent to an applicant who has already patented one for the same invention; the fact that he does not specifically claim the device which he might have claimed in the original patent will not avail since the law provides for the amending of patents by enlargement or restriction, or by division of the subject-matter; also held that no interference can exist except as between claimants of the same invention. *United States, ex rel., R. Hoe & Co., and George C. Gill v. Benjamin Butterworth, Commissioner of Patents.* This is a petition for a writ of peremptory mandamus to the Commissioner of Patents to receive the final fee and to cause a patent to issue to R. Hoe & Co. The Commissioner decided between interfering applications in favor of the relators and they having tendered the final fee, the Commissioner refused to accept the same because of the pendency of an appeal by the defeated patentee to the Secretary of the Interior, and because the Secretary had upon such appeal reversed the decision of the Commissioner. James, J., held that it is within the discretion of the Commissioner after making and communicating a decision in the favor of the applicant to reconsider that decision and make a contrary one. It appears, however, that the Commissioner has not changed his opinion and that it is his fixed decision that an applicant is entitled to a patent and it is his duty, therefore, to proceed to the step consequent upon such decision. A failure or refusal to so proceed may be cured by a writ of mandamus; also held that the right of appeal to the Secretary is only an inferential right and as such should be excluded. The Commissioner having finally adjudicated the matter the relators are entitled to a patent.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From April 15 to May 6, 1884 (inclusive).

Alarms and Signals:—*Call Bell*, G. P. Conant, April 15, 296,729. *Door Bell*, S. N. Blake, 296,812. *Fire Alarm Apparatus*, M. D. Porter, 296,874. *Alarm Apparatus*, M. D. Porter and E. R. Wilder, 296,875. *Bell and Annunciator*, J. D. Gilchrist, May 6, 298,086. *Annunciator*, P. Seiller, 298,242.

Clocks:—*Secondary Clock*, L. C. Hammer and W. F. Weisberger, May 6, 298,205. *Circuit Closer for Clock*, V. Hammer, 298,301.

Commutators:—*Cut-off*, C. H. Goebel, April 29, 297,928. *Automatic Circuit Closing Device*, C. T. Ross, May 6, 298,121. *Circuit Breaker*, E. Weston, 298,144. *Circuit Connector*, same, 298,336.

Conductors, Insulators, Supports and Systems:—*Insulator*, J. A. Seely, April 15, 296,881. *Apparatus for Distributing Currents*, G. W. Durbrow, April 15, 297,072. *Telegraphic Cable*, W. R. Patterson, April 15, 296,774; S. F. Shelbourne, April 22, 297,177; W. H. Sawyer, April 29, 297,855. *Insulator for Telegraph Wires*, L. C. Baldwin and J. C. Thurston, April 22, 297,101. *Conductor*, S. F. Shelbourne, 297,175; T. A. Edison, April 29, 297,586. *Method of Laying Subterranean Cables*, S. F. Shelbourne, April 22, 297,179. *Laying Underground Wires*, J. H. Page, May 6, 298,020. *Anti-Induction Conductors*, April 22, 297,176. *Means for Controlling and Limiting Induction*, S. F. Shelbourne, 297,178. *Method of and Apparatus for Insulating Cables*, same, 297,181. *Combined Electric Light and Telegraph Post*, same, 297,182. *Submarine Telegraph Cable*, same, 297,180. *Conduit and Attachment for Conductors*, same, 297,183. *Skeleton Iron Tower and Mode of Erecting the Same*, J. S. Adams, 297,333. *Skeleton Tower*, same, 297,331, 297,332, 297,334, 297,335, 297,336, 297,337, 297,338. *Conduit for Underground Wires*, E. O. Hilderbrand, April 22, 297,307. *Conductor for Telephone and Telegraph*, W. Jamieson, April 22, 297,406. *Underground Wire Conduit*, T. L. Smith, 297,402, 297,403; C. H. Goebel, April 29, 297,926, 297,927. *Binding Post*, T. R. Abernethy, April 29, 297,655. *Junction Box for Circuits*, Alex. P. Wright, April 22, 297,547. *Indestructible Compound for Insulation*, J. H. Page, April 29, 297,925. *Device for Attaching Wires to Posts and Insulating Them*, H. Cottrell, 297,677. *Telephone Line*, T. B. Doolittle, April 29, 297,683. *Do. Cable*, F. C. Guilleaume, 297,688. *Pin for Insulators*, J. M. Klein, April 29, 297,699. *Apparatus for the Production and Utilization of Secondary Currents*, L. Gaulard and J. D. Gibbs, April 29, 297,924. *Machine for Making Insulator Pins*, Wm. Snee, April 29, 297,865. *Conduit for Wires and Pneumatic Tube Combined*, C. H. Goebel, April 29, 297,929. *Insulating Material*, D. H. Dorsett, May 6, 298,072.

Dynamo Machines and Motors:—*Dynamo*, E. Thomson, April 15, 296,799. A. E. G. Labke, 296,857; T. A. Edison, April 29, 297,582, 297,583, 297,584, 297,587; C. J. Van Depoele, 297,878. *Field Magnet for*, J. W. Lawson, April 22, 297,373. *Commutator and Brush for*, E. A. Sperry, April 29, 297,867. *Motor*, L. W. Stockwell, May 6, 298,130.

Galvanic Batteries:—C. L. Clarke, May 6, 298,175.

Lamps:—*Arc*, J. J. Skinner, April 15, 297,022; E. Thomson, April 22, 297,104, 297,195, 297,196, 297,197, 297,198, 297,199, 297,200, 297,201; T. A. Edison, April 29, 297,580; P. P. Nungesser, 297,893. *Electric Light Fixture*, P. H. Klein, Jr., April 23, 297,269. *Incandescent*, T. E. Gatehouse, 297,377; T. A. Edison, April 29, 297,581; E. Weston, May 6, 298,325. *Socket for*, same, 298,142, 298,143. *Method of Testing Carbon Conductors for Incandescent Lamps*, same, May 6, 298,141. *Incandescent Lamp Fixture*, same, 298,327. *Incandescing Conductor for*, T. A. Edison, April 29, 297,585. *Gaso-electric Lamp*, J. H. Loder, April 29, 297,820.

Measurement:—*Rheostat*, E. Weston, April 22, 297,324; J. Doyle, May 6, 298,073.

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Miscellaneous:—*Locking Mechanism for Safes*, H. F. Newbury, April 15, 296,866. *Door-Keeper*, A. C. Woehrle, 297,096. *Printing Machine*, A. Campbell, April 22, 297,111. *Protecting Conductors from Induction*, S. F. Shelbourne, April 22, 297,184. *Coupling for Lightning Rods*, T. H. Patee, 297,290. *Portable Lightning Rod Machine*, same, April 22, 297,291. *Protector for Telegraph and Telephone Instruments*, E. M. Greene, 297,385. *Electric Regulator*, E. A. Sperry, April 29, 297,866. *Heat Regulator*, W. S. Johnson, 297,937.

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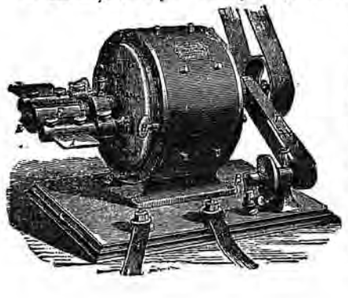

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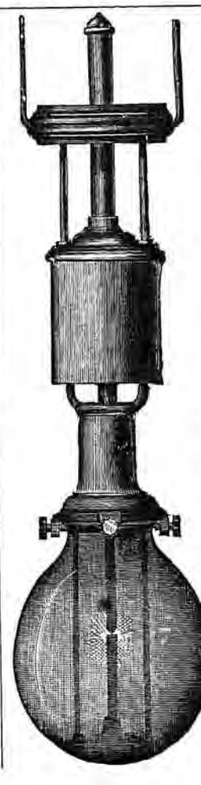

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Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

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NEW YORK, JULY, 1884.

THE MOUNTAIN BRINGS FORTH A MOUSE.

THE much discussed underground telegraph bill, having been duly signed by the governor has become one of the statutes of the State of New York, in spite of the opposition of the parties most directly interested in the subject. Under the circumstances it might reasonably have been expected that the advocates of such an important measure would have used language in some degree expressive of the results which they desired to accomplish. How thoroughly they have performed the duty which the public press has continually paraded as being one of paramount importance may be determined by an examination of the text of the bill, which is as follows :—

An Act in relation to telegraph and electric light companies in cities of this State.

The People of the State of New York, represented in Senate and Assembly, do enact as follows :

SECTION 1. All telegraph, telephonic, and electric light wires and cables used in any incorporated city of this State, having a population of 500,000 or over, shall hereafter be placed under the surface of the streets, lanes, and avenues of said cities.

SECTION 2. Every corporation, association, or person owning or controlling telegraph, telephonic, electric, or other wires and cables, including what is known as telegraph poles, and other appurtenances thereto, shall before the 1st day of November, 1885, have the same removed from the surface of all streets or avenues in every such city of this State.

SECTION 3. In case the owners of the property above enumerated shall fail to comply with the provisions of this act within the time herein specified and limited, the local governments of the said cities of this State shall then, and they are hereby directed to, remove, without delay, all telegraph, electric light, and such other wires, cables, and poles, wherever found above ground, within the corporate limits of their respective cities.

SECTION 4. No city in this State shall grant any exclusive privilege or franchise under this act to any corporation or individual by which a monopoly may be created or competition prevented on equal terms.

SECTION 5. This act shall take effect immediately.

In the first place, it may be remarked that the poles and wires now standing in the streets of New York and Brooklyn have been placed there under the provisions of, and in compliance with existing statutes, and inasmuch as the bill in question makes no provision for repealing previous legislation on the subject there seems to be no reason why electrical companies may not proceed with their overhead construction as heretofore. There would seem to be nothing to prevent their doing so, at least until November 1st, 1885. Guided only by the text of the bill, it is difficult if not impossible for the managers of electrical enterprises to decide what course is to be pursued. According to section 2, all telegraph poles and appurtenances shall be removed from the surface of the streets. It is well known that a very large proportion of the overhead wires are run over the housetops, and the supports are consequently situated wholly on private property, being placed upon roofs which in many cases are leased by the telegraph companies for that purpose. Is, or is it not the intention of the subterranean promoters to have these housetop wires removed? In reply to this query we shall very likely be referred to section 3 which was doubtless intended as the grand culminating blow, whereby the local governments of said cities are directed to remove, without delay, all wires, cables and poles wherever found *above ground*, within the corporate limits. If this provision is expected to be enforced without interference with the private interests of the citizen, it becomes interesting to know how a subscriber of a telephone, district, or quotation company is to be served, when his office is located say, in the third story of a building. Either the law must be evaded, or instruments of this character must be located in the basement. This may not be the spirit of the bill, but if it can be interpreted in no more definite manner than by guessing at the intention of its originators, the owners of telegraphic property may certainly be excused from conjecturing that their housetop wires are embraced in the provisions of section 2. It may possibly not have occurred to the promoters of the bill that millions of dollars have been invested in various branches of the electrical business, under the supposed protection of law. It has nevertheless been decided ostensibly by certain newspaper editors, but more probably by certain persons interested in subterranean telegraphic franchises, that these wires are dangerous, and consequently must be removed. It is absurd to suppose, however, that the owners of all this property, amounting in value to hundreds of thousands of dollars, will tamely submit to its destruction without compensation, under the provisions of this statute. If the further growth of overhead systems were prohibited, and a gradually increasing license fee demanded for the privilege of allowing those already built to remain above ground their gradual extermination might perhaps be effected without imposing an unjust burden upon either stockholders or taxpayers. The practical confiscation or destruction of this property, as it stands to-day, by a single blow without compensation, can be considered nothing less than an unparalleled outrage. Mr. Thomas A. Edison, who is quoted as authority upon this question, is reported to have said that 75 per cent of the Western Union wires can be placed underground for $100,000. Will he undertake to enter into a contract to bury *all* the Western Union wires in New York city for $250,000, and guarantee their working properly for three years? Why are 75 per cent and not the whole of them mentioned? The feasi-

bility of placing the trunk lines of the ordinary commercial telegraph wires underground has never been seriously disputed. It can be, and has been done.

The real question is, how to dispose of the branch lines, and of the enormous aggregate network of wires comprising the various house to house systems which are a peculiar feature of American telegraphy, and which have become indispensible conveniences in every day life, and these Mr. Edison, will not, we venture to say, contract to put underground, and guarantee to perform the present service for any sum of money whatever. It is idle to suppose that the local telegraphic companies can undertake so formidable a task upon their present financial basis. Their very existence is well known to depend wholly upon their ability to serve their individual customers at a comparatively low rate.

The bungling manner in which the bill has been drawn up proves that its originators knew no more about lawmaking, than they do about electrical engineering or English grammar. Our columns have borne continual testimony to the efforts which are being made in various cities, to solve this difficult problem, but in none of them is the prospective labor equal in magnitude to that which confronts the various companies in the city of New York.

THE TELEGRAPH AND THE PRESS.

The recent Republican convention at Chicago afforded a fine opportunity to demonstrate the possibilities of modern American telegraphy, and the thorough manner in which telegraphic managers perfect their preparations for an occasion of that kind. It is perhaps true that they have been forced to extraordinary efforts by reason of the intense competition between their patrons—the newspapers; and the representatives of the press are among the few who realize the gigantic character of the work, and the celerity with which the despatches are handled.

The lavish manner in which our great American dailies deluge the wires with specials, is in itself satisfactory evidence, that they have fairly outgrown that primitive organization for the economical collection and distribution of news, which has cast a blight over modern newspaper enterprise for the last twenty years. It is difficult to understand why its value should be so overrated, especially among publishers who are so thoroughly familiar with its shortcomings. It has certainly failed in its efforts to prevent the establishment of new journals, and the effective manner in which its reports have been forestalled throughout the country proves that it has passed its prime, if such an epoch ever existed. The secret of the more satisfactory service of its young rival may be found in the fact, that it was under the direct personal management of a wide-awake and energetic practical telegrapher, whose constant study has been to bring the key of the operator, and the stick of the compositor into the closest possible relations. Further than this, he has not been satisfied to attempt to carry on his work by the aid of mediocre talent, and lukewarm lieutenants. He has made a study of the weak points of the existing telegraph systems, as well as the news organizations, and when an emergency arises he is ready to meet it. The general public has never properly realized the practical perfection of the American telegraph, for the reason that it is only at its best when special provisions are made to meet the exacting demands of stock brokers, or similar branches of the commercial community. Its wonderful resources are most thoroughly known and appreciated by those who are behind the scenes; who are familiar with its language and who listen to the cadence of the sounder as the voice of a companion, whose presence enlivens either the silence of midnight or the turmoil of the busy day.

The time has long since passed when any newspaper or any news organization can cover the entire field of modern activity. Neither can any reader hope to find in the single journal to which he pins his faith, a chronicle of all the events in which he may be interested. The business of the world and the lives of its inhabitants are becoming more and more grouped into specialties, and the literature of each is growing apace. The instances are rare where two distinct branches are so closely interwoven as are the press and the telegraph, and their mutual extension is the index which points to the advancement of civilization.

THE EDUCATION OF TELEPHONE SUBSCRIBERS.

When the telephone was first brought into public notice, a great number of purposes which might be served by it naturally suggested themselves to those interested in the promotion of the invention, but not until recently, so far as we know, has it been used as an argument in favor of the higher education of the masses. We have observed, however, that considerable attention is now being devoted to the question of the propriety of educating telephone subscribers; but it does not as yet appear to be fully decided whether it is most advisable that the contract should be awarded to the day schools or to the Sabbath schools. The opinion however is gradually gaining ground that a full and effective educational course must necessarily embrace both secular and religious instruction in order to meet all the peculiar requirements of the case. Everyone must have observed the universal use in telephony of the singular expletive, "Hello," whose etymology is obscure and uncertain, but which is well ascertained to have no authentic foundation in classical literature, and have also perceived that it is frequently received by telephonic listeners in the reverse order of the syllables. This phenomenon is supposed to be due to the reflection of the sonorous vibrations from the organs of speech of careless, impatient and ignorant subscribers, and is certainly a strong argument in favor of a religious education. Surely it is a matter for profound regret that the telephone should deteriorate into an approved medium for the circulation of extra-dictionary words, or in short slang; and the frequent transmission to the central office of such objectionable and illiterate phrases as "What are ye givin' us?" "Oh! take your moustache out of your mouth and I can hear you better," etc., have no doubt given rise to the proposed plan of telephonic education.

Possibly the most effectual method of bringing about a reform would be to allow a sufficient leave of absence to each operator in turn, furnish her with a "black and tan" cab and an able-bodied escort, and request the lady to visit each of her subscribers in turn, where after a formal introduction and a few moments' conversation regarding present and prospective weather, attention might be directed to the pleasant and agreeable manner in which certain subscribers are accustomed to transact their business with the central office. Certain objections might possibly, however, be raised against a circulating educational system of this description. Operators who did not properly appreciate the value of their positions, might unthinkingly avail themselves of such a trip to formulate matrimonial schemes, to be carried out regardless of their employers' interest, a course of procedure which would tend to materially shorten their tenure of office.

There are obvious objections to the ordinary plan of organizing the pupils into classes, as most business men are deplorably ignorant of the vast importance of making life in the central office as agreeable and pleasant as possible to the staff, and consequently these parties would, in too many cases, absent themselves from recitations. The threadbare scheme of offering chromos and brass jewelry for perfect lessons and good conduct has become too common of late years to stimulate the exertions of even the most immature office boy. Possibly the most feasible method of enforcing compulsory education would be to threaten the discontinuance of the subscribers' telephones. Unfortunately, however, a new danger is liable to arise in this case; for it is extremely probable that higher education might completely destroy that insatiate craving for telephones, and other non-intellectual means of amusement, which is a well-understood peculiarity of the vulgar. A great loss of time in the aggregate might also ensue, owing to the excessive amount of verbiage which would be necessary in order to conform to the new state of affairs. An example of this might be cited in the case of a Massachusetts farmer noted throughout a wide extent of country for his extreme politeness, who was accustomed to address his yoke of oxen in the following language: "Haw! 'Bright' and you too, also, 'Golden,' if you please."

The thoughtful telephone manager will observe that this comprehensive scheme of education is one which should not be rashly entered into. While the general tendency of the human race to relapse into barbarism is doubtless greatly encouraged by the use of telephones, it would nevertheless scarcely be within the province of the manager to undertake to check the movement at the expense of a diminished revenue.

PROTECTION AGAINST LIGHTNING.

Considerable attention is being directed in Europe to the gathering of statistics, in order to ascertain whether any practical benefit is derived from artificially guarding buildings against injury by lightning. Whatever may be the result of these inquiries, the scientific value of lightning protectors will not be correctly determined for the reason that work of this character has been almost universally defective. With the growth of scientific knowledge among the people, it is to be hoped that a general reform may be effected in this branch of business, and that it may become recognized as a legitimate field for thorough electrical work. There is no reason why contracts so profitable, and useful in their results should be ignored by our electrical experts, and if the business is undertaken by them, and the mechanical details conscientiously executed, those scientific pretenders, popularly known as lightning rod peddlers, may be remanded to their appropriate vocation of licensed venders. Their well known volubility has aided them in taking advantage of the ignorance of the property owner, and the flippant manner in which they have expatiated upon the merits of insulation, surface conduction, and the virtues of magnetic steel points with platinum tips, has been the subject of ridicule amongst electrical people for years. It is time this was changed. A really serviceable lightning rod, instead of covering a building like a grape vine, may be made much more efficient by utilizing the same weight of material in a larger conductor and taking a more direct route to the ground. Without figures to base calculations upon, it is impossible to give the relative cost between good and worthless protectors, but it is very probable that thorough honest work will cost no more originally, and there is no reason why it should not endure as long as the building to which it is attached. There is now scarcely a town of any importance in the country, where there is not a person well known locally as a responsible representative of telephone or electric light interests. Such gentlemen acting as agents for some of our substantial electrical companies, would have little difficulty in convincing the owners of buildings that danger from lightning could be avoided to a great extent by the use of protectors. Such an organization of the business, with full records of buildings protected, and damages incurred from lightning, would soon result in the accumulation of valuable statistics hitherto unobtainable. Of course if ruinous competition is indulged in, regardless of good workmanship, the business may as well be permitted to remain in its present condition, but this could be avoided in a measure by apportionment of the territory to companies already appropriately located.

INSULATION.

Although much has been said and written regarding recent electrical progress, yet there has been so little practical improvement in the insulation of lines, that a period of rainy weather still wears upon the toiling operator especially on way wires, just as it did in early days. In one respect he may have gained an advantage: the waning of personal interest in the business, having schooled him to gaze with equanimity upon a message which has hung upon his hook for hours, provided the delay cannot be traced to his own neglect. The lack of progress in the improvement of insulation may, to a certain extent, be due to the prevailing tendency toward economy in construction, but if the loss incurred by leakage, and retardation in the transmission of business could be ascertained with any degree of exactness, no doubt true economy would be found to lay in the direction of more perfect insulation even at a greater cost of construction. There have been some recent improvements in the form of glass insulators which, judging from the tests already made, will eventually work a much needed reform in insulation, and it is to be hoped for the sake of the stockholders, employees and the public, that neither cents nor sentiment will be permitted to stand in the way.

ARTICLES.

THE ELEMENTARY PRINCIPLES OF ELECTRICAL MEASUREMENT.

BY F. L. POPE.

INTRODUCTORY.

The foundation of all exact knowledge in every branch of science rests primarily upon the comparison of one quantity with another, or more accurately, upon the comparison of unknown with known quantities. In case an experimental research is conducted by a single individual, the absolute value of the quantities with which he deals are usually immaterial, but when a number of persons are separately employed in investigating the same class of phenomena, it is obviously necessary that they should carry on their work with a mutual understanding of the units and methods of measurement to be employed. The design of the present treatise is to aid the student so far as possible in obtaining a clear understanding of the principles and of the standards employed by electricians in performing electrical measurements.

The strictly electrical phenomena which admit of measurement are four in number, viz., *potential*, *resistance*, *quantity* and *current*. These four measurable properties necessarily exist in connection with every electric circuit. *Electromotive force*, by which potential is produced, is also susceptible of measurement in terms of the same unit.

An *electric circuit*, in the most usual acceptation of the term, consists essentially of a generator or source of electricity, and of a conductor or series of conductors external thereto connecting the positive and negative terminals of the generator, forming a path for the electricity, whereby it is conveyed from one terminal to the other.

Such a source of electricity may consist of one or more voltaic cells or elements, in which electricity is produced by chemical action; of a dynamo or magneto or frictional electrical machine in which electricity is produced by the transformation of mechanical energy, or of a thermo-electric pile in which electricity is produced by the direct agency of heat. There are also other means of producing electricity which need not be mentioned in this place.

The conductor or series of conductors may be composed of any material capable of being traversed by electricity, and may be of any length from an inch or two to many hundreds of miles, but the essential features of the electric circuit in either case remain precisely the same.

Before entering upon the general subject of electrical measurement, it is necessary that the student should understand the precise meaning of the terms used to denote the different measurable qualities of the electric circuit.

ELECTROMOTIVE FORCE.

This may be defined as the immediate force which produces or tends to produce an electric current, or, in other words, the power which a voltaic cell, dynamo-electric machine or other generator of electricity, possesses, of causing or of tending to cause a transfer or flow of a certain quantity of electricity through a conducting circuit. This force, in the case of a voltaic cell, does not depend in the slightest degree upon the dimensions or form of the cell, but principally upon the nature of the dissimilar metals of which the elements of the cell are composed, and to a less extent upon the nature of the exciting solution in which these metals are immersed. It is also affected to some extent by the temperature of the metals and solutions.

The fact that the dimensions of a cell, or of its positive and negative plates, has no effect upon its electromotive force may be easily proved by the following interesting and instructive experiment:—Procure a common toy tumbler an inch and a half high, and with it construct a miniature Daniell cell by bending a piece of sheet zinc into a cylinder of such size as to just go within the tumbler. Make a porous cell of the bowl of a common clay tobacco-pipe having the stem broken off close to the bowl and the opening at the bottom closed by a bit of wax or tallow. Bend a piece of copper wire into a spiral, of such size as to go within the pipe bowl, which is to be filled with powdered sulphate of copper or blue vitriol. The protruding end of this wire forms one terminal of the cell, and a wire soldered to the zinc cylinder forms the other terminal.

Fill the tumbler and the pipe bowl with warm water, and place the miniature cell in circuit with a full size Daniell cell, connecting zinc to zinc and copper to copper so that the two cells oppose each other as shown in figure

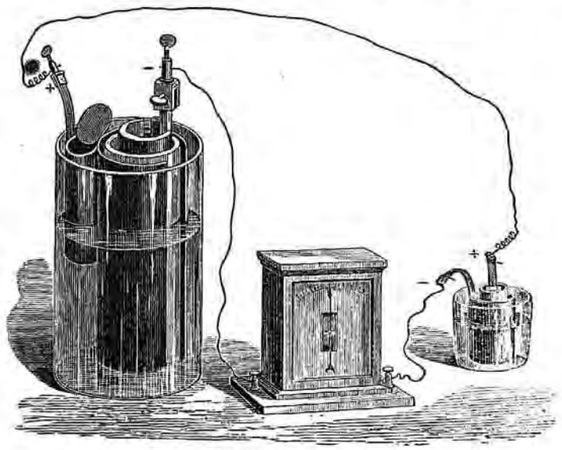


FIGURE 1.

1. By placing a galvanometer in the circuit it will be found that not the slightest current will pass, thus demonstrating that the electromotive force of the small cell is precisely equal to that of the large one.

POTENTIAL.

The existence of an electromotive force is necessarily accompanied by a certain peculiar electrical condition, which is termed by modern writers on the science a *difference of potential*. Although the idea expressed by this term in reality is a very simple one, it is nevertheless somewhat difficult to translate it into words so as to be easily comprehended. In fact, the terms *electromotive force* and *difference of potential* have often been indiscriminately employed in the same sense by writers on electricity, to the great confusion of the student. They are not, properly speaking, the same thing, although neither can exist in an electric circuit without the other. Perhaps this matter may be rendered clear to the student by an illustration.

If plates of two different metals (as the copper c and zinc z in figure 2) be immersed in water contained in a glass vessel, and a copper wire, c_1, be joined to the zinc z, the plate c will become charged with positive and c_1 with negative electricity. This being the case, the difference in the electrical condition of the *poles*, as they are termed, of the voltaic cell or element thus formed, is represented by their difference of potential.

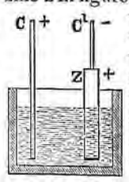


FIGURE 2.

Now, if the plates c and c_1 are united by a wire, that wire will be traversed by an electric current, and, other conditions remaining the same, the strength of this current will be strictly proportional to the difference of potential between the opposite poles before they were joined. The electricity thus existing in the plates c and c_1 before they are connected by the wire, is said to be in a *static* or stationary condition. When traversing the wire it is said to be in a *dynamic* condition—that is, in motion. Now, as it may be proved by experiment that the strength of the dynamic current is always strictly proportional to the difference of potential existing between the two statically charged points, it follows that the original static charge must be a measure of the resulting dynamic action. Electricity at rest bears a definite relation to the same electricity in motion. Similarly, the difference of potential existing between the plates c and c_1 is always strictly in proportion to the electromotive force of the cell or element, and in fact, may be considered to be caused thereby.

A difference of potential, therefore, may be defined as *that difference of electrical condition between two points by virtue of which an electric current tends to flow from one to the other when they are united by a conductor*. The existence or continuance of the flow of a current of electricity from one point to another consequently depends solely upon the maintenance of a continuous difference of potential between the two points.

Probably it would not be incorrect to say that an electromotive force causes a difference of electric potential between two points, and this difference of potential in turn give rise to an electric current whenever the two points are connected by a conductor.

This may, perhaps, be rendered clearer by using as an illustration a certain analogy which exists between the action of electricity and that of water, which has often been pointed out by writers upon the subject.

Suppose we have two water-tight vessels of equal size and capacity, A and B, figure 3, connected by a horizontal

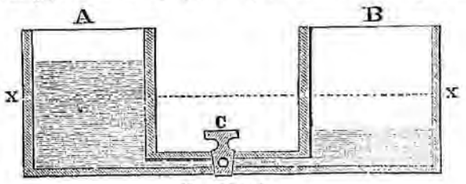


FIGURE 3.

pipe c, provided with a closed stop-cock. Now let such a quantity of water be placed in each vessel that the surface of the water in A shall be the same distance above the horizontal line x x as the surface of the water in B is below it. The difference between the level of the water in A and that in B may be termed their difference in potential. The two bodies of water are in a *static* condition, corresponding to that of the electricity in the voltaic cell shown in figure 1. Now, if we open the stop-cock, and establish a communication between the two vessels (which corresponds to the act of joining c and c_1 in figure 2 by a conductor) a current of water will flow from A to B through the pipe c. The greater the difference of level between A and B the more rapidly and forcibly will the water pass through c. When the water in both vessels has reached the same level —that of the line x x—the flow will cease, because there exists no longer any difference of potential. Hence the line x x may be termed the zero of the potential.

The original level in A, which was higher than this line, represents a *positive* potential, while the lower level in B in the same way represents a *negative* potential.

Now let us suppose that a suitable apparatus is set at work pumping water from B into A. The effect of this will be to lower the water in B, and simultaneously to raise it an equal amount in A; in other words it will tend to produce and maintain a difference in potential or head between the two vessels. This pumping apparatus corresponds to an electromotive force, and the difference in potential maintained between the vessels A and B, and consequently the quantity of water which will thereby be caused to pass through the pipe c in a given time, depends entirely upon the energy of the action of the pump, and is, of course, directly proportional thereto.

The action of a dynamo or magneto-electric machine, when employed as a generator of electricity, is strikingly analogous to that of a rotary pump in the hydraulic system which we have employed as an illustration, inasmuch as the electromotive force, and the difference of potential arising therefrom, will be in proportion to the speed with which the pump is driven.

It is scarcely necessary to observe that the quantity of water flowing through the pipe c depends upon the *difference* of level between the water in A and the water in B, and not at all upon the absolute level, which may be arbitrarily assumed at pleasure. For instance, the zero line x x might be assumed as corresponding with the mean level of the sea or with any other desired level. In precisely the same manner the potential of the earth is assumed by electricians as the zero of electrical potential merely as a matter of convenience of reference in electrical work; hence when we say that a given point has a certain *positive* or *negative potential*, we mean nothing more than that its potential is so much greater or less than the mean potential of the earth.

RESISTANCE.

All known substances, whether solid, liquid or gaseous, when they form part of an electric circuit, oppose a sensible resistance to the passage through them of an electric current. It is to be understood, therefore, that when two bodies having different electrical potentials are connected by a conductor composed of any material whatsoever, the quantity of electricity present must occupy a certain *time* in passing from one to the other. Hence if a certain difference of potential between two points is maintained by means of a constant electromotive force, and these two points are joined by a conductor in the manner before stated, it is found that by modifying the length, substance, cross-section or temperature of the conductor, the transfer of a given quantity of electricity may be made to take place in very different times. The inherent quality of a conductor, whatever it may be, by virtue of which the transfer of more than a certain quantity of electricity in a given time is prevented, is termed its *electrical resistance*.

Returning to our illustration of the flow of water, as shown in figure 3, if the pipe c were reduced to one half its original cross-section or conducting capacity, its resistance would be doubled. In such case it would require exactly twice as long a time as before (leaving friction out of the question) for a given quantity of water to be transferred from A to B, provided all the other conditions remained unchanged.

Electrical resistance is a property that differs very widely in degree in different substances. The best conductor known is pure silver. One of the worst is gutta percha, the resistance of which is no less than 850,000,000,000,000,000 times as great as that of pure silver. Substances commonly termed insulators are in fact nothing more than substances having a very great specific resistance. The terms conductor and insulator are, therefore, entirely relative and not in any sense absolute in their meaning, and it will be well for the student to consider all bodies as *conductors having more or less specific resistance*, as the case may be. This view of the matter will materially assist him hereafter in forming a clear and distinct conception of the nature of electrical action.

The resistance of any electric circuit is partly within the generator itself, and partly in that portion of the circuit outside the generator. The former is termed *internal* resistance, and the latter *external*, or sometimes *interpolar* resistance.

QUANTITY.

Much confusion of ideas has arisen from the loose and indefinite sense in which the term *quantity* has been used by the earlier writers upon electricity. A certain quantity of electricity means exactly the same thing as a certain quantity of anything else, that is, a given amount of it. In the organization shown in figure 1, it was explained that a

current of electricity would flow between the poles c and c_1 when these were joined by a conductor. This current is due in the first instance to the action of the electro-motive force, and is supposed to be maintained by the chemical combination of the zinc with the oxygen of the water, the substance of the metal being consumed exactly in proportion to the quantity of electricity developed. Therefore, the student may, at least for the purposes of this explanation, regard voltaic electricity from a chemical point of view as a component part of the zinc, which is set free when the latter combines with oxygen. We may conceive, then, that the zinc plate of a battery originally contains a certain definite quantity of electricity, just as the reservoir or vessel A, figure 3, contains a definite quantity of water above the line x x. Now it is obvious that the less the resistance of the pipe c, the greater will be the quantity of water which will pass through it in a given time, and the sooner will the water in the vessel A be reduced to the level of the line x x. Similarly, in a voltaic battery, the greater the quantity of current traversing the conductor joining its poles in a given time, the sooner will the original quantity of electricity (which we may regard as having been stored up in the zinc) be exhausted.

So also in the case of a charged condenser, or of a storage battery, which latter may be regarded as a liquid condenser. A certain measurable *quantity* of electricity may be stored up in a static condition. When the condenser or storage battery is discharged by joining its poles by a conductor, the conductor is traversed by a current. If the conductor has a great resistance, it will require considerable *time* for the whole quantity to pass, and thus the current will be a comparatively weak one. If on the other hand, the resistance of the conductor is small, the whole quantity will pass in a much shorter time, and the current will be a much stronger one. Thus the term *quantity* in its proper signification, refers solely to *static* and not to *dynamic* electricity, although the duration of the dynamic effect depends upon the quantity originally present.

CURRENT.

It will readily be understood, in view of the foregoing explanations, that the term current signifies simply *the quantity of electricity that passes through a given conductor or circuit in a given time.* To avoid circumlocution, the direction in which a current is assumed to flow is always from a higher to a lower potential, and the current is spoken of as if this were really the case. What we conventionally term an *electric current* is in fact the recombination of the positive and negative or two opposite electricities, which have previously been separated by an electro-motive force, and therefore, strictly speaking, must of course flow as much in one direction as in the other.

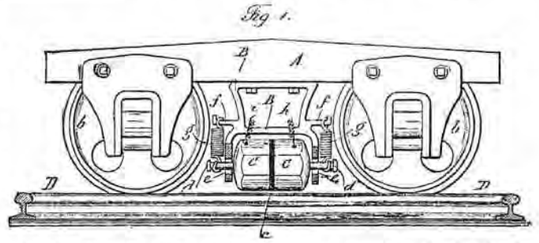
The strength of a constant current in any simple circuit —that is to say, the quantity of electricity that passes in a given time—is the same at every point in that circuit. This uniformity of quantity throughout the circuit is not influenced in the slightest degree, either by differences in the sectional area of different parts, or by differences in the material of which the conductor is composed. The distinction of "quantity" and "intensity" currents, formerly in vogue among electricians, is entirely a fallacious one. There is only one kind of an electric current, and that is a current of greater or less magnitude, volume or strength, by which is to be understood nothing more or less than the simple fact, that *a certain definite quantity of electricity is transferred or conveyed past a given point in a given time.* Here once more, we may refer to our illustration of the water flowing in the pipe c, figure 2. Suppose this pipe to be replaced by a series of pipes of various diameters, connected end to end and all filled with water, and the current of water from A to B to be made to flow through all of them. Precisely the same quantity of water per second will pass through each portion of the pipe, whatever the diameter or cross-section of that portion may be. It is true that the *velocity* of the water varies in proportion to the diameter of the different sections, but the current nevertheless remains uniform throughout, in the sense that it is a current of so many cubic feet of water per second. So it is with an electric current, the actual quantity of electricity passing any given point in the circuit during each unit of time is always the same irrespective of the thickness or specific resistance of the conductor.

(To be continued.)

KAMPFE'S ELECTRO-MAGNETIC CAR-BRAKE.

The introduction of power brakes for railway purposes has now become so universal, that a suggested improvement in this direction is received with more consideration than it was at a time when the hand brake was deemed proof against the innovations of modern inventors. The brake now in use, however, still embodies the old principle of friction against the revolving wheel, varied too often, especially in damp weather, by the sliding of the wheels along the rails. The latter fault is one of the chief objections to the present systems, as car-wheels are damaged in this way by the formation of flat places upon their peripheries, and this difficulty once begun is aggravated by every stoppage, causing the life of the wheel to be materially shortened. Another method of applying a brake which naturally suggests itself is that in which the shoe is pressed against the rail, and this principle was the basis of a patent granted to George Stephenson as early as 1832, and the same idea was embraced in a United States patent granted in 1882. In the latter case, a set of shoes was suspended between the wheels, which were forced against the rails by a system of levers. Among the objections to the latter were the impracticability of obtaining sufficient leverage to produce the necessary friction, and the car being used as a fulcrum, its weight was transferred from the wheels to the brake shoe, thus increasing its liability to jump the track. The substitution of electro-magnetic attraction for the leverage system was patented by Paul and Kampfe in 1882, but their form of brake shoe was not adapted to that thorough magnetization which is necessary in order to produce effective results, and was open to other serious objections. Further improvements were patented by Richard Kampfe, December 25th, 1883, bringing the invention into the existing form, which is believed to be not only serviceable for the purpose proposed, but a really practical device. By reference to the accompanying illustrations the action of this brake may be thoroughly understood. Figure 1 is a side view of a truck with the brake in position, the opposite side not shown, being provided for in like manner. A is the ordinary frame work of a truck, B is an iron support depending from A and carrying the shaft *d*, which is free to move in the slot *e*. Upon this shaft is secured the electro-magnetic brake C C, the construction of which is shown in figures 2 and 3. The wires *h* and *i* connect it with the circuit in the ordinary manner. The springs *g*, the respective ends of which are secured to the pins *f*, and the shaft *d* serve to draw the magnets, when not vitalized, up in the slot *e*, withdrawing

Fig 1.



the brake from contact with the rail D. The magnets are separated by a disc, c, of brass or other non-magnetic metal, the external case being of cast iron. In the sectional view, figure 2, the internal construction of the brake may be seen. The middle arm of the magnet c'' and the casing

Fig 2.

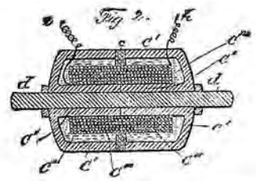
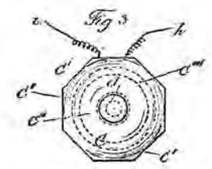


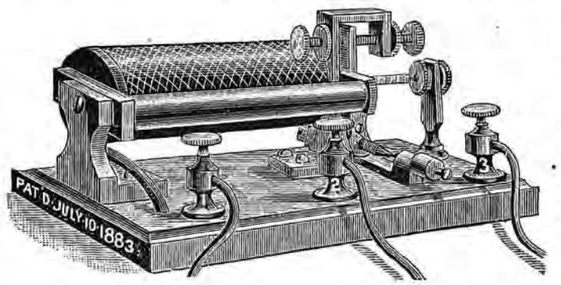
Fig 3



c' being vitalized by a current of electricity passing through the coil c''', the magnetic attraction presses the brake firmly against the rail D. It will be seen that the magnets are of a very efficient form. The outer case may be cylindrical, or have a number of plane faces as shown in figure 1, so that by turning the magnets upon their axis new points of contact will be presented to the rails. The effective manner in which the brake acts upon the rail can only be thoroughly appreciated by actual observation. Such a brake would be especially desirable for use upon elevated railways where the falling particles ground from the rails and wheels are found to cause serious injuries to the eyes of people in the streets below. The magnetic attraction would be sufficient to gather up all the particles of iron and steel, and the accumulations could be removed at proper intervals. A system of brakes of this description could be operated most effectively by a dynamo driven by a small rotary engine on the locomotive. In practice the brakes may be placed within half an inch of the rails without being liable to injury.

DRAKE'S AUTOMATIC PROTECTOR.

Since the very general introduction of electric lighting in cities, the liability of damage to telegraph and telephone instruments, caused by the burning of their fine wire coils, has greatly increased. Formerly the only danger of this kind to be apprehended was from atmospheric electricity, but now an ordinary "cross" with an arc light wire frequently disables all of the instruments which may be connected with the line thus accidentally brought into contact with such a conductor. Several devices have been introduced to protect such instruments, but where they are liable, in themselves, to cause interruptions to the line on which they are used, they do not meet with general



approval. The protector patented by C. C. Drake, of which we give an illustration, has been thoroughly tested and appears to be well calculated to serve the purpose for which it is intended. In construction it is simply a Morse relay, in which, however, but one magnet core is wound, and that, with wire of No. 16 gauge, making the resistance only about half an ohm. The magnet is connected in circuit with the instruments to be protected, but owing to its low resistance, the ordinary working current of a telegraph or telephone line produces no movement of the armature, which is consequently held against the back

contact by the spiral adjusting spring in the ordinary manner. When, however, an abnormal current of sufficient power to fuse a small wire, comes over the line, the magnet is instantaneously and powerfully charged and the armature brought over against the front contact. By this movement the current is at once shunted across by the completion of a connection between the leading in wires, which effectually "cuts out" the office instruments. So long as the excessive current remains on the line wire it is obvious that it is permitted to pass harmlessly through the short path thus provided, but upon its cessation the retractile action of the spring restores the circuit to its normal condition. It is claimed for this instrument that it will successfully divert any current which can be conducted over an ordinary telegraph wire.

In placing it in position over a telephone outfit, as shown in the annexed cut, the instrument is arranged in such a manner that the weight of the armature is sufficient to hold it against the back contact, in case the adjusting-spring should become inoperative from any cause.

THE CONSTRUCTION OF LINES FOR ELECTRIC CIRCUITS.

BY THOMAS D. LOCKWOOD.

Ten years ago, had it become necessary to write a disquisition on electrical construction such a title as the above would have been unnecessary.

Then, it would have been eminently proper to say "Telegraphic Construction." For though the age of electricity had commenced, and although we had already been made acquainted with the established systems of commercial telegraphy, including the Morse, the various forms of chemical and automatic, and the type-printing telegraph, as brought to our offices to indicate the quotations of gold and stocks; its further extension into our homes in the form of the district messenger, police and fire telegraphs was barely inaugurated; the telephone, so far as speaking was concerned, was yet in the future, and there was not a single electric light regularly maintained in the city of New York.

Now, if we speak or write of construction, we have to contemplate alike the telegraph, the telephone and the illuminating wire, and to adapt our ideas to the different result which is to be produced.

We know that in order to effect a result at any given point electrically, by an operation performed, or work done at another point, we must unite the two points by a conductor of electricity, and place in circuit with the said conductor some source of electricity at one end, and some apparatus adapted for the desired result at the other.

Moreover as a rule the conductor must be well insulated from the slightest contact with the earth.

Thus in the establishment of a line of electric telegraph between any two points, we require a conducting wire well insulated to conduct the electricity or convey the electric impulses between the stations; a battery or dynamo-electric machine to furnish the electricity; a circuit-breaking and closing key or some other manipulating device to effect changes in the electrical condition of the circuit; and a Morse recorder, a sounder, a type-printing instrument, or some other suitable receiver, according to the nature of the system, at each receiving station.

These appliances or instrumentalities may be arranged

or disposed with reference to one another, in almost an infinite variety of ways; but in one shape or another we always find them.

In the ordinary Morse telegraph we find, for example, that each transmitting station is also a receiving station, and vice versa, so that each station must necessarily possess both transmitting and receiving instruments.

For purposes moreover, which will hereinafter appear, it is usual in such a system to divide up the vitalizing battery, so that a portion of it shall be at each of the two terminal stations; and sometimes in the case of long lines, a portion of the battery is connected in the circuit at one or more way stations also.

The circuit itself may be, and generally is, what is called an earth circuit; that is to say, leaving the earth at one terminal station it passes through the battery and instruments, out to the line, and through the way stations, and ultimately reaching the distant terminal station is again united to the earth.

The complete circuit is therefore composed of the line wire, the instruments, the battery and the earth.

In some cases, notably the municipal fire telegraph systems, the circuit instead of terminating at each end in the earth, is brought back to the originating station. Leaving the positive pole of the battery, the circuit wire runs out and passes successively through its way stations, returning again to the battery station, where it is connected to the opposite pole of the battery.

A circuit so organized is called a metallic circuit.

If we consider the arrangement of a telephone line we shall find some differences from the foregoing—chiefly however in the direction of simplification.

These are of two classes, viz., private lines, and exchange or central office lines. A private line usually implies a line connecting a definite number of offices or stations, and having no appliances whereby it may be switched on to or connected with other lines.

A contract definition of the term private telephone line is "a telephone line consisting of a single circuit on which telephones are to be used for the individual and private business of the individuals, business firms, or corporations leasing the same."

An exchange line on the contrary is one of a number of telephone lines converging at a central station, and radiating from the same to any number of subscribers' stations. At the central station all of the lines are connected with a switchboard or commutator for the purpose of affording the requisite facilities whereby any line may be connected with any other line for through communication.

We find that telephonic circuits share with telegraphic circuits, the great feature of the conducting line. In most cases also, that line must be either grounded at its extremities, or be provided with a wire return. The battery may be dispensed with, since it is found to be more convenient and also more economical to supply at each station with the telephones, a small magneto-machine to develop the signaling currents; this may readily be done, because the only time when a strong current of electricity is wanted on a telephone line is when it is desired to signal or attract the attention of another station.

Again, the apparatus of the telephone line differs from that of the telegraph, for whereas, the calling and communicating are in the Morse telegraph effected by the same means, in the telephone circuit of the exchange line we find at one end an apparatus for giving a visual signal, at the other end an apparatus of producing an audible signal, and at both ends apparatus for transmitting currents capable of actuating both classes of signal receiver, and also transmitting and receiving telephones.

Glancing for a moment at the electric light circuit, we note further alterations, but still no radical change in the inevitable line conductor; the only actual difference being that it has greater carrying capacity.

The vivifying influence is in this case a dynamo-electric machine, and the medium of the work done is one or more electric lamps. The circuit must be completed either through the ground or by a metallic return, the latter being in every respect far preferable.

There is still one more use of electrical energy which in these preliminary remarks should be noticed—the electric transmission of mechanical power.

Once more we see that the conductor is the connecting link, and the one fixed appliance shared by every system of electric utilization. The dynamo-machine, as in the illuminating system, supplies the electricity; and strange to say, a similar machine is the electro-receptive device. The armature of the first machine is rotated in a closed circuit by suitable power, and the current so developed passes along the conductor and through the coils of the receiving machine, causing its armature to revolve in unison with the armature of the first.

The analogy between these electrical organizations, and the higher systems of animal life is most striking. Comparing them with the human body, we may regard the heart as the battery or machine generating the vital fluid, the arteries as the outward conductor, and the veins as the return circuit; the brain and nervous system may be called the transmitting or manipulating devices, and the senses, and the organs by which they are manifested, the receiving instruments.

ON THE MOST ECONOMICAL SIZE OF ELECTRICAL CONDUCTORS.

BY W. L. HOOPER.

(Physical Laboratory, Tuft's College).

THE problem of determining the most economical size of a conductor designed to transmit electrical energy for lighting, or as a source of power, is one of great importance and not difficult of solution.

Let E represent the difference of potential between the terminals of the main conductor at the dynamo, R the resistance of the conductor, r the combined resistance of the lamps, and C the total current, then by Ohm's law:

$$E = C\,(R + r)$$

If P represent the energy of the current measured in horse-power, then

$$P = \frac{C\,E}{745} = \frac{C^2\,(R + r)}{745}$$

The resistance is here composed of two parts; and since the heating effect of the current, or the loss of electrical energy in various parts of the circuit, varies directly with the resistance, the horse-power wasted upon the conductor is evidently expressed by the equation:

$$P = \frac{C^2\,R}{745} \qquad (1)$$

Let p be the cost of an electrical horse-power transmitted to the conductor for one hour, and n the number of hours in a year that the current is used; then the cost of the current wasted in the conductors during the year will be:

$$\text{Loss per year} = p\,n\,P$$

Substituting value of P in (1)

$$\text{Loss per year} = \frac{p\,n\,C^2\,R}{745} \qquad (2)$$

Let R^{sp} be the specific resistance (the resistance of unit length of unit cross-section) of the material composing the conductor, l its length, and l its diameter, if round. Then the area of cross-section of the conductor will be expressed by

$$\square = \Pi\left(\frac{d}{2}\right)^2 = \frac{\Pi\,d^2}{4}$$

The total resistance of the conductor will be

$$R = \frac{R^{sp}\,l}{\frac{\Pi\,d^2}{4}} = \frac{4\,l\,R^{sp}}{\Pi\,d^2} \qquad (3)$$

Substituting this value in (2) we have

$$\text{Loss per year} = \frac{p\,n\,C^2\,4\,l\,R^{sp}}{745\,\Pi\,d^2} \qquad (4)$$

Let W represent the weight of unit length of unit cross-section of the conductor, then the

$$\text{Weight of conductor} = \frac{W\,l\,\Pi\,d^2}{4} \qquad (5)$$

If the cost of unit weight *in situ* be q, then the

$$\text{Cost of conductor} = q\,\frac{W\,l\,\Pi\,d^2}{4} \qquad (6)$$

Let i be the current rate of interest, then

$$\text{Interest on cost of conductor} = \frac{i\,q\,W\,l\,\Pi\,d^2}{4} \qquad (7)$$

Now, the cost of the conductor, and consequently the interest on that amount, may be supposed to vary directly with its area of cross-section; but the resistance of the conductor, and consequently the waste of energy in it, will vary inversely with its cross-section. Hence the interest on the cost of conductor and the cost of the current wasted in a year will vary inversely with each other. Now, the sum of two quantities that vary inversely is a minimum when the two quantities are equal. The most economical size will, therefore, be that with which *the cost of current wasted in a year will equal the interest on capital invested in the conductor.* Hence

$$\frac{4\,p\,n\,C^2\,l\,R^{sp}}{745\,\Pi\,d^2} = \frac{i\,q\,W\,l\,\Pi\,d^2}{4} \qquad (8)$$

$$d^4 = \frac{16\,p\,n\,C^2\,R^{sp}}{745\,\Pi^2\,i\,q\,W} \qquad (9)$$

It will be noticed that l cancels out of equation (8), therefore the size of conductor is independent of its length.

EXAMPLE.

Let p = $.03
n = 365×6 = 2190 hours
C = 1000 amperès
R^{sp} inch, copper, pure, at 0° C. = .000 000 64645 ohms
i = 8%
q per lb., *in situ* = $.30
W cubic inch = .32523 lbs.

Log 16	= 1.204120	Log 745	= 2.872156
" .03	= $\bar{2}$.477121	" Π^2	= 0.994302
" 2190	= 3.340444	" .08	= $\bar{2}$.903090
" 1000000	= 6.	" .30	= $\bar{1}$.477121
" .00000064645	= $\bar{7}$.810538	" .32523	= $\bar{1}$.512192
	2.831223		1.758861
	1.758861		
	4)1.072362		
Log d	= .268090		
	d = 1.8539 in.		

From equation (9) it appears that the area of cross-section varies with the current, hence a copper conductor that carries 10 amperès under the conditions in the above example should have a diameter of

$$\frac{1.8539}{\sqrt[4]{\frac{1000}{10}}} = .18539 \text{ in.}$$ No. 5 gauge would answer.

It is important now to determine the heat generated in the conductor by the current. The heat in water gramme centigrade degrees, generated by any current in t seconds is expressed by the equation

$$H = .24\,C^2\,R\,t \qquad (10)$$

The ratio between the gramme centigrade and pound Fahrenheit degree is $\frac{9}{5\times 453.54}$, which multiplied by .24 gives .00095251. Hence the heat in pound Fahrenheit units will be

$$H = .00095251\,C^2\,R\,t \qquad (11)$$

Substituting for R its value in (3)

$$H = .00095251\,C^2\,t\,\frac{4\,l\,R^{sp}}{\Pi\,d^2} \qquad (12)$$

The temperature to which the conductor will be raised in any time, supposing no heat is radiated or conducted away, will be the quotient of the whole amount of heat divided by the weight of the conductor multiplied by the specific heat (H^{sp}) of the material composing it.

$$T = \frac{H}{\text{weight} \times H^{sp}}$$

Substituting for weight its value in (5)

$$T = \frac{4\,H}{W\,l\,\Pi\,d^2\,H^{sp}} \qquad (13)$$

Finally substituting for H its value in (12)

$$T = .00095251 \times 16\,\frac{C^2\,t\,R^{sp}}{W\,\Pi^2\,d^4\,H^{sp}} \qquad (14)$$

Since in the above equation C^2 and d^4 are the only variables, T is constant under the same conditions for wires of different sizes, each carrying its most economical current.

EXAMPLE.

The copper wire in the last example, current 1000 amperès, t one hour or 3600 seconds, H^{sp} of copper being .09515.

Log .00095251	= $\bar{4}$.978869	Log .32523	= $\bar{1}$.512192
" 16	= 1.204120	" Π^2	= 0.994302
" 1000000	6.	" d^4	= 1.072362
" 3600	3.556303	" .09515	= $\bar{2}$.978409
" .00000064645	$\bar{7}$.810538		
	1.549830		0.557265
	.557265		
Log T =	.992565		

T = 9°.8302 Fahrenheit.

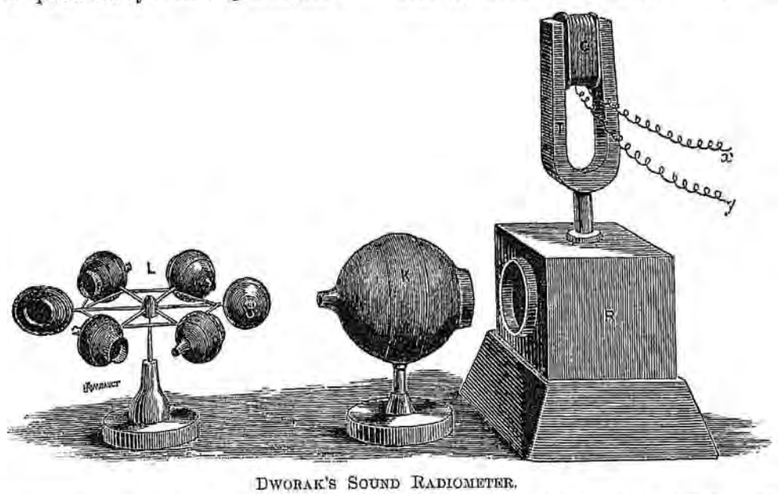
In the above example it is assumed, as has been before stated, that no heat is lost by radiation or conduction. But it is evident that a conductor whose temperature rises only at the rate of 10° Fahrenheit per hour would soon reach a point where the heat given off would equal that acquired; hence, it could never be many degrees hotter than surrounding objects, especially if Prof. Forbes' suggestion of making the conductors flat was adopted. I have no data for computing what this final difference of temperature would be for a wire buried in the ground (the only way to dispose of conductors carrying large currents), and it would evidently vary in different localities, but it is safe to say that the difference would be so small that it would only be objectionable on account of slightly increasing the resistance of the conductor.

College Hill, Mass., May 7, 1884.

ABSTRACTS AND EXTRACTS.

DWORAK'S SOUND RADIOMETER.[1]

At a recent soiree of the Royal Society, one of the most interesting exhibitions was that of the sound radiometer, given under the personal supervision of Mr. W. H. Preece, F. R. S. In this apparatus a wheel is set into rapid rotation by the sound waves produced by a vibrating tuning fork.



DWORAK'S SOUND RADIOMETER.

In the accompanying illustration T is a large tuning fork, mounted on a resonating chamber R, and vibrated continuously by an electro-magnet C fixed between its prongs, to which an intermittent current of electricity is transmitted by a contact breaker, consisting of a similar fork tuned in unison with T and connected thereto by the wires x and y. Opposite the orifice of the resonating chamber R and on the same horizontal axis is fixed a Helmholz resonator, K, and in front of its smaller end is placed the rotator L, which consists of six little Helmholz resonators fixed to the periphery of a wheel, which is so poised at its centre on a needle point as to be capable of rotation in a horizontal plane. These resonators are attached to the wheel in such positions that their axes are tangential to their circle of rotation, their smaller ends pointing in the direction in which they revolve. The tuning fork T being set into action the air within the chamber R takes up the vibration and the sound is greatly reinforced, especially if a mass of cotton wool or soft rubber be interposed between the chamber R and the table. The action of the resonator K is to take up the sound waves and concentrate them in the direction of the rotator L. This effect is so strongly marked that if the finger be placed a short distance in front of the smaller orifice of K, a sensation is felt exactly similar to that which would be produced by a rapidly intermittent jet of air issuing from the nozzle. The rotation of the wheel L may be due to the fact that as the air within each of the little resonators, is thrown into vibration under the influence of the sonorous vibrations, and in the direction of its axis, and as it is freely open to the external air towards one end of that axis, it is probable that the energy of motion expends itself partly on the envelope and partly on the air, and the former receiving a greater proportion over that part of its surface which is opposite to the large orifice than in the contrary direction, rotation takes place. The action has also been attributed to the effect of one vibrating body upon another through the intervention of a common vibrating fluid medium in which they are immersed.

1. Abridged from *Engineering*.

THE ELECTRICAL CONGRESS OF PARIS, 1884.

THE first Congress of 1881 has borne good fruit. It has not only brought about an *approchement* between electricians of all countries, but it has led to the adoption of an international system of measurement which will be in universal use. It is satisfactory to find that there are questions which can be amicably settled internationally. The congress was divided into three commissions which dealt with (1) electrical units, (2) atmospheric electricity and earth currents, (3) standard of light. The first commission virtually dealt with the length of a column of mercury of one square millimetre section, which represented the ohm—it having been decided at the Congress of 1881 that this should be the unit of resistance. Many physicists had been working on this in different countries and on different methods. M. Mascart grouped the results in the following useful table:—

Methods	Experimenters	Column of Mercury in Centimetres
1. B.A.	British Association	104.33
	Rayleigh-Schuster	106.00
	Rayleigh (1882)	106.27
	H. Weber	106.16
2. Weber (I.)	Kohlrausch	105.81
	Wiedemann	106.19
	Mascart	106.33
3. Kirchhoff	F. Weber	105.02
	Rowland	105.79
	Glazebrook	106.20
	Mascart	106.33
4.	Róiti	105.9
5.	Fr. Weber	105.33
6. Lorenz	Lorenz (first)	107.1
	Rayleigh	106.24
	Lenz	106.13
	Lorenz (second)	106.19
7. Weber (II.)	Dorn	105.46
	Fr. Weber	105.26
	Wild	105.68
	Baille	105.37
8. Heat	Joule	106.22

From this it appears that the figures obtained by the different methods were—

B.A.	106.21
Weber's I.	106.14
Kirchhoff's	105.93
Lorenz	106.19
Weber's II.	105.47
Joule	106.22

The mean of which was 106.02, but 106 was taken as a round figure sufficiently near the truth for all practical and useful purposes. Hence the congress decided that "the legal ohm should be the resistance of a column of mercury of one square millimetre section and of 106 cm. of length at the temperature of freezing," and a resolution was passed desiring the French government to transmit this resolution to the different governments, with a view of making its adoption international. It was decided that primary standards should be constructed in mercury, but that secondary coils should be made of solid alloys, which should be frequently compared among themselves and with the primary standard.

It was resolved that the ampère should be exactly 10^{-1} c.g.s. electro-magnetic unit of current, and that the volt should be the electromotive force which maintained an ampère in a conductor whose resistance was the new ohm.

We can now congratulate ourselves upon having a scientific system of electrical units independent of any particular instruments or of any particular process. It is not absolutely exact. That is, the new ohm is not 10^9 c.g.s. units, but it is the nearest approach to it that can be practically attained. It will probably be known as the *Congress ohm*, to distinguish it from the true ohm (10^9 c.g.s.) or the B.A. ohm of 1864.

One subject of regret is that Prof. Rowland's measurements in Baltimore are not completed, and will probably not be ready before the end of the year. The United States Congress voted a large sum of money to enable this to be done. He is using a Planté secondary battery and employing three methods, viz. Kirchhoff's, Joule's and Lorenz's. His well-known experimental skill has given much interest to this investigation of Rowland's.

The second commission dealt with atmospheric electricity and earth currents, and recommended that it was desirable to send each year to the Bureau International des Administrations Télégraphiques in Berne, the reports that were collected in the different countries, so that they might be distributed to the different governments.

The third commission dealt with the standard of light, and it was decided, not without considerable opposition, that the unit for each simple light should be the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of fused platinum at the temperature of solidification, and that the practical unit of white light should be the total quantity of light emitted normally by the same source. This is a very unsatisfactory standard. It was accepted because there was virtually none other before. But it was obtained by only one observer (M. Violle); it is not portable; it is not even reproducible except at great expense, and it is so eminently impracticable that it is scarcely likely to be generally adopted. It is to be regretted that the British Association Committee on a Standard of White Light has not yet finished its work; but we may hope that at Montreal Capt. Abney will be able to give some results which will give us a better and more practical standard.

There was a universal consensus of opinion that the congress had faithfully and earnestly done its work, and that the success of its labors and the rapidity of its action was due to the energy and ability of M. Cochery, the Minister of Posts and Telegraphs. The English representatives were Sir William Thomson, Capt. Abney, Prof. Carey Foster, Prof. Hughes, Prof. Fleeming-Jenkin, Mr. Graves and Mr. Preece. The full text of the resolutions is as follows:—

"I. *Electric Units*, strictly so called. First resolution: The legal ohm is the resistance of a column of mercury of a square millimetre cross-section and 106 centimetres in length at the temperature of melting ice. Second resolution: The conference expresses the wish that the French government should transmit this resolution to the different States, and recommend an international adoption of it. Third resolution: The conference recommends the construction of primary standards in mercury conformable to the resolution previously adopted, and the concurrent employment of scales of secondary resistances in solid alloys which shall be frequently compared amongst one another and with the primary standard. Fourth resolution: The ampère is the current the absolute value of which is ten to the power minus one in electro-magnetic units. Fifth resolution: The volt is the electromotive force which maintains a current of one ampère in a conductor the resistance of which is one legal ohm.

"II. *Earth Currents and Lightning Rods.* First resolution: It is to be desired that the results of observations collected by the various administrations be sent each year to the International Bureau of Telegraph Administration at Berne, which will make a digest of them and communicate it to the various governments. Second resolution: The conference expresses the wish that observations of earth currents be pursued in all countries.

"III. *Standard of Light.* Resolution: The unit of each kind of simple light is the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of molten platinum at the temperature of solidification. The practical unit of white light is the quantity of light emitted normally by the same source."—*Nature.*

THE ELECTROMOTIVE FORCE OF ACCUMULATORS

M. REYNIER, the well-known electrician, has made experiments on three systems of secondary battery: (1) the Planté accumulator of reduced lead, peroxide of lead and sulphuric acidulated water; (2) the copper accumulator of lead, copper, lead peroxide, acidulated solution of sulphate of copper; (3) the amalgamated zinc accumulator, of zinced lead, lead peroxide, acidulated solution. His object was to test the electromotive forces of the combinations and find their variations of sulphate of zinc. The accumulators were not completely formed. The electromotive forces were measured during charge and discharge by the method of equal deflection. His results confirm those formerly obtained by M. Gaston Planté, and are as follows: (1) In the three systems of accumulators studied, the secondary electromotive force is notably more elevated during charge than during discharge. The ratio of the smallest of these values to the greatest may be called the *coefficient of fall*. It is a factor of loss which affects the efficiency of accumulators. (2) The fugitive super-elevation of the electromotive force augments with the intensity of the charging current and the electromotive force of the source. (3) In the Planté accumulator the electromotive force is at least 1.95 volts during the charging and at most 1.85 volts during the discharge. The coefficient of fall is therefore 0.95 under the most favorable conditions. (4) In the copper accumulator the electromotive force is at least 1.43 volts during charging and at most 1.25 volts during discharge. The coefficient of fall is therefore 0.87 under the most favorable conditions. The copper accumulator is that which loses most. (5) In the amalgamated zinc accumulator the electromotive force is at least 2.4 volts during charging and at most 2.36 volts during discharge. The coefficient of fall is 0.983 in the most favorable conditions. The amalgamated zinc accumulator is that which loses least. (6) In practice the losses due to variations of electromotive force will be greater than are indicated above, because the times of charging and discharging are generally more rapid than correspond to these experiments.—*Engineering.*

BLEACHING BY ELECTRIC LIGHT RAYS.

MM. DEPIERRE and Clouet have communicated to the Industrial Society of Mulhouse some experiments upon the bleaching action of rays of solar and electric light upon colors printed upon calico. The electric light bleaches, as does the solar light. All colors of rays bleach, but not equally. The bleaching takes place either in air or in vacuum. The yellow rays are the least active, and the red rays the most active. Of all artificial lights the electric light is the most active.—*Textile Recorder.*

REMEDY FOR NITRIC ACID BURNS.

ACCORDING to A. Irving, as stated in the European electrical journals, the deleterious effects of nitric acid burns may be quite easily prevented. Mr. Irving had the misfortune to severely burn his face with concentrated nitric acid while making some electrical experiments, and reasoning that the effect was one of oxydation, concluded that dilute sulphuric acid should alleviate the suffering. In a few minutes after the application was made, the accounts say, "the blister was reduced, and the oxydation completely arrested; the painful irritation disappeared, and the wound was comparatively cured." To those who are using concentrated acid batteries this information may be of service.

A PHOTO-ELECTRIC BATTERY.

IN constructing his photo-electric battery, Dr. Borgmann places a number of U tubes in a black box having removable sides, and fills the tubes with a 2 per cent. solution of sulphuric acid, the light being carefully excluded. Silver plates iodized on the surface by electrolytic means are immersed in the acid. On exposure to light an electric current is set up.

LITERATURE.

REVIEWS.

Electricity: its theory, sources and application. BY JOHN T. SPRAGUE, M. S. T. E. London and New York: E. & F. N. Spon, 1884.

The remarkable advances in the development of electrical science which have been made since the publication of the first edition of Mr. Sprague's work render the present revised and enlarged volume a welcome addition to the library of every electrician, and especially to those who are aware of the practical value of its predecessor. Over the signature of "Sigma" the distinguished author has for many years been a frequent contributor to the columns of the *English Mechanic*, and it is doubtful if any writer in the electrical field has been so profitable a teacher to so large a constituency. The new edition consists of 650 pages, nearly double the size of the previous book, and contains all the original matter, partially revised and rearranged. It retains that special feature of simplicity and freedom from unnecessary mathematical formulæ which gained for it a well merited reputation amongst the extensive class which so thoroughly appreciates that unusual qualification. The author's platform as suggested by his preface, not only foreshadows the nature of the book, but the thoroughly practical character of the man. He at once secures the attention of his readers, or at least that portion of them who read the preface, by the following statement incorporated therein:—"There are two electricities known to the scientific world: the electricity which exists in nature; and the electricity which, created by mathematicians, exists chiefly upon the blackboards of the professor's classroom. It is the first of these electricities which this work endeavors to elucidate." He has, however, trespassed somewhat farther upon the domain of the mathematicians than in his previous work, and considering the general advancement in the science, it is perhaps necessary and right that he should do so.

A considerable addition has been made to the chapter on static electricity, more especially in conjunction with inductive capacity, and a description of recent improvements in the Voss and Wimshurst machine is given. It is evident that the author considers the subject of primary batteries either at a comparative standstill, or perhaps of declining importance, in view of the development of electrical generation by power, which is gradually creeping in wherever galvanic batteries have previously been used in considerable quantities. Very little change has been made in that department, but as it was so complete originally, there was really scarcely anything more to be said upon the subject. New batteries which have been invented since, in many cases lack that important test of endurance, practicability and cost which can only be affected by the lapse of time. This fact in itself is sufficient to account for the absence of some forms of battery, whose names are at least familiar. An extended and detailed description of storage batteries, will be found valuable to many experimentalists who are actively engaged in that branch of electrical science, embracing as it does the most trustworthy information that could be obtained at the time of writing.

By incorporating in the chapter on measurement the results of his personal studies in that extensive field, the author has been compelled to make many changes, all of which, however, are in the direction of improvement, and especially valuable to the student desirous of attaining correct results by the simplest methods. In elaborating the chapter on "Lightning" under the more imposing title of Terrestrial Electricity, he has, however, ventured into the domain of the "unknowable," and in promulgating theories which it is impossible, or at least extremely difficult to sustain by facts, we doubt whether Mr. Sprague has really added materially to the value of his work as an electrical text book. Strictly speaking, however, he may not have wandered away from its title, or its preface, which taken together may be expressed by the phrase, "the theory of natural electricity."

The reader in search of information regarding the important field embraced by dynamo machines and electric lights, will not be disappointed when he opens this book in search of facts, unadorned by the illusive figures which too often attend the descriptions of these various devices compiled from the researches of interested parties. This matter is new and complete, and in itself must be of great value to all who are interested in those subjects.

The chapter on the telephone includes the latest discoveries which are naturally associated with it by reason of their being based upon the principle of harmonic vibrations. The subject of thermo-electricity is touched upon, and as the question of the generation of electricity directly from combustion is already attracting some attention, inventors have here an opportunity to avail themselves of the advances which have already been made in that direction, in order to avoid annoyance and expense. The information imparted by Mr. Sprague is not only original so far as a work of this character can be, but may be depended upon as correct. It is supplemented by a dictionary of technical terms which will be found exceedingly useful, and a copious index, which will be thoroughly appreciated by the reader who sometimes is at a loss to determine exactly what it is he wants to know, or where to find it if he does know.

NEW PERIODICALS.

Bulletin of the International Electrical Exhibition.—Published by the Committee on Exhibitions of the Franklin Institute. The Committee has shown a very commendable spirit of enterprise in undertaking the publication of this neatly printed semi-monthly. It will be devoted expressly to the interests of the exhibition, and give official information regarding the preparations to be made for exhibitors, and the progress of the work. The paper will be mailed to those requesting it on the 1st and 15th of each month until September, when the exhibition opens.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Canadian Electrical News (Montreal), June 1.—*Toye's* quadruplex system (illustr).

Electrician (London), May 24.—Some relations of chemical corrosion to voltaic current—*G. Gore.* Artificial light tables (illustr.)—*A. P. Trotter.* Telpherage (illustr.)—*Prof. Jenkin.* May 31.—Tubular carbons for incandescent lamps—*M. A. Bandsept.* June 7.—Electricity and light—*J. T. Sprague.*

Electrical Review (London), June 7.—Primary batteries for electric lighting. Magnetic rotations (illustr.)—*E. L. Voice.*

English Mechanic (London), May 9.—Self regulating dynamo machines (illustr.)—*W. B. Esson.*

Engineer (London), May 9.—Electric lighting at the Health Exhibition (illustr.).

Engineering (London), May 16.—*Gauz's* electrical generator (illustr.). May 30.—*Lucchesini's* type printing telegraph (illustr.).

RECENT PUBLICATIONS.

Abernethy, J. P. The modern service of commercial and railway telegraphy in theory and practice. Cleveland, O., *Author*, 1884. 333 p., illustr. 12°.

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CORRESPONDENCE.

NEW YORK AND VICINITY.

Telegraph Consolidations.—The Stock Quotation Companies.—Underground and Overground Wires.—Shooting a Railway Track. A New Torpedo Boat.—Wire Privileges in Brooklyn.—Further Removals.—A Model Down-town Club.—The Maxim Incandescent Lamp.—The New City Contracts of the U. S. Illuminating Co.

THE prevailing impression after last month's panic was that the Bankers' and Merchants' Telegraph Co., would be brought into closer relations with one or more of the other companies in the field. When the announcement was made that an alliance had been formed with the Postal Telegraph and Cable Co., the only surprise caused by it, was that the Baltimore and Ohio Company did not prevail in the new deal. It is well understood that no successful opposition can be maintained against the Western Union so long as competing companies divide their share of the business and incur unnecessary expenses by maintaining separate offices and management The general consolidation of the opposition lines may be looked for at any moment, in spite of emphatic denials which appear from day to day.

The Commercial Telegram Co., is considered an important factor of the consolidated companies. Its very existence as a nucleus to a great system of market reporting, renders it a valuable feature, and its electro-mechanical arrangements are at present unequaled. By its competition it is stirring up the Gold and Stock Telegraph Company, and Superintendent Scott of the latter is preparing for a revolution in stock reporting by the introduction of a printer with an average capacity of 40 words per minute equal to that of the best Morse operators, the type-wheels running at a normal speed of 250 revolutions per minute. By the use of two type-wheels he has improved upon the instrument referred to in our April number, and it is thought that a sufficient gain in speed has been made to warrant the gradual displacement of the printers now in use.

Now that the underground telegraph bill has become a law, the policy of the different companies under its provisions will be watched with interest. It is certain that none of them can comply with the newspaper interpretation of it within the specified time. The Western Union company has already placed some of its wires underground, but last week those leading to Broad street were pulled out of the tubes on account of failure in insulation. It is a fact that pole lines in the streets are often a serious obstacle to the manipulation of fire apparatus, and at a recent fire on Rose street, in attempting to raise the "water-tower" it came in contact with the telegraph wires in front of the building, and was temporarily disabled. It should not be forgotten, however, that the telegraph has been the most efficient ally of the fire department, so that an occasional interference of this kind should be forgiven.

A curious accident occurred recently on the West Shore railway near West Point. The cadets were engaged in target practice with a sea-coast battery, when a shot went 100 yards wide of the mark, striking a steel rail in the centre, bending it in the shape of a letter U and tearing it from its fastenings. The automatic electric signals used on that section gave warning of the breakage, and the rail was replaced before any further trouble ensued.

A new torpedo boat which has recently been exhibited to government officials at Milford Bay, is to be taken to the experimental station at Sandy Hook where it will undergo still further tests. It is driven and steered by electricity, the operator on shore having perfect control of it although he may be a mile away.

The city of Brooklyn has granted to the New York and New Jersey Telephone Company rights on the fire telegraph poles, provided it keeps the line in good order, and furnishes the city, free of expense, 100 telephones and 35 exchange connections.

Among other removals in electrical circles, is that of J. L. Lazelle & Co., manufacturers of electrical instruments, formerly in Centre street, but now in a more convenient location at 110 Liberty street. The Excelsior Electric Light Company has moved its office to No. 18 Dey street, and its factory to Willoughby street, Brooklyn, between Raymond and Navy.

The New York Press Club is an example of what might and should be done in electrical circles. It has recently moved into its new and commodious quarters at 120 Nassau street, where it occupies three floors. The first is the parlor and reception room, the second contains a library valued at $10,000, with an ample reading and working room, while the third is occupied by three billiard tables. An invitation reception and house-warming was given on the 17th of June, and was a most enjoyable affair. Its membership is over 500, and its dues but one dollar per month with an initiation fee of $10. Its down-town location makes it accessible at all hours, and deservedly popular with its members. The subject of a telegraphers' club has been agitated several times, and the similarity in the requirements seem to indicate that by pursuing the same policy, a successful organization could be formed and maintained.

The superior brilliancy and illuminating power of the Maxim incandescent lamp is frequently remarked by those who are well informed upon the subject of electric lighting. Among the installations of this system during the current month by the U. S. Illuminating company are the following: New York Press Club, 70 lights; Union Club, 130, to be increased 70; Lotos Club, 70; Phœnix Insurance Co., 50. The same company has just increased its plant at Feltman's hotel, Coney Island, to 22 arc and 200 incandescent lamps. Its new contracts with the city cover the following territory. Tompkins square, 16 arc lamps; Bleecker street, 32; Gansevoort market, 13; East Broadway, 20; Broadway from Canal to the Battery, 29, with 3 additional lamps at the Battery; South st., from the Battery to Grand st., and West st., from the Battery to West 11th, making a total of 227. The old contract for 73 lamps has also been renewed, making a total of 300 now furnished. Property owners in the newly lighted districts are highly pleased with the change, and some of them consider the value of their holdings enhanced from 10 to 20 per cent in consequence.

NEW YORK, June 18, 1884.

PHILADELPHIA.

Plans of the Electrical Exhibition.—Increase of Electric Lighting Plant.—Municipal Raid on the Postal Telegraph Line.—Administration of the American Estate of the Late Charles William Siemens.—Destructive Fire in a Western Union Cupola.

THE structures for the Electrical Exhibition have so far advanced towards completion that it is safe to say that they will be turned over by the contractor in a few days to the committee of the Franklin Institute having in charge the arrangements for the interesting display in September and October. The plot of ground upon which the buildings have been erected is completely covered, every available inch being occupied. The main structure occupies the larger portion, and may be likened in appearance to Agricultural Hall, one of the features of the Centennial Exhibition. It is not only lighted from the sides, but at the top as well. The interior is covered by a light wash. There have been plenty of openings provided as means of entrance and exit. Notwithstanding the space at the command of the committee in charge, it was found inadequate to accommodate all who desired to exhibit, and it became necessary to obtain additional room. The committee then made application to the management of the Pennsylvania Railroad Company for the use of the old depot at Thirty-second and Market streets. This received favorable consideration and now the committee of arrangements will have ample room for the reception of exhibits from all who may make application for space. The reception or waiting room will be utilized for lecturing purposes during the exhibition. The shedding on Thirty-second street and the track-way will be utilized for exhibits of rail way signals, lock switches, and for the accommodation of the large motors. Within the structures erected for the purposes of the exhibition will be displayed philosophical apparatus, clocks, sewing machines, musical instruments, and all contrivances to which electricity has been applied. Three electric light companies will also have exhibits, and it is expected that they will furnish the light for the buildings at night, alternating weekly until the close of what is now held will prove to be one of the most interesting and instructive exhibitions that has ever been opened to the general public. The committee on printing has authorized Messrs. Burk & McFetridge, of this city, to publish the official catalogue for the exhibition which will make a book of about 300 pages. The first number of the semi-monthly paper, published by the committee, contains a sketch of the sixty years' history and work of the Franklin Institute, specially noting the meteorological observations made during many years as the first step toward the present signal service of the country; and its researches at the request of the Treasury department into the causes of "explosions of steam boilers." Congress has already given formal recognition to the exhibition by appropriating $25,000 to defray the expenses of a scientific commission in collating the discussions and results of a national convention of electricians, which is to meet in the Academy of Music from September 4th to September 11th. Among the other features of interest at the exhibition, will be a thorough series of tests of engines, and the conditions under which they can work most economically.

The increasing demand for electric lights throughout the city has necessitated an enlargement of the buildings of the Brush Electric Light Company on Johnson street, and the increase of the plant to double its present capacity. The company is now supplying 700 lights, and it is stated that the demand for them continues as fast as they can be put in, and by the first of October it is expected to have 1200 lights in operation. With the dynamos in their new quarters it is stated that the capacity of the establishment will be increased to 2500 lights.

The Postal Telegraph company seems to be in a little difficulty in this city. In February last, city councils passed an ordinance permitting the Postal company to erect two wires upon

the poles of the city in various localities, and to maintain them until May 1st, providing that the wires should be placed underground at that time. When the limitation expired Superintendent Walker, of the city police and fire alarm telegraph department, ascertained that the company had failed to comply with the ordinance, and had not even paid the customary tax for the use of the poles and making connections. After giving the company ample time to carry out its stipulated agreement, Superintendent Walker notified General Manager Cummins that the time granted the company to erect and maintain telegraph wires on the city's poles had expired, and directed him to comply with the terms of the ordinance without delay. No reply having been received from the officers of the company, Superintendent Walker wrote to the city solicitor, asking if he would be justified in taking down the wires. Upon receiving an affirmative reply the wires were at once removed or rendered useless by cutting.

The agents of the Guarantee Trust and Safe Deposit company, which was appointed administrator in Pennsylvania of the estate of Sir Charles William Siemens, under the English executors, have filed an inventory in the office of the Registrar of Wills, aggregating $11,000, which has been in the hands of bankers in this state. The paper makes extended references to the numerous valuable patents made and controlled by the late scientist, but no attempt was made to appraise their value as this has already been done by the English executors. The personal property alone will amount to several million dollars, and from the royalty on the patents in this country, many thousands have been collected and forwarded to England. Among his numerous inventions are improvements to kilns for calcining ores and limestones; to glass furnaces; a process for converting cast iron into cast steel; a device for regulating electric currents, and a regenerative condenser, for which, in 1850, he was awarded a gold medal by the Society of Arts.

The cupola, containing the wires of the Western Union company, on their building at Third and Chestnut streets, took fire on the night of the 12th of the present month, and damaged the wires and instruments to such an extent as to cut off communication with the offices of the bankers and brokers in the immediate neighborhood. In consequence, the "tickers" ceased to tick for one day, and it is to be presumed that the "lambs" in this vicinity escaped their usual fleecing for the time being. The damage to the building, instruments, etc., amounted to about $6000.

PHILADELPHIA, June 17, 1884.

CHICAGO.

Electric Lighting on the Gain.—The Incandescent Lamp on the Stage.—Progress in Subterranean Lines.—Heavy Work at the Republican Convention.—Improving the Telephone Exchange Service.—The Boom of the Indianapolis Thermo Battery.

WHENEVER a staple article suddenly decreases in cost, consumers invariably call a halt in contemplated changes or departures from former practices, and await developments. When electric lighting in Chicago—and the same is true of other cities—had made a place for itself, as a necessity, or at least a desirable luxury, the gas companies became alarmed, and cast about for some means of staying the march of the enemy. A cheaper method of production—the use of petroleum in place of coal—presented, and was adopted. Immediately, the gas companies dropped their rates, in some cases to one dollar per thousand feet, and light consumers generally lost all interest in the electric lighting propositions of the various companies.

Still, the new gas service was not more satisfactory, despite its cheapness, than the former. Complaints are made that the bills are but little less than those of previous years, the quantity used being greater, and the aggregate amount paid each month, shows that more gas is required for the same amount of light. A still more serious complaint is made, *apropos* of the color of the flame, in which the yellow rays largely predominate, it is claimed, reminding one of the sickly hue of a tallow dip, and it is further claimed that its specific gravity is such that upper stories of buildings have much less pressure than first floors or cellars.

Time has now elapsed for reaction to set in, and the natural result is a quite general boom in electric lighting. All the companies seem to be thriving, if one may judge from appearances—at any rate new plants are going in constantly, not only in the city, but in all the adjacent territory.

Two temporary plants for theatrical purposes were placed, the first of the month, one at McVicker's theatre, the other at the Grand Opera House; the first, Edison lights in Kiralfy's spectacular "Excelsior;" the second, Swan, in Suppe's "Trip to Africa." The effect of suddenly illuminating portions of the scene, wands in the hands of the players, etc., is always startling, and for this purpose the incandescent systems are both fitted and safe when properly handled. It looks a little odd, however, in a scene where poor disheartened Volta, by a change in his battery elements (one jar of Callaud), astonishes himself as well as the audience by evolving a spark nearly as large as a chestnut!

The underground system is making practical advances. The city is placing its wires to the new City Hall. The Western Union is also availing itself to some extent, of the underground franchise granted to the Mutual Union: and the Bankers' and Merchants' have already seven miles of kerite buried. The B. & O. people commenced, but were restrained by an injunction in the interests of the Sectional Underground Conduit Co., which has quite exclusive privileges here in that line, and the B. & O., unlike the B & M., was endeavoring to work independently. The city was also enjoined at the same time, but came off victoriously and continued its work.

During the nominating convention the several companies vied with each other in keeping the wires hot, and a deal of lively work was done from the Exposition building, direct, the sharp clicking of the instruments keeping up a subdued accompaniment to the louder buzz of the convention, while occasionally the droning hum of the pneumatic tube added its mite to the general confusion. A little farther away from the speaker's desk would perhaps have been better for those on the stage, who could at best hear but a portion of what was said. How the unfortunates at the opposite extreme of the great hall heard anything is a mystery. The Bankers' and Merchants' Co. made its *début* on the occasion of the convention, and got away with about 25,000 words of specials to the Boston *Globe*. The W. U. claims to have handled 600,000 words of specials, in addition to its regular work.

The announcement of a pooling arrangement between the Bankers' and Merchants' company and the Postal, with its cable facilities, has taken many by surprise, and it looks as if a formidable company would loom up out of the combination. They state that they will be ready for regular business in a short time now—and that, too, with no outside lines in sight—not a wire to cut in case of fire or house moving, nor a break in a sleet storm. All the wires enter the office from the cellar, and climbers for city use will be superfluous. Think of a telegraph office without a ladder or a pair of climbers. Why, the office may burn, and within a few hours afterward a tent may be erected over the ruins and the cables be again in successful operation as before. These experiments will insure the burying of all the telegraph wires in a comparatively short time, as far as Chicago is concerned, should the success be what is confidently hoped by the advocates of what is sometimes derisively called the "ground hog" system.

The Chicago Telephone company, after many trials in the matter of switch boards, has finally adopted a form which is to be placed in each of its several city exchanges, which differs from any heretofore used here. By this plan it is confidently expected by the management that fewer errors will creep in to vex subscribers, and quicker time will be made. It is also claimed that "half connections" will be prevented, so that subscribers will at all times find their instruments connected with somebody, if not with the central office. To quote from the last circular explanatory of the system—"To work the new system it is only necessary to observe three rules: '1st. Don't leave the telephone after giving an order. 2d. Repeat the order immediately when asked, 'What number do you want?' 3d. Answer your bell promptly.'" The company claim to make 26,000 connections in 24 hours, and in support of the necessity of the 3d rule, shows that a delay of 30 seconds by each subscriber, mounts up to 211 hours lost time in a day: a rather potent argument.

The wonderful results claimed for the thermal battery at Indianapolis, which have been telegraphed far and wide, astonished the electrical fraternity, but awakened at the same time a deal of skepticism. The known law in mechanics which refuses the right to claim more power than exists in the source, seemed good ground for denying that a coal oil lamp and a kettle full of thermal elements could develop energy enough to light a lot of Swan lamps, run a motor, or 600 miles of telegraph wire. I have but a few facts relative to this apparatus, for a very mysterious secresy shrouds the entire matter, as was the case with Redheffer's perpetual motion, and the Keely motor. When the battery was started it had a very smooth, even current, about equal to 83 Callaud cells, but this weakened, so that at the end of 8 days it had fallen some 30 per cent. As it is to remain on trial for one month, should it continue to run down in that, or even a much less ratio, it can hardly be said to be a very permanent battery; yet if it will do its work for even 15 days, it will be a pretty good thing. The inventor, whom I would not intimate is other than honest in his statements, should certainly be permitted to prove, for his own good, that the suspicion is unfounded; that the only part the thermal portion of his system plays in the combination is the closing of a battery circuit, which does the work. I do not assume that this is so, but it could be done readily and so concealed as to render detection very difficult except at the hands of an expert wire man. We would all rejoice to have the new battery succeed, but in its present status prefer to wait and see. Time will certainly show if it becomes a success.

The coming Democratic convention is expected to even exceed in general interest its Republican predecessor on account of the peculiar political situation. The rival telegraph companies are vieing with each other in perfecting their arrangements, and if the weather be fine lively work may be expected.

CHICAGO, June 14, 1884.

BOSTON.

Recent Acts of the Massachusetts Legislature.—The Experiments made to Relieve Boston of Overhead Wires.—Antagonism of City Officials toward the Electric Light.—Proposed Installation of the Bernstein Lamp.

IT appears probable that various laws enacted by the legislature, may be preliminary to an attempt to place all electrical wires underground. An act passed June 2d, authorizes owners of lands abutting on a highway along which electric lines have been or may be placed, to apply to the local authorities to appraise any damages which may have been incurred thereby. In case of the company's refusal to pay the damages, or the final judgment in case of an appeal, within 30 days, the authorities may upon request of the abuttor, remove the wires and supports after 48 hours' prior notice to the owners.

Chapter 302 imposes a fine not exceeding $100 upon any person who places any fixtures or wires upon the property of another without proper consent. It also provides that all supports shall be plainly marked with the name of the party maintaining the same. Our state and local authorities have been very conservative in this direction so far, and the electrical companies have been helped very materially in all directions.

The general idea seems to be, however, that the electrical people are somehow endeavoring to get an advantage over the rights and properties of the citizens, when the very reverse is true. Take for instance electric light companies, who have the most dangerous wires or rather the strongest currents. In general, all their wires are carefully insulated and so located as to avoid unsightliness and danger. Our fire alarm wires are specially placed higher up than any others. The telephone companies have of course the majority of overhead wires, a constantly increasing majority too; and to-day, after all the newspaper grumbling and gratuitous advice, very little is known of their real purposes and plans, and of what has been actually done by them to obviate the overhead evil, both for the convenience of the public and for their own safety and economy. These companies foresaw the inconveniences of the shadowing spread of wires, and in this vicinity the system of overhead cables was introduced in 1880. Wires are led from the central office switch boards to the terminal boxes, there connected to the wires in the overhead cables which are carried, in some cases 3200 feet, in various directions, entering other terminal boxes from which they are fanned out to iron wires. In January 1883 an elaborate underground system was laid down, composed of a series of iron tubes embedded in cement and asphalt, with working chambers. Cables of various manufacturers were drawn into them. From 1880 to the present time over 10,000 feet of subterranean and 20,000 feet of aerial cables have been placed at great expense. All varieties of cables have been and are under trial, cables in lead pipes, and in canvas tubes, all kinds of insulations, windings, tapes, and foils. It has been the determination, seemingly, to leave no cable unturned in the search for the best.

Besides this, in April 1882, an experimental covered cable, 5 miles in length, was laid underground between the tracks of the Boston and Providence railroad, near Attleborough, upon which tests were made lasting several months. This undertaking cost about $80,000, and the cable remains in the ground to-day, a total loss.

The cable system has been very trying to the owners and many of the subscribers whose connections have been made through them, and much experience has been dearly bought. The cables have not only had internal experiences but external ones, not at first suspected.

The internal foes, such as lack of insulation, plenty of induction and retardation have been met. Much trouble from the improper suspension of cables has arisen. There are instances where whole cables have been destroyed and consequently, abandoned by a method of suspension which allowed them to twist and stretch to such a degree as to strip the wires of insulation and cause crosses and grounds with one another, and with the anti-induction covering, or the outer lead pipe. Besides these, in several instances lively electric wires improperly strung, have sawed across the canvas covered overhead cables destroying the insulation and transferring their molecular changing energies into the small copper wires of the cable to the destruction of the latter.

The cable results are often curious and against pre-arrangement of theory and practice. Some lines talk well through an underground cable of one manufacture, and through two continued overhead cables of another pattern, and an iron line wire, and bad results are obtained through the same underground cable continued directly to an iron wire. All possible combinations prevail here,—for instance, an underground cable is branched to two different overhead cables, one of which is continued to another branch cable, and then to iron wires, while the other connects directly to iron wires. Underground cables continue as overhead cables, etc. The best method of suspension seems to be by means of hooks or clamps to an iron cable or wire, the iron wire being always more tightly strung than the cable, so that no stretching of the latter can take place. Other things being equal, lead covered cables for overhead lines give the best results.

It would be well if every large exchange had a foreman and a few choice spirits as assistants trained to the suspension of cables, so that experience in such matters might be concentrated and preserved. A cable may be ruined in stringing into place. We might proceed in this line, but enough has been said of our local lines to show that the electric companies are interested in securing the best results, and the best interest of the community is always the best for the companies. They have not been dilatory in investigating and boldly putting theories into concrete shape.

The public forget when they refer to the high prices charged for various electrical services which are too frequently inferior, and the growing overhead inconveniences, that these things are all new; that they demanded and are receiving comparatively wonderful results now, before perfection has been obtained. Men, who 50 years ago would have considered the things they now have to enjoy the effect of magicians' enchantment, growl and splutter if their telegrams from England are an hour late, if their electric lamps flicker once in a while, if their central office operator makes them wait 30 seconds at the telephone in a talk from one city to another. Forgetting that no rose in this world is without its thorn, no good without evil; that the universe is made up on this plan. Refusing to see the immense and far reaching results of modern electrical wonders, they unreasonably complain of the rough bark that protects the juices and sweets of the tree.

The present city officials continue their antagonistic attitude toward the electric street lamps. They do not allow them to increase appreciably; 19 of the Thomson and Houston lamps are to be removed from the Common for the reason that the leaves upon the trees prevent the radiation of light. It is understood that they will be placed elsewhere.

The Edison lamps are illuminating the large post-office and sub-treasury building; the employés express themselves as highly pleased with the mild, non-heating light obtained.

There has been talk about the owners of the Bernstein or "Boston" lamp putting in an installation to light the square bounded by Washington, Summer, Chauncey and Avon streets, including the large dry goods store of Jordan, Marsh & Co.

BOSTON, June 18, 1884.

WASHINGTON.

Beginning the Work of Consolidation.—Electric Light Companies Moving Against the Gas Interests.—Opinions of the Advocates of a Government Telegraph.—Another Embryo Telephone Scheme.

THE event during the past month has been the amalgamation of the Postal and Bankers' and Merchants' Telegraph lines, which has caused a good deal of trepidation among the employees of both companies, who fear a consolidation of offices and a reduction of managers, chief operators and others. Without any sufficient data to warrant such a belief there seems to be an apprehension that this is but a first step, and that the next movement will be the union of the newly consolidated company with the Western Union or the Baltimore and Ohio Telegraph company.

The electric light companies have been doing but little apparently, although their managers have not been idle. A clause was at their instance inserted in the District of Columbia appropriation bill, giving the district commissioners authority to substitute other illuminating material on condition it could be done at the same price, or less than that fixed for gas, viz., $22 per annum for each street lamp to burn not less than 2,600 hours per annum. This clause was amended by the Senate so as to deprive the commissioners of the discretion to substitute other lighting, except in the event of the refusal of the Washington Gas Light company to contract with the district at the above figures, which there is no reason to anticipate.

But little has been done openly; but neither side is idle while this matter is pending before the conference committee. The gas companies of the country seem disposed to make common cause with the Washington gas company, and are sending letters to the representatives from their own locality intended to sustain the gas interest in this controversy. The question is still undecided, but from the temper of the House conferees there is good reason to believe the Senate will be forced to recede from its amendment and leave the commissioners free to select the light the city shall have, subject only to the limitation as to the cost. These gentlemen are not pre-eminently noted for their progressive ideas and the introduction of the electric light is by no means assured even if the Senate amendment is rejected.

The rapidly approaching day of final adjournment of Congress with the hurry and scramble for precedence, makes it at this time an impossibility that any government telegraph system should be authorized this year even if members had been educated up to it. Senator Hill is determined to continue his efforts to have the Senate consider his bill, and it may be he can secure a little more discussion. With the views that prevail in the House

there is no possibility of any measure of the kind being considered.

Mr. Anderson, of Kansas, who introduced his bill early in the session, says he is satisfied with the progress made. It has had the effect to call attention to the subject. The speeches in support of a governmental system of telegraph have, in spite of the associated press, been sent broadcast over the land,—people are beginning to think; and when they have thought they will demand it.

Mr. Sumner, of California, says the operators and employees of the existing companies are beginning to see, and will see more clearly after a few more consolidations, that the permanency of their positions will be much safer when the telegraph is under the control of the government, and their salaries less likely to be scaled down whenever opposition is for the time being crushed out.

Mr. J. Harry Rodgers, late electrician of the capitol, has patented a telephone, and the management of it has passed into the hands of Dr. Harlan, of this city, who is putting into the business a good deal of energy, but has not reached a point at this time to warrant predictions as to final success.

WASHINGTON, June 16, 1884.

PROVIDENCE.

Right of Way Granted to the Multiplex Company.—Doings of the Baltimore and Ohio.—Alliance with a District Company.—The Opposition Reaches Newport.—The Electric Light Rivalry.

THE Boston Multiplex Telegraph company has finally been given a right of way into the city. On the night of the 3d inst., the city council after listening to a lengthy report from the committee on ordinances, wherein the liability to induction and other bugbears was set forth, unanimously granted the petitioners' request except on certain streets, whereon the Baltimore and Ohio Telegraph company desired to erect poles, in which case the Multiplex company was directed to place its wires upon them. This was hardly satisfactory in view of the fact that the Multiplex people asked first for the right of way, but it was accepted after an unsuccessful endeavor to tack on an amendment which would give them the top arm. Meanwhile the Multiplex company had brought its two wires to the office over a private right of way, had connected in the motor and was working its system experimentally. It has not yet been decided when the company will open for business, but probably in about three weeks.

The line to Boston is substantially constructed of No. 6 wire, and offers every facility for giving the new system a practical test which it is expected will demonstrate its commercial value. Whether it will actually form the basis of a new competing line, or be placed on the market for adoption by the highest bidder among existing companies is entirely a matter of conjecture among outsiders. As yet it does not appear to be quite equal to the claims originally made for it, but it must be remembered that its inventor has heretofore had but limited opportunities to carry on experiments upon an actual working line.

At the present writing the Baltimore and Ohio Telegraph company has not yet closed the gap in the line between New York and Newport, but it is very probable that by the 19th inst. it will be working from New York through Providence, and Taunton to the city by the sea. The B. and O. people were hampered in various ways, one annoyance was a little episode on Pitman street where the irate abutters cut down four poles. Last night in order to close the gap in the city they were running two light covered wires and straining every point to get a through connection. The company has made a five years' contract with the Providence District Messenger company for the collecting and delivery of messages, and the two parties will occupy the same office at 57 Westminster street. The District company which has 496 boxes in circuit has not been a success financially. The calls average about 200 a day which is not sufficient to pay expenses.

Under the new arrangement with the B. and O. the prospects appear to be brighter.

The Bankers' and Merchants' Telegraph company has just completed a line to Newport, and opened for business on the 14th inst.

Much bitterness has been engendered between the two electric light companies in this city. One day last week while the employés of the Narragansett Electric Lighting company were at work putting lights in the City hotel, their blocks were knocked off and considerable trouble ensued. Both companies furnish good lights but the one that bids the lowest will get the trade. The Rhode Island company's incandescent lights at the Narragansett hotel, and the Hotel Dorrance are perfect, while the same may be said of the street lights furnished by the Narragansett company. I am a close reader of the daily papers, and I have failed to see anything in the way of fault to be found with these street lamps. They are steady and bright.

PROVIDENCE, June 17, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents. Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city.*

"ALTANDI" OR TUBULAR ELECTRO-MAGNETS.

[13]—Referring to the enquiry of your correspondent, J. W. Rogers, Jr., on the above subject, a little more information may be in order.

I believe the first mention of such a magnet is in the English patent of De Moleyn's, No. 9,053, August 21, 1841.

In that patent it is proposed to construct an electro-magnet by rolling a strip of sheet iron with insulated wires laid upon it, upon a cylindrical rod, so that upon the withdrawal of said rod, the sheet iron and wires may present a compact electro-magnet, each wire having a surface of iron on both sides.

An electro-magnet is also described, consisting of "soft iron hollow cylinders properly covered with insulated wires, introduced into one another."

The next, according to the editorial note on page 132 of your paper, is the form invented by Farmer, of which the writer confesses his ignorance.

Other and successive English and American patents referring to electro-magnets encased by iron tubes, are the following:

Soren Hjorth, No. 806, 1855; Isham Baggs, No. 1,152, May 22, 1858; José S. Camacho—U. S. patent, No. 129,000, July 16, 1872 and No. 138,316, April 29, 1873; Camacho—English patent, No. 3,461, of 1873; H. Smith—British patent, No. 3,981, of 1877; Rapieff—British patent, No. 4,432, of 1877; Varley—British patent, No. 4,435, of 1877, and Jensen—British patent, No. 1,027, of 1878.

The same contrivance was utilized in Prof. Bell's Centennial receiver—and was patented by him in the United States, March 19, 1878, No. 201,488.

A considerable mass of published information may be found relating to the Altandi magnet in the Journal of the Society of Telegraph Engineers, 1876, pp. 153, 180.

Reference is also made to the same magnet in the English Telegraphic Journal, London, 1874, p. 342. Also in the same periodical, 1875, pp. 59, 84. THOS. D. LOCKWOOD.

BOSTON, Mass., June 3, 1884.

[This form of electro-magnet is shown in Farmer's patent for printing telegraph, No. 15,373, of July 22, 1856, in which it is employed to effect the impression. It is not described nor claimed, as the inventor had already had it in public use for such a length of time as to prevent him from securing an exclusive right to it. —EDITOR.]

FURTHER DETAILS OF THE CHEAP THERMOPILE.

[14]—I will try to make as clear as possible to your correspondent the arrangement of the thermopile. In the pile described in the March number, there are 75 strips of copper and 75 of iron, each strip being 3 inches long and ⅜ inch wide (not, as printed, 3 inches wide). Three equal layers of 25 pieces of each metal are then made separately by soldering the pieces in alternate succession, iron always joined to copper at both ends, and copper to iron at both ends. The layers are then put together by a single connecting piece (⅜ inch x ⅜ inch) between the middle layer and the lower, and also a single connecting piece between the middle layer and the upper. Each of these connecting pieces is soldered to the free end of the last copper strip of one layer and to the free end of the first iron strip of the next layer. Place the lower layer before you with the free ends turned away from you and the iron terminal strip on the right; place upon this, at an interval of ¼ inch, the middle layer with the free ends away from you and the iron terminal strip on the left, over the copper terminal of the lower layer; place upon the middle layer the upper one in the same relative position as the lower, the iron terminal on the right. Binding temporarily the 3 layers in this position with 2 thin boards between to separate them, solder a connecting piece to the left terminal of the lower layer (copper) and to the left terminal of the middle layer (iron); the other connecting piece to the right terminal of the middle layer (copper) and the right terminal of the upper layer (iron). The wires constituting the poles will be soldered, one to the lower right hand piece (iron), the other to the upper left hand piece (copper). All these junctions will be at the same end of the pile, the one opposite to you, as placed. Respectfully yours,

STATE NORMAL SCHOOL, C. L. PENNY.
Shippensburg, Pa., June 18, 1884.

THE SOURCE OF SUPPLY OF ELECTRO-STATIC GENERATORS.

[15]—IN the May issue of THE ELECTRICIAN AND ELECTRICAL ENGINEER, I noticed an article entitled "Experiments with the Töpler Electric Machine," by P. Atkinson, A. M.

The article as a whole is highly interesting, but in the remarks upon the source of electric supply, I can see but little evidence pointing to the conclusion arrived at, namely, that the air constitutes such source.

It is difficult to conceive of electricity being drawn from a non-conductor (and dry air is such in a high degree) with sufficient rapidity to supply the Holtz, or Töpler, or even the common friction machine, with the immense quantities they are capable of developing.

If we suppose all substances to contain electricity in a neutral state, *i.e.*, the positive and negative fluids in combination, it will readily be seen that to *charge* any substance whatever, it is only necessary to decompose the neutral fluid contained in that substance, withdrawing one element, while the other remains. Therefore, in the case of electric generators, no source of supply is necessarily exterior to the machine itself, or the apparatus in connection therewith.

Take, for example, the ordinary friction machine. In this the friction between the rubber and glass plate, tends to separate the two fluids existing on their surface, the negative accumulating on the rubber and the positive remaining on the glass. Induction now takes place between the electrified plate and the prime conductor, whereby a portion of the negative element of the latter is conveyed, by means of the metallic combs, to the former, tending to neutralize its positive charge.

The effect of this operation is to transfer the negative element from the conductor to the rubber, and it can continue only so far as to charge the rubber—if it be insulated—with negative electricity; after which, if further action is desired, some means must be provided for withdrawing this charge as fast as accumulated.

This means is furnished by a metallic chain, or other conductor, connecting the rubber with the earth. Thus provided, the operation may be continued indefinitely, or until all the negative fluid has been abstracted from the prime conductor, thus leaving it charged with free positive electricity.

The action of the Töpler machine is easily explained on this hypothesis.

In machines of this class, two conductors are provided, by means of which both elements are retained on the instrument.

The induction influence exerted by the revolving discs, effects the decomposition of the neutral fluid on the two conductors, the positive element belonging to both being concentrated upon one, and the corresponding negative upon the other. The conductors are now charged with opposite fluids; and with every discharge they re-combine, to be again separated as before, and so on indefinitely.

In this case neither fluid is conveyed to the earth, hence the necessity of perfect insulation. From this we see that the machine itself furnishes the elements for its own activity, and the addition of a Leyden battery, however extensive, detracts nothing from the power of the machine, but comprises within itself the source of its own supply.

ARKWRIGHT, N. Y., June 17, 1884. E. F. COLE.

QUESTIONS AND ANSWERS.

[28.]—**Siemens' Telephone and Ader's Speaking Trumpet.**—C. F. Gissler inquires where he can find descriptions of these instruments. **Ans.**—Siemens' telephone is described in "Telephon, Microphon und Radiophon" by Theo. Schwartze. Ader's Microphonic Trumpet, in "The Modern Applications of Electricity" by E. Hospitalier, edition 1883. The same work also contains a description of Siemens' telephone.

[29.]—**A Cheap Thermopile.**—F. Guichetean, Vineland, N. J., desires further particulars as to construction of this instrument. **Ans.**—See letters to editor in this number.

[30.]—**E. M. F. of Bi-chromate Cell.—Glazing Porous Cup.—Medical Coils.**—E. H. T., Hagerstown, Ind., writes:—"1. I have a galvanic cell consisting of a glass jar 5x7 inches, zinc 7⅛x2x¼ inches in dilute acid solution in porous cup, containing metallic mercury. 2 carbons 7x2x¼ inches in bi-chromate solution. Porous cup is glazed except a band about 2 inches wide. What is the E. M. F. of the cell? Why is the porous cup glazed? 2. How can I glaze a porous cup, so that the material will not be acted upon by the fluid? 3. How do Harris, Kidder and others get so many so called 'currents' from one cell? How do they make their connections, and what do they mean by layers, or 3 or 4 coils?" **Ans.** 1. The E. M. F. of your cell is 2.028 volts according to Poggendorff's determination. It does not in the least depend upon the dimensions of the parts (see article *Elementary Principles of Electric Measurement*, in the present number). The porous cup is partly glazed to prevent unnecessary local action. The internal resistance of the cell is thus made somewhat greater, and consequently the length of time it will remain in action is increased. 2. Use melted tallow or paraffine; a common paraffine candle will furnish the material. 3 We have not space to explain the Kidder apparatus, but full information is contained in his patents as follows: 30,068 Sep., 18, 1860; 41,927 Mch., 15, 1864; 52,054 Jan., 16, 1866; 58,105 Sep., 18, 1866; 93,625 Aug., 10, 1869.

ELECTRICAL NEWS AND NOTES.

REFUSAL OF SPECIAL RAILWAY FACILITIES.

The petition of the Baltimore & Ohio Telegraph Company for special facilities on the New York & New England Railroad has been dismissed by the railroad commissioners. The case grew out of the refusal by the railroad company to deliver poles, wires, etc., at points between stations, the telegraph company's location bordering upon that of the railroad. Mr. Clark, the receiver, bases his refusal on the terms of the contract existing between the railroad corporation and the Western Union Telegraph Company, and the commissioners hold that "the facilities asked for by the petitioners are not within the scope of the ordinary duties of railroad companies as common carriers. The rule is to deliver passengers and freight at stations established by the company. To entitle the petitioner to accommodation it must be shown either that the exceptions to this rule are so numerous that such delivery is to be regarded as a reasonable facility whenever it is conveniently desirable, and also that such a practice is safe, and not an unreasonable hindrance to general traffic; or it must be shown that the course of this railroad company has been such toward like applicants that the refusal in this case constitutes undue disadvantage."

The board holds that these requisites are not proven, and adds that even if the railroad company, with a view of securing telegraph facilities for its own advantage, should contract with one company to deliver its materials in the manner indicated, such a contract would establish no precedent for a second telegraph company, which could not in the nature of things offer a like advantage.

LIMITED LIABILITY OF TELEGRAPH COMPANIES.

In the case of the Western Union Telegraph Company vs. Meredith, decided on April 22d, the Supreme Court of Indiana held that a telegraph company may reasonably limit its liability by an express contract, and that a limitation of sixty days for the presentation of claims was a reasonable one. The court also held that the right to a penalty for negligence provided by a statute of the state was not defeated by the fact that the act of negligence which constituted the breach of duty occurred beyond the limits of the state.

OFFICIAL APPROVAL OF ELECTRIC RAILWAY SIGNALS.

Auditor-General Rice, of Indiana, has written an official letter approving the Westinghouse system of pneumatic and electric crossing signals tested at Hammond, Ind., May 23d. The Auditor expresses entire satisfaction with the system as being perfectly safe, and gives consent, in accordance with the authority invested in him by the statute, to the use of this system by the roads where tracks cross at that point, without stopping trains at the crossing. As soon as General Superintendent E. C. Brown, of the Michigan Central, can consult with General Manager Lewis Williams, of the Nickel Plate, and General Superintendent J. C Williams, of the Chicago & Atlantic, concerning some details which have not yet been arranged, the roads will accept the plant at Hammond and commence its use.

The Union Switch and Signal Company have made contracts for putting in the same system of signals and switches at the Union Stock Yards, Chicago, where the Lake Shore and Rock Island roads, each with a double track, cross the stock yard tracks, and also at Valparaiso, Ind., at the crossing of the Chicago & Grand Trunk with the Nickel Plate and Fort Wayne roads.

SUICIDE OF JOSEPH W. BURNHAM.

THE failure of the firm of Hotchkiss & Burnham, during the recent panic, has been followed by the death of the junior partner, at Yonkers, N. Y., on June 24th, by a pistol shot from his own hand. In the management of the telegraph office at the Fifth Avenue Hotel, and by the sale of railroad tickets on commission, Mr. Burnham, by prudence and economy, accumulated a moderate fortune of about $80,000. In 1874 he retired from this position and embarked in the business of stock brokerage in company with H. L. Hotchkiss. The venture was so successful that in 1881 the partners considered the question of retiring, which it is said they could have done with half a million each. Mr. Burnham was happily married less than two years ago, and leaves a young widow with a child eight months of age. As a

practical operator, he could have earned a modest living at the key, after allowing his fortune to be absorbed, as he did, by the demands of his creditors. He had been left alone by his partner at a time when sympathy and advice were invaluable, and after his departure, the pressure, worriment and care of a disorganized business, forced his sensitive nature to succumb to the demand for rest and peace.

MEETINGS OF THE NEW YORK ELECTRICAL SOCIETY.

The 47th meeting of the New York Electrical Society was held at its room, No. 24, Cooper Union, on the evening of June 4th. After the transaction of routine business, Mr. T. J. Perrin was introduced, who exhibited models and explained his underground system for electrical wires, claiming for its advantage over other systems, a practical method of using glass tubes for the reception of conductors, making one of the best, as well as one of the cheapest insulators.

The first paper for competition for the Jones award, entitled "The Light of the Future," was then produced, and it being anonymous, the President requested the author, if present, to read the same. As no person responded, the Recording Secretary was called upon, who read the paper, which was well received. After passing a vote of thanks to Mr. Perrin for exhibiting his Underground Telegraph System, the meeting adjourned.

The 48th meeting was held in the same place on June 18th. Mr. Sinclair, of the government station at Sandy Hook, explained the subterranean system of Prof. Brissett, of Lowell, Mass., which they have been working for a distance of 400 feet at the station. The wires are insulated with a composition of tar, rosin and other materials, and are laid in a box four feet deep in the ground. The insulator hardens in the ground and breaks if the wire is bent. It has worked well, he said, since December last, when it was laid, but the station officers want to have a summer test before they report on it.

Professor Van Der Weyde said that he thought there would be no excuse for not burying the wires except the one of expense. All the others which the telegraph companies put forth have been or will soon be overcome.

ELECTIONS AND APPOINTMENTS.

At the annual election, on May 27, of the New York Mutual Telegraph Company, the following named gentlemen were chosen directors: John G. Moore, George F. Baker, George S. Scott, H. C. Fahnestock, Jay Gould, Russell Sage, George William Ballou, George G. Haven, George J. Gould and C. F. Peck.

At a recent meeting of the directors of the American Electric and Illuminating Company, held in Boston, the following officers were chosen: President and General Manager, Edward H. Goff; First Vice-President, Silas Gurney; Second Vice-President, Loren N. Downs; Treasurer and Clerk, F. Montague Snowden.

A. W. Dimock has resigned as President of the Bankers' and Merchants' Telegraph Company, and G. S. Mott, the General Manager, has been elected to succeed him. Mr. Dimock remains a director.

At the annual meeting of the Bankers' and Merchants' Telegraph Company, held in Boston, June 2, the following gentlemen were re-elected as directors: A. W. Dimock, G. P. Smith, G. S. Mott and J. G. Case.

At the annual meeting of the stockholders of the Franklin Telegraph Company, held at Boston, June 4, the following directors were chosen for the ensuing year: Charles A. Tinker, Norvin Green, T. T. Eckert, John Van Horne, A. R. Brewer, Jay Gould, Frederick L. Ames, Joseph F. Greenough and Thomas Roche. R. H. Rochester was elected Treasurer and Thomas Roche, Clerk.

The following board of officers has been elected by the directors of the Providence Telephone Co.: President, Henry Howard; Vice-President, Henry C. Cranston; Secretary and Treasurer, Charles T. Howard; Assistant Treasurer, H. H. Harris; General Manager and Superintendent, J. W. Duxbury; Assistant Superintendents, J. H. Clark, A. C. White.

Annual meetings of the stockholders of the Pacific and Atlantic, Delaware River, and Continental Telegraph Companies were held May 20. The first-named company elected the following directors to serve during the year: Norvin Green, President; Thomas T. Eckert, C. A. Tinker, Henry Bentley, James Merrihew, and S. S. Garwood. The Delaware River Company elected directors as follows: Henry Bentley, President; C. A. Tinker, John Van Horne, R. H. Rochester, S. S. Garwood, G. W. Porter, and James Merrihew. The Continental Company elected as directors: James Merrihew, President; Henry Bentley, C. A. Tinker, S. S. Garwood and G. W. Porter.

THE TELEGRAPH.

Domestic.

Rome, Ga., is to have the electric fire alarm, and the city has ordered twelve boxes of the Gamewell system.

The annual meeting of the Southern Telegraph Company, which is controlled by the Bankers and Merchants' by ownership of stock, took place May 27.

To all points covered by the Postal Telegraph and Cable Company the rates of the Bankers' and Merchants', with which it is allied, will hereafter be the same—20 words for 25 cents.

The Bankers' and Merchants' Telegraph Company, the Postal Telegraph and Cable Company, and also the Mutual District Telegraph Company of Newport, were chartered at the May session of the Rhode Island Legislature.

At a meeting of the Providence City Council, on the 16th inst., a petition was presented for the removal of the Baltimore and Ohio Telegraph Company's poles on Pitman street.

Foreign.

The longest single line of pneumatic tubes in successful operation runs between the London (England) Central Telegraph office and the House of Commons, a distance of two and three-fifths miles.

The proposition of the English Postmaster-General to teach telegraphy to the blind can scarcely be considered a visionary scheme. He appears to be really in earnest, and intends shortly to send out full instructions for teaching, to the various blind institutions in England.

In order to avoid delay in acting upon the contents of telegrams in case of the absence of the addressee, the German telegraph authorities have adopted the symbol R. O., which is transmitted before the address, and signifies that the message may be delivered unsealed. The sender may authorize these instructions by payment for one extra word.

THE TELEPHONE.

Domestic.

The war between the Bell and the Overland Telephone companies is raging in Cincinnati through the columns of the local papers.

The telephone people have been successful in a conflict with the authorities at Sioux City, Iowa. The poles on a certain street were cut down by order of the mayor. Protected by an injunction, the company commenced rebuilding the line, when the men were arrested by the police and fined. Judge Palmer subsequently decided in favor of the company, and fined the mayor, marshal and police justice for contempt.

Foreign.

The Telephone Exchange at Toronto, Ont., was burned out on the 24th of May. The six ladies on duty were rescued after being so thoroughly frightened as to contemplate jumping into the street. The subscribers were put to some inconvenience by the disturbance of connections, but by working day and night communication was soon restored.

The crusaders against overhead wires have been joined in Rio Janeiro by a species of large bird, known as the "Aasgeir," which in scavenging the streets flies very low, frequently hitting and breaking the telephone wires, or becoming entangled in them. It is a violation of the law to kill these birds, and at present there appears to be no remedy against their depredations.

The etiquette of the Portuguese court was recently evaded by the use of the telephone, when the King and Queen, who were in mourning for the Princess of Saxony, could not attend at the first production of the new opera "Lauriana." Six microphone transmitters connected in multiple arc were placed along the front of the stage, connected with receivers at the palace, enabling the royal family to listen to the melody, although the audience was deprived of their presence.

RAILWAY SERVICE.

By a recent act of the New Jersey legislature, the use of electric or pneumatic train signals is now authorized in lieu of the bell cord which has heretofore been required by law.

A convention has been called to meet at Louisville, Ky., Aug. 20, for the purpose of organizing an association of train dispatchers. The movement thus far has been confined chiefly to southern and western railways, but it is the intention to make it a national body.

ELECTRIC LIGHT AND POWER.

Domestic.

An Edison plant of 1,000 lights is being installed at Circleville, O.

Anniston, Ala., has a plant of 25 Brush arc lamps, and a 40 light storage battery. The streets are lighted by 7 arc lamps placed on 42 foot poles. The opera house is lighted by the Swan incandescent lamps.

The city of Detroit, Mich., is about to enter into a contract with the Brush company to light the streets for 1 year from July 1st, using for the purpose 72 towers, 6 of 150 feet and 66 of 104 feet, with 300 lamps of 2,000 c. p. each, for $95,000 per annum. The company is to assume the entire expense of towers, poles, wires and lamps, and maintenance of the same.

Local companies are being formed in New England for the introduction of Daft's system of electrical transmission of power. A small plant is already in operation in Boston, working the printing presses of an office on Washington street, also lighter machinery in an adjacent establishment.

The city of Geneva, N. Y., has decided to adopt the Brush-Swan system of lighting.

About 15,000 incandescent lamps will be required to light the Cotton Exhibition building in New Orleans. Should the arc system be adopted, 700 lamps will be necessary. It is the intention to illuminate the grounds with 5 arc lamps of 36,000 c. p. each.

75 Thomson-Houston lights are operated at Ottawa, Ill., by the Thomas Electric Light and Power Co., and an additional incandescent plant is in contemplation.

A plant of 25 Thomson-Houston lamps is in operation at La Salle, Ill., which is to be doubled as soon as the necessary machinery arrives.

The contract of the city of New Orleans with the Brush Electric Light company includes the lighting of Canal street from the levee to Metaire Ridge, a distance of three miles—said to be the longest straight stretch of electric light in the world.

The electric motor which was placed on the Saratoga, Mt. McGregor & Lake George railroad by the Daft company, has been repaired, and is now said to be running satisfactorily on the road. In connection with the experiments made with the motor on the road recently, wires were connected with the track and a current of electricity run off to a saw-mill near by. While the motor was dragging an 18-ton car up the heavy grade of the mountain, 3-inch boards were being sawed out by electricity in the mill.

Hailey, Gray & Co.'s barrel factory, and the Mobile Electric Light company's works, Mobile, Ala., have been destroyed by fire. Loss, $60,000.

It is said that an electric railway will be one of the attractions at the Exhibition of the New England Manufacturers and Mechanics Institute next fall.

At a meeting of the common council of Hoboken, N. J., June 24th, the franchise for the introduction of the Thomson-Houston electric lighting system was granted to Pope, Sewall & Co., of New York, and all other franchises previously given to other companies rescinded. The action of the council was immediately approved by the mayor.

All the electric apparatus used in lighting the New York and Brooklyn bridge has been purchased from the United States Electric Light Company by the board of bridge trustees.

The American Electro-magnetic Brake Company, of Illinois, has been incorporated in that state with a capital stock of $100,000.

The Panhandle road is fitting up a train of passenger cars with the electric light.

A new electric light company has been formed in California. It has decided to adopt the Thomson-Houston Company's system of arc lights, and will use the Armington & Sims engines. The first engine and dynamo has been sent forward.

The manufacture of electric headlights for locomotives has begun at Akron, by the American Locomotive Electric Headlight Co., of which Lewis Miller, of Akron, is president, and Mr. Lynn, formerly of Indianapolis, is acting superintendent.

The Daft Electric Light and Power Co. have fitted up a second elevator on Spruce street, New York city, operated by one of the Daft motors. One has also been shipped to Boston for the same purpose. At the Greenville, N. J. factory a sawmill is driven by power brought over a mile of wire.

The gas company at St. Paul, Minn., has solved the question of competition by going into the electric light business, and serving customers with either electricity or gas.

Foreign.

Mr. J. S. Watson, Superintendent of the Cunard Steamship Line, says: "We now have electric lights, three different kinds, in the Servia, Aurania, Pavonia, Cephalonia, Bothnia and Gallia, and we have every reason to be entirely satisfied with them. All new steamships will be furnished with them. They are economical, give a better light than gas or oil, and, best of all, give out no heat.

The electric railway at Brighton, England, is being run very successfully, but the customary agitation is being made against its use, chiefly by the cabmen and omnibus proprietors, who complain that the line detracts custom from them. The usual argument is also made that horses will be frightened by the noiseless electric car.

The parliament houses in Melbourne, Australia, are to be lighted with 1,000 Swan lamps. The contract has been awarded to the Australian Electric Light company, which has also received the lighting of the post-office in the same city.

The Frankfort-Offenbach Electric railway, 2 miles in length, is in successful operation. The current is carried overhead from the central station by 2 parallel cables. The power is sufficient to run 2 or 3 carriages, each containing 25 passengers, at a speed of about 9 miles per hour.

In view of the success of the electric lighting of railroad cars in Australia, the Austrian Minister of Commerce has recommended its adoption by all railroad lines of the empire.

The factory of the Swan United Electric Light Co., at Lille, France, has been destroyed by fire, the loss amounting to $100,000, mostly covered by insurance. The fire originated from the gas used to light the establishment.

MISCELLANEOUS.

Domestic.

An electrical exhibition is announced to be held in Boston next winter. The preliminary arrangements are nearly completed.

Foreign.

The British government has decided to ask for the appointment of a select committee of the House of Commons to examine into and report upon the whole subject of overhead telegraph and telephone wires.

A patent has been granted in England for a process of facilitating submarine exploration, in which the oxygen required for breathing purposes is produced by electrically decomposing sea-water.

SUBTERRANEAN.

The *Pall Mall Gazette* is of the opinion that the New York underground telegraph bill is enough to crush the life out of any undertaking.

The New York Underground Cable Company, organized to acquire and sell rights under letters patent, for useful devices pertaining to underground electric work, and for their manufacture and sale, has filed articles of incorporation. The capital stock is $250,000, and the corporators are William H. Sanford, Thomas G. Turner, Philo S. Bemis, J. Dixon Roman and Hiram R. Sheldon.

SUBMARINE CABLES.

It is reported that upon completion of the Bennett-Mackay cable, the existing cable companies will reduce the transatlantic rate to 6 cents per word.

The concession granting the right to lay a cable between Portugal and America, which was obtained some time ago, has been transferred to a joint stock enterprise entitled the American and British Continental Cable Company. The first section of the cable, to St. Michael's, one of the Azore Islands, will be laid in September.

A movement has been started in England for the establishment of a system of lower rates for night cable messages between England and the United States. The subject will be brought to the attention of Parliament at an early day.

MANUFACTURING AND TRADE NOTES.

Domestic.

The Electric Light works, Denver, Col., have contracted with the Western representative of the Pond Engineering company, St. Louis, to set a 60-inch boiler with the Jarvis patent furnace.

The Sperry Electric Light, Motor & Car Brake Co. Chicago, are placing in their works a new engine lathe, four hand lathes, and a milling machine, and one drill and emery wheel in addition to their regular line of machinery, preparatory to increasing their working force.

The Westinghouse Machine Company of Pittsburg, Pa., has issued four special circulars descriptive of the Westinghouse engine, one of which sets forth its special adaptability to electric lighting.

James W. Queen & Co., issue a catalogue of their very complete assortment of dynamos, lamps and secondary batteries, designed especially for experimental purposes.

The Callender Insulating & Waterproofing Co. has just completed its works at East Newark, N. J., and is now prepared to furnish wire for all electrical purposes, insulated with "Bitite," a material which is said to be unequaled for such use.

Foreign.

The strike of the English wire makers has been compromised, the manufacturers securing a sufficient reduction in the price of labor to enable them to successfully meet the German competition.

FINANCIAL.

NEW YORK, June 20, 1884.

Dullness is the principal feature of the stock market at the present time, and is likely to continue so at least until September. Western Union has partially recovered from the effects of last month's panic, but is still quoted very low for a 7 per cent. stock. A rumor prevailed at one time that the dividend would probably be reduced to 6 per cent., in accordance with the views of some of the more conservative members of the Board. It is probable, however, that such a change would be imprudent in the present weak condition of the Gould stocks. American Bell has rallied, but is not likely to recover its former standing until the Drawbaugh case is decided. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	158 00	162 00	Molecular	4 00	10 00
Am. Speaking	110 00	125 00	New England	20 00	23 00
Currier-Telo. Bell	3 00	—	New York	—	85 00
Colombia & Pan	24 50	25 00	New York & N. J.	20 00	60 00
Continental	10 00	—	N. Y. & Penn	30 00	70 00
Dolbear	5 00	10 00	Peoples	7 00	10 50
Erie	20 00	22 00	do. N. E.	1 10	9 00
Globe	4 00	5 00	Southern Bell	95 00	125 00
Hudson Riv.	40 00	80 00	Southern N. E.	—	175 00
Inter-Cont.	25	2 50	Tropical	1 00	3 00
Mexican Central	—	3 00	W. I. Tel. & Telph.	1 00	1 25

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	40 00	50 00	Manhattan Telegraph	10 00	85 00
Bankers' & Merchants'	—	30 00	Mexican	125 00	147 00
Commercial Tel. Co., prfd	—	100 00	Postal	4 87	5 15
Com'l Tel. Co., common	—	95 00	do. bonds	44 50	48 00
Harlem Dist. Tel. Co.	2 00	2 50	Western Union, ex div.	55 87½	56 00
Bankers' & Merchants' 1st m. bonds	20 00	30 00			

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
American	2 00	4 00	Edison European	11 00	14 00
Baxter	22 00	24 50	Excelsior	8 00	
Brush	50 00	80 00	Swan	12 00	40 00
Brush Ill.	80 00	90 00	U. S.	75 00	95 00
Edison	70 00	100 00	do. Ill. Co.	—	90 00
Edison Ill.	30 00	75 00	United Globe	60 00	75 00
Edison Isolated	—	90 00			

The annual report of the Cumberland Telephone and Telegraph Co., shows the net earnings for 10 months to have been $57,818, out of which dividends have been declared of 5¼ per cent., leaving a surplus on hand April 1st, of $1,264.

The Mutual District Messenger Company, of Boston, has declared a quarterly dividend of $2 per share, which was payable June 1.

The Western Union directors at their quarterly meeting declared a dividend of 1¼ per cent., payable July 15. After this is paid the company will have a surplus of $4,256,017. The report says that the present quarter closes the fiscal year, which will exhibit gross earnings within a fraction of $20,000,000, about half a million more than last year; but, on account of the extraordinary expenses during the strike in July and August, the net will not be quite so large. There had been expended in the construction and purchase of new lines, etc., since January, 1884, up to the close of the present quarter, $5,700,000. The company's statement is as follows:

Surplus, April 1	$4,049,817
Net revenue for quarter ending June 30	1,750,000
Total	$5,799,817
Interest	$124,000
Sinking fund	20,000
	144,000
Balance	5,655,817
Dividend	1,399,800
Surplus	$4,256,017

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

United States Supreme Court—*Cochrane, et. al. v. Badische Analin and Soda Fabrik.* Appeal from the Circuit Court of the Southern District of New York. This suit was brought on a reissued patent for a product known as "artificial alizarine," when produced from anthracine by either of the methods described, or by any other method which will produce a like result. It appeared that in this case the article itself was old, although it had been made artificially for the first time by the patentee. He sought to cover this artificial product, whether made by his own or any other artificial process. The Supreme Court, reversing the opinion of the Circuit Court, held that the reissued patent was for a different invention from that described in the original, unless the product claimed is precisely the product, and no other, produced by the process described in the original patent; and that as it did not appear that the patentee's method was followed in order to produce the defendant's article, nor that the article could be produced by no other process, that there was no infringement. *McMurray v. Mallory.* Appeal from the Circuit Court for the District of Maryland. The Court, affirming the decree of the Circuit Court dismissing the bill, held that a claim to a combination of parts, which specifies that such parts are used in a particular way for a special purpose, cannot be expanded by reissue so as to include combinations of those parts, expressed so as to cover them broadly, and without limitation as to their construction. It was also held that the patentee or his attorneys cannot by merely disclaiming all the changes made in a reissue, revive and restore the original patent. This can only be done, if at all, by a surrender of the reissued patent and the grant of a new reissue. *Turner and Seymour Manufacturing Company v. Dover Stamping Company.* Appeal from the Circuit Court for the District of Connecticut. The Court, reversing the decree of the Circuit Court, held that the complainant's reissued Letters Patent, granted eleven years after the date of the original and with a broader claim, were invalid, and that it is immaterial whether or not a certain construction might have been covered by the language of the specification since the claims are to be dealt with and nothing else. *Eagleton Manufacturing Company v. West, Bradley and Carey.* Appeal from the Circuit Court for the Southern District of New York. In this case the Court affirmed the decree of the Circuit Court which dismissed the bill. It appears that Eagleton made oath to and filed an application for a patent for japanning steel furniture springs accompanied with the power of attorney to his attorneys to amend the application. After the death of the applicant, amendments containing entirely new matter were inserted by the attorneys, and a patent was granted without any new oath by the administratrix. It being shown that japanning itself was old, it was held that the patent for the interpolated matter could not be valid.

United States Circuit Courts—Southern District of New York. *Simon v. Neumann.* In this case, Wheeler, J., held that an expansion of claims by reissue nearly five years after the issuance of the original patent, is not warranted, according to the recent decisions upon this subject. In the Eastern District of Wisconsin, in *Saladee v. Racine Wagon Company*, Dyer, J., dismissed the appeal upon the ground of non-infringement, without deciding the validity of the reissue, on the ground that the scope of a patented invention may be so narrowed by the prior state of the art that infringement cannot be adjudged unless there has been an appropriation of the identical elements in substantially the form of construction which the inventor had the right to claim as new. In the Northern District of New York, *Worswick Manufacturing Company v. City of Buffalo*, which was a suit under the original patent for a harness for fire engine horses, which is normally suspended above the position to be occupied by the horse, while being attached to the engine, so that it can be dropped upon him and fastened with great expedition. Coxe, J., held that the invention was a useful and patentable one, and that when an inventor is the first to enter a particular field of invention his claims should be construed broadly to cover similar apparatus which effects the same result in substantially the same manner.

United States Patent Office.—The interference between Stephen D. Field and Thomas A. Edison of New York, and E. W. Siemens of Germany, involving the question of priority of invention of the fundamental principle of the electric railway system, which has been pending in the patent office for four years, was decided on June 25th in favor of Field. This is a very important decision as it gives to the successful contestant the virtual control of this invention within the United States.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From May 13 to June 10, 1884 (inclusive).

Alarms and Signals:—*Watchman's Time Detector*, C. G. Spengler, May 20, 298,006. *Signal Box for District and Fire Alarm Telegraphs*, C. H. Carter, 298,015. *Watchman's Recorder*, J. Redding, 299,011. *Call Box for District Telegraphs*, M. J. O'Sullivan, May 27, 299,417. *Fire Alarm*, G. E. & E. R. Hovenden, June 3, 299,546. *Indicator*, W. S. Johnson, 299,552. *Alarm Applied to Cots, etc.*, W. F. & W. H. Keep, 299,649. *Bell and Annunciator*, D. Rosseau, June 10, 300,134. *Bell*, E. W. Hazazer, 300,233.

Clocks:—S. Schlisgall, June 10, 300,139.

Commutators:—*Multiple Circuit Closer*, W. F. C. M. McCarty, June 10, 300,098.

Conductors, Insulators, Supports and Systems:—*Lightning Conductor*, T. H. Dodge, May 13, 298,337. *Insulator*, J. S. Lewis, 298,593. *Terminal do.*, same, 298,594. *Machine for Turning Insulator Pins*, J. J. Baldwin, 298,543. *Skeleton Arch for Supporting Wires*, G. M. Hoag, 298,602. *Covering for Conductors*, F. S. Harrington, May 20, 298,751. *Insulated Tie Wire*, C. C. Hinsdale, 298,753. *Pole*, J. Hunter, 298,975. *Insulating Pipe Union*, C. Deavs, May 27, 299,206. *Combined Curbstone and Wire Conduit*, J. S. Woodward, 299,449. *Circuit Connection*, D. E. Drake, 299,457. *Conduit for Wires*, W. Magner, June 10, 299,092; A. Campbell, 300,210. *Joint for Lead Pipes*, W. R. Patterson, 300,005. *Compound Cable*, P. H. Vander Weyde, 300,034. *Apparatus for Distributing Electricity*, A. I. Gravier, 300,068 *Manufacture of Electric Conductors*, J. J. Williamson, 300,179.

Dynamo Machines and Motors:—*Motor*, C. A. Saxe, May 13, 298,507. *Regulator for*, C. G. Burke, 298,550. *Armature for*, J. C. Vetter and S. G. Putnam, May 20, 298,922. *Mode of Operating Dynamos*, T. A. Edison, 298,-935. *Construction of Dynamos*, P. Diehl, May 27, 299,117. *Magneto-Electric Machine*, H. F. Joel, June 3, 299,551. *Dynamo*, E. T. Starr, June 10, 300,154; T. A. Edison, May 20, 298,954, 298,955.

Galvanic Batteries:—O. Millard, May 20, 298,997. *Galvanic Element*, June 10, 300,176.

Ignition:—*Apparatus for Gas Lighting*, LeRoy S. White, May 13, 298,531.

Lamps and Appurtenances:—*Arc*, S. H. Short, May 20, 299,025; E. & A. E. Jones, May 27, 299,397; T. G. Turner, June 3, 299,600; M. N. Lynn, June 10, 300,095. *Incandescent*, A. Welsh, June 3, 299,708, 299,885. *Socket for Incandescent Lamps*, S. Bergmann, May 13, 298,658. *Method of Treating Carbons for Electric Lights*, T. A. Edison, 298,679.

Metallurgy:—*Process and Apparatus for Extracting Gold and Silver from their Ores*, C. P. Bonnett, May 13, 298,663.

Miscellaneous:—*Work Indicator for Mills*, A. D. Blodgett, May 13, 298,341. *Eye Shade*, L. K. Oppenheimer, 298,397. *Inductorium*, C. J. Van Depoele, 298,431. *Mounting Electrolype Plates*, R. W. Nelson, 298,703. *Automatic Recording Apparatus for Weighing Machines*, W. H. Beehler, May 27, 299,338. *Means for Disclosing Obstacles to Navigation*, F. D. Torre, June 10, 299,968. *Cauterizing Apparatus*, E. T. Starr, 300,155. *Door Lock*, C. Wiest, 300,331.

Railway Appliances:—*Block Signal*, S. J. Swayze and J. C. Lane, May 20, 298,913. *Signal*, L. Finger, June 10, 300,238.

Storage Batteries:—*Element for*, Willard E. Case, May 13, 298,348. *Apparatus for Charging*, R. P. Sellon, May 20, 299,031. *Secondary Battery*, W. Stanley, Jr., May 27, 299,177, 299,178; E. T. Starr, May 27, 299,434; A. G. Davis, June 10, 300,052.

Telephone Systems and Apparatus:—*Transmitter*, D. Drawbaugh, May 13, 298,676; G. W. Drawbaugh, 298,677; H. E. Waite, May 20, 298,923, 298,925; J. D. Husbands, 299,073. *Receiving Telephone*, C. E. Scribner, 298,783; H. E. Waite, 298,924; J. D. Husbands, 299,074. *Individual Call Apparatus*, A. P. Howes, May 13, 298,383. *Mechanical Telephone*, A. B. Kurtz, 298,479. *Exchange Apparatus*, T. B. Doolittle, 298,559. *Multiple Switch Board*, T. N. Vail, May 20, 299,089. *Exchange System*, F. B. Herzog, 299,070. *Holder for Receivers*, J. N. Stewart, May 27, 299,288. *Support*, N. G. Warth, 299,300. *Time Signals*, H. B. Lytle and J. J. Carty, June 3, 299,561, 299,562. *Metallic Circuit for Exchanges*, J. C. & E. P. Warner, 299,603. *Telephone System*, C. H. Haskins, 299,926. *Spring Jack for do.*, C. E. Scribner, June 10, 300,143. *Derived Circuit for Clearing Out Annunciators*, C. E. Scribner, 300,144. *Annunciator and Circuit*, T. N. Vail, 300,169.

Tools:—*Cutting Pliers*, J. H. Jencks, May 13, 298,587, 298,588; E. Stevens, June 3, 299,872. *Wire Cutter*, E. Stevens, May 20, 299,033. *Vise*, W. M. Whiting, June 3, 299,889.

Telegraphs:—*Quadruplex*, G. W. Gardanier, May 13, 298,571. *Printing*, W. J. McCausland, June 3, 299,664. *Transmitter*, N. J. Bishoprick, June 10, 299,949. *Relay*, J. S. Lamar, 300,269.

The following electrical patents were omitted from previous lists: *Submarine Vessel*, J. H. L. Tuck, April 29, 297,647. *Automatic Copying and Engraving Machine*, A. Schmid, May 6, 298,030.

Expired Patents.—A list of the more important electrical patents which have expired during the past three months, with the date of expiration, is subjoined: C. J. B. Gaume, *Electro-Magnetic Engine*, No. 63,389, April 2; S. Chester, *Connecting Telegraph or Fire Alarm Stations*, No. 63,613, April 9; J. L. Martin, *Ageing Alcoholic Liquors*, No. 64,990, May 21; L. W. Worth, *Telegraph Paper Reel*, No. 65,038, June 11; S. G. Cabell, *Electro-Magnets*, No. 66,001, June 25.

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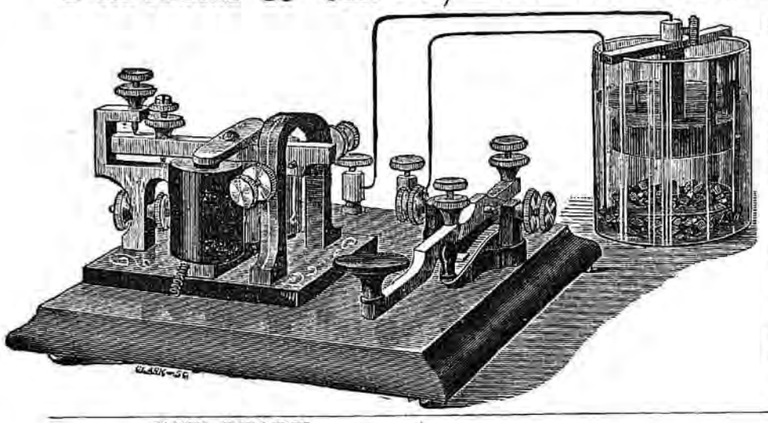

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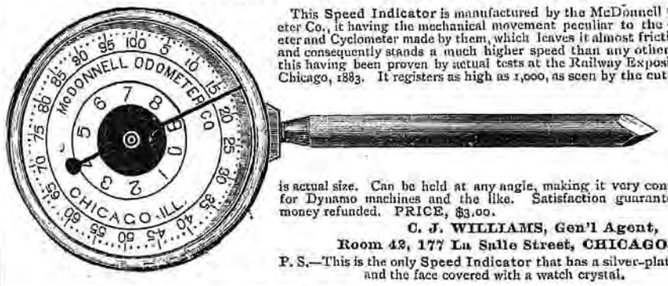

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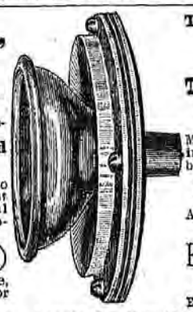

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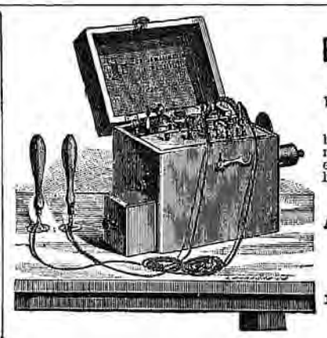

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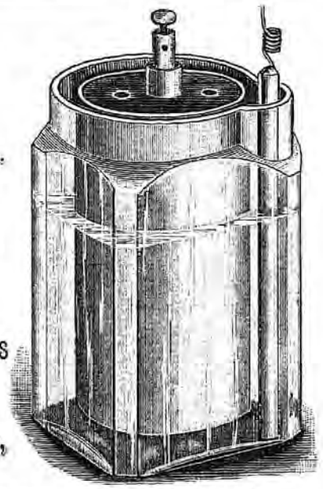

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C. Arnold & Co. Flour Mill	Sterling, Kansas,	65 H. P.
Lynn Electric Light Co	Lynn, Mass.	50 "
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" " " " (3d order).	" "	50 "
" " " " 4th order).	" "	50 "
Dallas Barrel & Woodenware Co	Dallas, Texas,	50 "
Benjamin Eastwood, Machine Shop (2d order).	Paterson, N. J.	50 "
Benjamin & Bower, Marine Engine	Seattle, W. T.	50 "
Geo. W. Moyer, Saw Mill (3d order).	Altamonte, Fla.	50 "
Wilkinson & Cole, Planing Mill	Mountain Creek, Ala.	40 "
" " " " (2d order).	" " "	20 "
A. Higley, Stamp Mill	Cleveland, Ohio,	40 "
Siddall, Carroll & Co. Planing Mill	Calvert, Texas,	40 "
M. L. Braswell, Saw Mill	Blythewood, S. C.	30 "
R. D. Wood & Co. Machine Shop	Philadelphia, Pa.	30 "
Arkansaw Oil Co. Oil Mill	Texarkana, Ark.	30 "
M. M. Conger, Flour Mill	Mexico, Mo.	30 "
Pittsburgh Bessemer Steel Co	Pittsburgh, Pa.	30 "
Albany Oil and Refining Co. Oil Mill	Albany, Ga.	30 "
Payne & Hammond, Cotton Ginning	Hammond, Texas,	30 "
C. H. Howland, Electric Light	Los Angeles, Cal.	20 "
Banks & Matthias, Chair Factory	Allentown, Pa.	20 "
Chester Huntington, Machine Shop (2d order).	New York, " "	20 " 12 "
Adams & Price, Machine Shop	Nashville, Tenn.	12 "
Burrell & Whitman, Manufacturers' Tinware	Little Falls, N. Y.	12 "
C B. Lee, Machine Shop	Galveston, Texas,	12 "
R. M. McDonald, Machine Shop	Greenville, S. C.	8 "
Charlotte Gas Co	Charlotte, N. C.	8 "
J. W. Shaffer, Machine Shop	Ottawa, Kansas,	8 "
E. B. Golet, Grist Mill	Mobile, Ala.	8 "
M. V. Monarch, Distillery	Owensburg, Ky.	8 "
Cumberland & Passumpscott Mills (2d order).	Cumberland, Me.	4 "
Washington Packing Co	Astoria, Oregon,	4 "
Lowe & Isherwood, Laundry	Austin, Texas,	4 "
Total, Thirty-five Engines		975 H. P.

SALES FOR MARCH, 1884.

Northern New York Manufact'g Co. Talc. Mill	Governeur, N. Y.	160 H. P.
Piedmont Manufacturing Co. Cotton Mill	Piedmont, S. C.	160 "
Utah Electric Light Co	Salt Lake City, Utah,	95 "
Marshalltown, Electric Light Co	Marshalltown, Iowa,	65 "
Lombard, Ayers & Co. Oil Refinery	New York,	65 "
Reynoldsville Mining and Manufacturing Co	Reynoldsville, Pa.	50 "
Russell & Erwin Mfg. Co. Machine Shop	New Brittain, Conn.	50 "
Jackson Lime Co	Blount Springs, Ala.	50 "
Giverneud Bros. Silk Mill (4th order).	Homestead, N. J.	50 "
" " " (5th order).	" "	12 "
Equitable Gas Co	New York,	40 "
" " (2d order).	"	40 "
" " (3d order).	"	40 "
" " (4th order).	"	40 "
J. W. & E. Grove, Saw Mill	Fredericksburg, Pa.	40 "
Spring Lake Iron Co	Fruitport, Mich.	30 "
Neal Bros. & Brooks, Paper Mill	Lockport, N. Y.	30 "
Barker & Hopkins, Planing Mill	Yarrellton, Texas,	30 "
Chesapeake & Ohio Elevator Co	Newport News, Va.	30 "
Standard Underground Cable Co	Pittsburgh, Pa.	30 "
C. G. Washburn & Son, Saw Mill	Shelby, N. C.	30 "
Austin Hydraulic Cement Co	Austin, Texas,	20 "
Cole & Frank, Ginning	Elm Creek, Texas,	20 "
Phil. & Reading Coal and Iron Co. (5th order).	Reading, Pa.	20 "
West & Renfrew, Ginning	Blanco, Texas,	20 "
Brayton Petroleum Engine Co	Bridgewater, Mass.	20 "
Texarkana Ice Co	Hot Springs, Ark.	20 "
S. A. Blasangaine, Saw Mill	Clanton, Ala.	20 "
Oakland Paper Co	Manchester, Conn.	20 "
The Levett-Muller Electric Light Co	New Orleans, La.	20 "
Geo. O. Baker & Co. Electric Light	Selma, Ala.	20 "
Justice Bateman & Co. Elevators	Philadelphia, Pa.	12 "
W. B. Creight, Ginning	Wiunsboro, S. C.	12 "
Walter A. Taylor, Chemist	Atlanta, Ga.	12 "
People's Gas Light Co	Rutland, Vermont,	12 "
Carrie Furnace Co. Electric Light	Rantsburgh, Pa.	12 "
S. C. Brooks, Electric Light	Eau Clair, Wis.	12 "
Okeechobee Land Co (2d order).	Kissimee, Fla.	12 "
May & Lackey, Ginning	Leander, Texas,	12 "
J. B. Gray, Ginning	Georgetown, Texas,	12 "
J. J. Barber, Ginning	Florence, Texas,	12 "
Imray, Hirsch & Kaeppel	Melbourne, Australia,	12 H. P.
J. H. Robbins & Sons, Machinists	Selma, Ala.	12 "
A. J. Mullin, Brick Yard	" "	12 "
J. B. Pearce, Marine Engine	Portland, Or.	8 "
Amos Johnson, Marine Engine	" "	8 "
A. Hackstadt	North Topeka, Kan.	8 "
Iwaco Steam Navigation Co (2d order).	Astoria, W. T.	8 "
Steamer "Josie Harry," Electric Light	Memphis, Tenn.	8 "
R. Neptune & Co	Vincennes, Ind.	8 "
E. D. Pearce	Portland, Or.	4 "
The Fort Wayne Organ Co	Fort Wayne, Ind.	4 "
Evans & Roberts, Boiler Shop	Birmingham, Ala.	4 "
Van de Poele Electric Light Co	Chicago, Ill.	4 "
Total, Fifty-four Engines		1,627 H. P.

SALES FOR APRIL, 1884.

Gov't of New South Wales, Electric Light	Sydney, Australia,	100 H. P.
Anson, Eldred & Sons, Pl'g Mill (3d order).	Ft. Howard, Wis.	125 "
Phil. & Reading Coal & Iron Co (6th order).	Reading Pa.	80 "
John Carson, Saw Mill	New Tacoma, W. T.	80 "
Omaha & Grant Smelting & Refining Co	Omaha, Neb.	80 "
Lawrence Machine Co	Lawrence, Mass.	65 "
Portland Electric Light Co	Portland, Or.	65 "
" " (2d order).	" "	65 "
" " (3d order).	" "	65 "
Council Bluffs Electric Light Co	Council Bluffs, Ia.	65 "
Beloit Straw Board Co. Paper Mill	Beloit, Wis.	65 "
Wm. E. Pierce, Woolen Mill	Allentown, R. I.	50 "
A. & V. P. Brow, Drainage	Providence Plant'n, La.	50 "
L. Godchaux, "	Mary Plantation, "	50 "
O. Hymec, "	Hymelia " "	50 "
Foos & Barnett "	Shadyside " "	60 "
McKeesport Electric Light Co	McKeesport, Pa.	50 "
" " " (2d order).	" "	50 "
James Kirk, Flour Mill	Winfield, Kan.	50 "
Thompson-Houston Electric Light Co	St. Louis, Mo.	50 "
Alex. Wilson & Co. Flour Mill	Clarke, Dak.	50 "
Shepard Mfg. Co., Planing Mill	Minneapolis, Minn.	50 "
R. Viterbo, Drainage	Edmee Plantation, La.	40 "
B. Johnson, "	Carroll " "	40 "
R. Milliken, "	Waterford " "	40 "
E. F. Dugas "	Armalee " "	40 "
L. D. Martin, "	Marmillion " "	40 "
Felix Chillingworth	New Haven, Conn.	40 "
Palmer & Trowbridge, Hoisting	Chicago, Ill.	40 "
E. F. Johnson, Drainage	Rosaland Plant'n, La.	30 "
John A. Morris, "	Ashton, " "	30 "
L. D. Martin, " (2d order).	Marmillion " "	30 "
T. S. Wilkerson, "	Myrtle Grove " "	30 "
Folse & Naquin, "	Assumption " "	30 "
Edmund M. Ivens & Son, Drainage	New Orleans, La.	30 "
J. E. Thropp & Co., Ore Crusher	Edge Hill, Pa.	30 "
Howard Oil Co	Houston, Texas,	30 "
Walter Alford, Planing Mill	Bellville, Ont.	30 "
F. Wohlleb, Ginning	Cameron, Texas,	30 "
F. H. Goldthwaite & Co. Button Manufactory	Springfield, Mass,	30 "
Wells & Ferguson, Ginning	Allen, Texas,	30 "
Isaac Strauch, Flour Mill	Cressona, Pa.	80 "
F. N. Burt, Tannery	Ogdensburgh, N. Y.	30 "
O. Hymce, Drainage (2d order).	Goldmine Plant'n, La.	20 "
R. O. Martin, "	Albemarle " "	20 "
J. W. Gallaher & Bro. Planing Mill	Coopers, Ala.	20 "
Aberdeen Electric Light Co	Aberdeen, Miss.	20 "
Emmor Camp, Saw Mill	South Strabane, Pa.	20 "
M. Pierce, Spice Mill	Toronto, Ont.	20 "
Rayford & Nickel, Ginning	West Station, Texas,	20 "
Reedy & Langhouse "	Waxahatchie, Texas,	20 "
Paine Lumber C . Planing Mill	Oshkosh, Wis.	20 "
Okeechobee Land Co., Hoisting (3d order).	Kissimee, Fla.	12 "
Canning & Gill, Wagon Factory	Selma, Ala.	12 "
Perin Plow Works	Topeka, Kan.	12 "
Asa G. W. Smith	Reading, Pa.	12 "
C. H. Mitchell, Electric Light	Detroit, Mich.	12 "
McTighe Electric Light Co (5th order).	Pittsburgh, Pa.	8 "
Thomps'n-Houst'n Electric Light Co. (2d order).	St. Louis, Mo.	4 "
H. B. Claflin & Co	New York,	4 "
St. Albans Gas Light Co	St. Albans, Vt,	4 "
Crescent Stave Manufacturing Co	New Orleans, La.	4 "
Total, Sixty-two Engines		2,420 H. P.

THE ELECTRICIAN

AND

ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

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NEW YORK, AUGUST, 1884.

THE DEFEAT OF THE BRUSH PATENTS.

THE action which was brought in the United States Circuit Court of the Southern District of New York, on December 3, 1880, by Charles F. Brush and the Brush Electric Co., against C. H. Condit and others, now represented by the United States Electric Lighting Co., has been dismissed by Judge Shipman. It will be remembered that the complainants alleged an infringement by the defendants of two separate patents granted to Mr. Brush, one for metal-plated carbons and the other for the well-known ring-clutch movement employed to regulate the carbons in the Brush arc lamp, a device which was asserted to have been used in a large number of the Weston arc lamps made and sold by the defendants. The suit has been pending nearly four years and a vast mass of evidence has been taken on both sides. The record, including the testimony, exhibits and arguments of counsel, occupies some 2,500 printed pages, the "brief" filed by the complainants' counsel alone comprising no less than 448 pages. The case was argued before Judge Shipman at Hartford by consent of counsel in March last, the hearing occupying 8 days. The judge has now decided that the claims of the "clamp patent," properly construed, are not anticipated by the well-known English lamp of Slater and Watson embodying a very similar mechanism, which was set up as a defense, but that a lamp constructed in 1876 by one Charles H. Hayes, an employé of Wallace and Sons of Ansonia, Connecticut, did in fact embrace a construction and mode of operation substantially the same as that claimed as new in the patent of Brush, and, therefore, furnishes a complete anticipation of such claims. The complainants contended that the lamp of Hayes was an abandoned experiment, inasmuch as but one of them was ever made. The evidence, however, showed that it was practically used in public. The judge says:—

> The case is that of the public, well-known, practical use in ordinary work, with as much success as was reasonable to expect at that stage in the development of the mechanism belonging to electric arc lighting, of the exact invention which was subsequently made by the patentee, and although only one clamp and one lamp were ever made, which were used together two and one-half months only, and the invention was then taken from the lamp, and was not afterwards used with carbon pencils, it was an anticipation of the patented device under the established rules upon the subject.

The bill for the metal-plated carbon patent was dismissed, with costs, upon the complainants' motion.

As we have already remarked in relation to this case, no fundamental principle of importance is involved in the decision. The clamp mechanism of Brush, although perhaps the cheapest and most convenient, is only one method among many of effecting the desired result of controlling the movement of the carbons, so that the competitors of the Brush company, in case the patent had been sustained, would probably have done nothing more than alter their mechanism at a comparatively small expense, and go on with their business.

But the result of the litigation must nevertheless have been severe disappointment to the complainants, as they appear to have confidently expected a decision in their favor, and in that event, would at least have been able to collect a large amount of royalty from their competitors on account of past infringement upon the patents, even though some other device not covered by the patent should hereafter be substituted by them for the ring-clutch. Inasmuch as the Hayes mechanism was never patented at all, this decision virtually makes the ring-clutch movement of the arc lamp public property. An appeal to the United States Supreme Court will doubtless be taken by the complainants, although in view of the circumstances of the case as developed in the testimony taken by the defense, there would seem to be but little reason for them to hope for a reversal of the decision of Judge Shipman. If the decision had turned upon the question whether or not the defendants' apparatus was an infringement of the patent, the prospect might have been very different, but it really amounts to a question of fact as to the public knowledge and use of the Hayes lamp, and upon this point it is not very likely that the Supreme Court can come to a different conclusion from the Circuit Court.

The claims of the Brush patents on electric light apparatus are many of them of such a broad and sweeping character, that if sustained they would have gone far to ensure to the Brush Electric Company a virtual monopoly of arc lighting, but the unexpected strength of the defense, and the able and thorough manner in which it has been developed, has now practically destroyed two of the patents and thus materially weakened the position of that company.

It now seems probable that the comparative future progress of the principal arc lighting companies will depend much more on the actual merits of the apparatus presented to the public than upon the results of litigation which may hereafter take place between them, a result at which the public at least, can have but little occasion to complain.

ELECTRICAL FALLACIES.

It is exceedingly strange that so-called intelligent people should continually be misled by the wildest statements regarding the remarkable results attained by different inventors, especially of novel electrical apparatus. There can be no law of nature more firmly established than that of the conservation of energy, which teaches us that in the transmission of power, or the translation of energy from one form to another, the net result *must* exhibit a certain loss, due to friction, absorption, radiation and other causes. Notwithstanding this apparently simple and easily understood fact, fabulous stories are circulated from time to time, which are originally started under corrupt influences. These are subsequently admitted into the columns of alleged scientific papers, where they acquire additional prominence from the supposed endorsement of experts. Since the introduction of the electric light, the generation of electricity by steam power has become a familiar process to the public, as well as to scientists and electricians. The inventor or promoter of nearly every new lamp or dynamo machine which is brought out, invariably asserts that less power is required to produce a given result, than was the case with previous inventions.

The evolution of the storage battery is making similar progress, and in this the margin between the electricity which goes in, and that which is subsequently taken out is the real test of efficiency; hence, whatever merit there may be in a new form of secondary battery will generally be found to be based upon its greater percentage of efficiency.

Generators which produce electricity in effective quantities at a merely nominal cost may generally be looked upon with suspicion, and should their results be out of all proportion to well established scientific formulæ, it is usually safe to assume that the true inwardness of the experimental exhibition has been carefully concealed.

The use of galvanic batteries for the production of light, and for the generation of motive power, has a peculiar fascination for many investigators, even at the present day, and after the use of steam and water power has been conclusively proven to be the most economical method of evolving electricity. As a matter of convenience such a process may be frequently advantageous, but generally speaking it cannot be otherwise than wasteful, cumbrous and inconvenient.

Various schemes are set on foot, from time to time, which have no other object than the fleecing of victims who are induced by misrepresentations to invest money in them. Scientists and experts are ridiculed for their skepticism, the growth of which has been fostered by the bursting of hundreds of bubbles, practically as visionary as perpetual motion. We regret to say that electricity has been the foundation of so many questionable enterprises, owing to the fact that to the masses it appears to be an unfathomable mystery, with hidden resources, which may be infinitely developed by ingenious inventors. Upon this basis of popular ignorance, manufacturers and venders of magnetic ointments, electric plasters and galvanic belts have laid the foundations of vast fortunes. Unfortunately a wider field has been opened up for cultivation by adventurers of this class, and the efforts of the press should be directed toward their suppression, rather than encouragement.

A STRIKE AMONG TELEPHONE SUBSCRIBERS.

The establishment of telephone exchanges has developed a class of strikes, which has not yet received due consideration at the hands of experts in social topics. Among the earliest problems which the promoters of telephone enterprises were called upon to solve, was that of the amount to be charged for service, and the particular manner in which the revenue should be collected. As exchanges were established, and the number of subscribers increased, the question became more and more complicated. No universal system was adopted for the reason that exchanges were generally under the management of independent local companies. One of the curious features of the business was the fact that the *pro rata* expenses increased with the addition of new subscribers. As might have been expected the rates were in many cases placed at so low a figure, that it was found impossible to continue the business at a profit, and consequently an increased price was compulsory. Whatever reason may be promulgated, any movement of this kind is decidedly unpalatable to subscribers, and to counteract it, they have occasionally resorted to the decisive argument of dispensing with the service. The efficacy of this plan is augmented by the banding together of tradesmen, who by depriving their customers of the convenience which a telephone connection gives them, renders *their* instruments comparatively useless. A recent movement at Stamford, Conn., is an example of this kind. Out of a total number of 225 subscribers about 50 were tradesmen in various lines of business. About 40 of the latter discontinued their instruments, and the telephone management proposed to substitute a system of messengers for the convenience of their customers, to enable them to communicate with their favorite butchers and bakers. It cannot be readily seen why such a plan, should be an improvement upon the custom in vogue before the advent of telephones, in which the driver of a grocery wagon was sent over his morning route to collect orders for goods to be delivered after his return to the store. Should the obdurate tradesmen persist in their refusal to accommodate their customers, we see no reason why the telephone companies holding their monopoly of intercommunication may not engage in a grand scheme for the establishment of co-operative markets in which all domestic supplies may be procured at reasonable prices. By combining a reliable messenger service with such a system, small orders could be filled within a reasonable time, and the general welfare promoted accordingly. The fear that this might develop into an odious monopoly would be groundless, for the reason that there would be ample business outside of telephone subscribers to maintain healthy competition. For the sake of securing paying subscribers, the profits on goods sold could be reduced to a minimum. Of course it will be argued that the telephone people are not familiar with the grocery business, but the same genius which has developed the exchange system as it exists to-day, might reasonably be expected to master the intricacies of a country store. It is well known that this class of trade is sub-divided beyond all reason, and that it could be consolidated, and conducted much more satisfactorily and economically under one management. A cash basis could also be established and enforced, which would be highly beneficial to the community.

This policy might be looked upon as a hardship from the tradesmens' point of view, but it is no greater than has heretofore been encountered by the skilled artisan who has been forced from his accustomed path of labor by the competition of machinery. The individual has been taught that his rights are subordinate to the general welfare, and in cases of this description it can be readily pointed out to the victims that they have brought their troubles upon their own heads.

THE UNCERTAINTY OF THE LAW.

When the law-abiding citizens of our great metropolis learned from their morning papers that the finest police officers in the world had actually arrested linemen for violating the provisions of the so-called "underground" act, they doubtless felt that the club was mightier than the climbers. No more fitting climax to this foolish agitation could have been devised, than the scene enacted when the culprits were brought before a justice for sentence. The text of the law was produced, when still another flaw was discovered in this gauzy statute. No penalty had been prescribed for its violation, in case it was discovered that it was possible for human ingenuity to violate it. As it was evident that the energies of the police department could be used to better advantage than in the arrest of laborers, and their escort to the station house merely to be discharged from custody, it has been decided that linemen in the ordinary routine of their duties, will be allowed the freedom of the city as heretofore. The authorities having discovered that they have no right at present to proceed against the erection of telegraph lines upon the supposition of what the law-makers thought they were going to say; private individuals believing that all overhead construction should stop, are striving to bring about that result.

An irate citizen of Brooklyn, in order to more effectually protest against the erection of a pole in front of his premises, jumped into the hole which had been dug, possibly with a view to pointing out a feasible underground route. He was quietly removed, and the work proceeded with. It was being done for the fire department under a contract with the New York and New Jersey Telephone company. In order to define the duties of the city officials under the new law, corporation counsel Taylor, of Brooklyn, has written a letter to the city works commissioner in which he says: "that he does not concur in the belief that he is required to literally construe section 1 of the law, which requires all the wires stretched after the passage of the bill to be placed underground. To give this extreme construction would make it impracticable to repair lines broken by accident or to re-erect poles thrown down from any cause. It would work an oppressive interference with vested interests. No such prohibition is imposed in set terms, and it is to be found only by implication in the first section, which seems to be declarative only of a policy as to future plants."

It now appears to be generally understood that the law cannot be immediately enforced, as was pointed out in our June issue. Meanwhile, however, existing companies should labor harmoniously together to provide some comprehensive plan for their mutual protection. While resting secure in the belief that existing plants cannot be removed without compensation, there can be little doubt that the present law will be so amended that it will be made effective, at least to the extent of prohibiting such promiscuous line construction as has heretofore prevailed. Whatever subterranean work is undertaken should be under the supervision of electrical, rather than political or newspaper engineers.

PUT THEM UNDERGROUND.

Now that the underground telegraph bill has become a law, and the lives of our citizens thereby protected from the dangers of the air, the attention of the authorities should be directed to the perils attending ordinary street travel. During the past year over 50 people were killed, and four times that number injured, in New York city by horse cars, and only a few days since a well-known actress was fatally injured by a runaway horse, which had been carelessly left unhitched by his driver. There is, apparently, but one remedy for this highly dangerous condition of our streets, and that is to put the horses underground. Experts in horseflesh may say that this is an unreasonable requirement, and impossible of execution; and such might have been the general supposition but for a fortunate accident which recently occurred in Newark, N. J., that fully demonstrates the entire feasibility of subterranean equine communication. After the termination of the severe rainstorm, on the night of July 12th, a hackman was leisurely returning with his team to the Market street station, in search of fresh victims, when the pavement suddenly gave way, and his two horses disappeared into the earth, followed by a miniature landslide of paving stones and sand, which not only effectually concealed them from view, but temporarily cut off all hopes of immediate rescue by their bewildered owner. It appears that the top of the main sewer had become weakened by the heavy rainfall, and had given way under the combined weight of the two horses. As soon as the necessary authority and assistance could be obtained the *debris* was cleared away, and ambitious explorers entered the sewer to ascertain the condition of the engulfed animals. They were found to be not only uninjured, but apparently perfectly satisfied with the new condition of affairs—evidently preferring the shady, cool and well-watered thoroughfare to which they had been so suddenly transferred, to the hot and tortuous cobblestones above ground. Instead of welcoming their would-be rescuers, they fled at their approach, and it was only by the introduction of numerous small boys at various man-holes, that they were finally intercepted and captured. The subterranean journey of half a mile which one of these horses performed voluntarily and without bodily injury, should be accepted as conclusive evidence that the question of working them underground is merely one of expenditure. Of course the perfecting of certain details would involve a considerable amount of experimenting, but hack owners and car companies have been granted certain valuable privileges by the authorities, and if the interests of the public require that they should be excluded from surface traffic, they must be removed, as would be the case with any other nuisance.

ARTICLES.

THE ELEMENTARY PRINCIPLES OF ELECTRICAL MEASUREMENT.

BY F. L. POPE.

(Continued from page 142.)

OHM'S LAW.

EACH one of the several electrical phenomena that have been described is susceptible of being measured with a high degree of accuracy by means of appropriate apparatus. The essential properties of an electric circuit may be said to be, first, the difference of potential included or contained within it; second, the resistance which it offers to the passage of the electric current; and third, the magnitude of the current traversing the circuit, as determined by the relation which the difference of potential bears to the resistance. When any two of these three properties have a known value the value of the third may readily be calculated.

This is done by means of the law of Ohm, upon which all electrical measurements are founded—a law the importance of which is only equaled by its simplicity. This law is expressed in most treatises upon the subject in a series of mathematical formulæ, and hence students are apt to be very much afraid of it; but there need really be no difficulty whatever in understanding it. Unless he does thoroughly understand it, it is certain that the student can make but little progress in the direction of a satisfactory knowledge of the phenomena of electricity and of the electric current.

Ohm's law may be briefly stated as follows:

1. The volume or strength of the *electric current* in any circuit is found by dividing the value of the electromotive force (as measured by the difference of potential existing in the circuit) by the value of its total resistance.

2. The *resistance* in any circuit is found by dividing the value of its electromotive force by the value of its current.

3. The *electromotive force* in any circuit is found by multiplying the value of the resistance contained in it by the value of the current traversing it.

4. The *quantity* of electricity produced in any circuit is found by multiplying the value of the current by the time during which such current flows.

The mathematical formulæ so often employed in electrical works are nothing more than an abbreviated way of writing down the same thing, thus:

Let Q denote the total quantity of electricity generated in any circuit.

Let E denote the electromotive force in the circuit.

Let R denote its resistance.

Let C denote the current flowing in the circuit.

Let T denote the time during which the current flows.

We may then write down the above four rules of Ohm's law thus:

$$(1)\ C=\frac{E}{R};\ (2)\ R=\frac{E}{C};\ (3)\ E=RC;\ (4)\ Q=CT.$$

For the benefit of those not familiar with mathematical notation, it should be explained that when two letters standing in the place of numerical quantities are placed one above the other in the form of a common fraction, it is signified that the quantity above the line is to be divided by the quantity below the line.

Thus $\frac{E}{R}$ signifies the same as E ÷ R or E divided by R.

The sign = denotes equality, or that the quantities on the right hand of the sign are equal to those on the left hand.

When two or more letters standing for numerical quantities are written together, one after the other, it is signified that they are to be multiplied together. Thus, in the above case, the expression E = RC means that E is equal to the product of R multiplied by C; or, in other words, that the electromotive force (E) is equal to the resistance (R) multiplied by the strength of current (C), which is exactly what was stated above in the third section of Ohm's law, only in the former case it required 26 words to explain it, while by the latter method we express precisely the same thing by means of 4 letters and 1 arbitrary sign. This explanation may, perhaps, serve to give the student some idea of the reasons why persons who understand the notation prefer to use it, as a matter of convenience, when circumstances permit, instead of entering into a labored explanation and elaboration in every case.

UNITS OF ELECTRICAL MEASUREMENT.

In order to measure tangible quantities of any kind we must first provide ourselves with suitable known standards or units of measurement, wherewith the unknown quantities with which we have to deal may be compared. Thus, in measures of length, we have, for example, the inch, in measures of time, the second, and in measures of mass or weight, the pound.

The first well-defined and accurate unit of electrical measurement proposed which met with anything like general acceptance in practical work, was the resistance unit of Dr. Werner Siemens, of Berlin, Germany, which he constructed in 1860.

The Siemens unit is based on the international or metric system of weights and measures, and is defined as being equal to the resistance of a column of chemically pure mercury, 1 metre[1] in length and 1 square millimetre[2] in sectional area, maintained at a temperature of freezing (0° Centigrade or 32° Fahrenheit). No definite standards of electromotive force or of quantity were authoritatively established in connection with the Siemens resistance unit. The ordinary Daniell cell furnishes a unit of potential or electromotive force of sufficient uniformity and constancy for ordinary purposes, and one which has been very generally used in this way by practical electricians.

A system of related electrical units, based also on the metric system of measures, was established by committees appointed in 1861 and subsequently, by the British Association for the Advancement of Science, which are now usually known as the B. A. units. They are as follows:

The *Volt* is the unit of potential. It does not differ greatly from the potential normally existing between the poles of a single sulphate of copper cell (being about 95 per cent. of it), and for approximate calculations may be considered equivalent to it.

In other words, a Daniell cell is a little more than a volt, the determinations of its value by different experimentalists being as follows:

Werner Siemens	1.106 volts
Latimer Clark	1.079 "
Sir William Thomson	1.13 "
F. Kolrausch	1.138 "

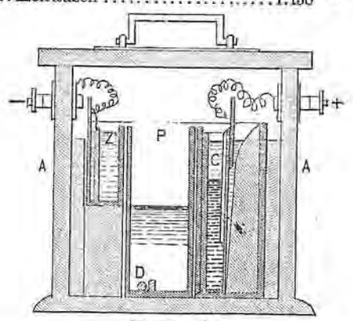


FIGURE 4.

1. 1 Metre = 39.37 inches, or for convenience of memorizing, may be taken approximately as 3 feet, 3 inches and one-third.

2. 1 Millimetre = one thousandth of a metre.

At the general post-office in London, a standard cell has been adopted for the measurement of potential or electromotive force, consisting of a Daniell element, arranged as shown in figure 4, in which A A is a containing vessel divided into 3 compartments. The middle compartment is about half filled with a saturated solution of sulphate of zinc. A plate of zinc Z is immersed in water in the left compartment. In the right compartment is a porous cell, filled with crystals of pure sulphate of copper, in which the copper plate, C, is immersed. A small cylinder of zinc, D, is placed at the bottom of the compartment, P, of the vessel, as shown. In the position of the parts shown in the figure, the cell is inoperative. To set it in action the cell containing the copper C, together with the zinc Z is placed in the middle compartment. When the experiment has been concluded, the cell C is restored to its original position. The rod D receives the deposit of copper from the sulphate which has percolated through the porous cell P; the solution in P is thus always kept clear.

The *Ohm* is the unit of resistance. As established by the British Association committee, it may be defined as equal to the resistance of a column of mercury of 1 square millimetre section and 1.0483 metres in length, or of a round wire of pure copper $\frac{1}{10^{0}}$ of an inch in diameter and 408 feet 4 inches in length, at a temperature of 60° Fahrenheit. This is the size generally known as No. 16 wire Birmingham gauge. Roughly, it is nearly equivalent to the resistance of 330 feet of ordinary No. 8 galvanized iron wire, such as that used in the construction of telegraph lines. The Ohm and the Siemens resistance unit, before referred to, do not differ greatly from each other. According to the most trustworthy determination, 1 B. A. ohm is equal to 1.0486 Siemens units.

At an international congress of electricians, assembled in Paris in 1881, which was attended by representatives from different countries, a uniform system of electrical units was established which have since been adopted in practical work throughout the world. It was determined by the congress that all electrical units should be based on three fundamental units, the *centimetre*, *gramme* and *second*. Of the units already established by the British Association, the *ohm* and the *volt* are preserved, and their values are established as follows: The legal ohm is represented by the resistance of a column of mercury of 1 square millimetre section at the temperature of melting ice or zero Centigrade. After comparing the results of numerous experimenters the congress decided that the length of this column should be 1.06 metres, being about 1 per cent. greater than that of the original British Association ohm. It was also resolved that the volt should be the difference of potential or electromotive force capable of maintaining a current of 1 ampère (hereafter to be explained) in a conductor having a resistance of 1 legal ohm. The units having these amended values are known as *Congress units*, in order to distinguish them from the British Association units.

(*To be continued.*)

APROPOS OF LIGHTNING RODS.

C. C. HASKINS.

FROM the days of the sage Franklin, whose wonderful discoveries in the domain of nature's electrical generators so startled the world, it would seem as if scientific research in that particular field had been almost entirely given over, and the fruitful soil had been abandoned to electrical pagans and charlatans. True, within a comparatively short time some encroachments have been made upon the camp of these ignorant infidels, and the redemption of the holy land is becoming possible, through the earnest endeavors of a few zealous defenders of the faith. The insulated, shackle-jointed rods which erstwhile "ornamented" our churches and public buildings, often terminating a foot or more above the earth, or barely stuck into it, instead of penetrating to a watery depth, have largely disappeared; but their place has been usurped by equally useless appliances, while in nearly every instance a so-called protected building, unless rodded under the supervision of some known electrician, is far worse off then it would be if the rod had been erected in the next county.

With the extension of electrical knowledge, coeval with the growing frauds of ignorant pretenders, it is to be hoped that in the near future these dangerous attachments under the name of lightning rods may be relegated to oblivion, and proper substitutes, of real value for purposes of protection, reign in their stead.

The scientists of the old world are stirring in the matter. England has a code of rules for the installation of rods, emanating from the "Lightning-rod Conference of London." The French academy has fulminated its laws. The Berlin and the Belgium academies have each issued their mandates on the same subject; but these are so at variance with each other that they seem to furnish evidence of very positive uncertainty as to the best method for adoption, and demand further investigation and research. Our own electricians, at the coming exposition of the Franklin Institute, will, it is to be hoped, thoroughly sift the matter to the bottom, and finally settle the question, not only of how to pose a lightning rod plant, but make a serious and determined move towards a legal enactment which will put a final quietus on the lightning rod fiend, whose name is legion, and whose mission on earth seems to be to compel payment from the ignorant for endangering his life and property.

Nature's electricity—lightning—is so full of caprice, yet endowed with so much power, and so difficult of control, that experimental investigation is not easy of attainment. Franklin's experiments, in one of which, to use his own words, he tried to kill a pigeon "and came near killing a goose," was a warning which has probably saved the life of many another "goose" since his day. Playing carelessly with nature's huge condensers is fraught with great danger, and it is probably largely owing to this that progress in the line of lightning rod perfection has been comparatively slow.

The different circumstances too, under which these immense charges are aggregated and dissipated, have probably done much to mystify the experimenters and the results of their observations, and thus add to the general confusion, as instance the following table of areas protected, as claimed at different dates, and by various investigators since Franklin. Taking the first as a standard of comparison, the succeeding claims bear about the proportions given as fractions of the first; the rod being similar and having the same perpendicular height, in all cases.

AREAS OF PROTECTION CLAIMED.

1st.	A circular space having a radius equal to twice the height of the rod	or 1
2d.	A space of conical shape, of which the rod is the axis, the radius of the circular base being twice the height.	$\frac{1}{2}$
3d.	A space similar in shape to the last, having a radius equal to the height of the rod multiplied by 1.75	$\frac{1}{4}$
4th.	A cylinder with a radius equal to the height of the rod	$\frac{1}{4}$
5th.	A cone, the radius of which is equal to the height of the rod	$\frac{1}{12}$
6th.	A cylinder, the radius of which is one half the height of the rod	$\frac{1}{16}$
7th.	A bell shaped cone, *i. e.*, a cone having a concave base	$\frac{1}{32}$
8th.	A cone, the radius of the base of which is one half its perpendicular	$\frac{1}{48}$
9th	"Our experience is that no appreciable extent is protected by a single rod conductor, in the presence of other influences."—*Report of the Lightning Rod Conference*	

Number seven of the above table is accredited to W. H. Preece, the eminent English electrician.

If the ninth estimate of protected space be accepted as correct, truly the case is one calling for more light, further investigation and immediate action.

It would seem that the nature of atmospheric electricity is sufficiently known to enable the provision of fair, if not perfect prevention for the disastrous effects of these dangerous disruptive discharges. There are undoubtedly complicated cases, like oil tanks, from whence a highly inflammable gas constantly arises into the cloud region, and these may require specially arranged adaptations; but ordinary buildings, steeples, chimneys, masts, etc., these can be provided for. Electrical discharges of this nature may occur in either of three directions: perpendicularly, horizontally, or diagonally; and from cloud to earth, earth to cloud, or from one cloud to another. A cloud may hover so near the earth as to induce a strain, under certain circumstances, both laterally and perpendicularly at the same time, or at one or more angles between these two. In doing this it forms one or more condensers, having a non-electric of air between the plates. A discharge of one of these pairs of plates would disturb the equilibrium of the other. Nature's condensers are replete with this kind of excentricities. Cases are on record where churches and other buildings of considerable altitude, protected by rods—or supposed to be—have been struck below the roof, and others where the ground has been found to contain fulgurites in close proximity to these, showing unmistaken evidence of disruptive discharges, where protection was considered assured. An instance is mentioned of a church unprotected by a rod of any kind, the steeple of which terminated with a ball of wood, through which projected an iron rod upward, as an ornament. This rod was struck during a thunder-shower of that class when water is said to fall in sheets. The charge tore down the dry timbers of the steeple, along the dry rafters—shivering several—to the eaves, passed out through the brick to the conductor pipe, down which it made its way to the ground, making a round hole two inches in diameter through an inch wooden trough. A second flash followed, which came upward—the return stroke—at the root of a tree on the opposite side of the street. This stroke tore much of the bark away at the root of the tree, an elm, not twenty feet high, and was dissipated in the air from the ends of the branches, bursting the little twigs into shreds. The buildings near by, drenched with the flood of falling water would seem to have been a far better conductor, and these were of greater altitude than the tree, and the church was also there, but this of several trees, was selected, many of them being but a few feet from the building struck. I only mention one or two samples as illustrations—the books are replete with similar freaks.

It is undoubtedly this class of electrical vagaries which have shaken the faith of observers, and thus reduced the area of the lightning-rod's protective power, until it has come to be almost or quite nothing, under certain circumstances.

The remedy, I believe, will be found, in so placing the rods as to entrap these errant currents, and conduct them silently away, up or down, or across the space to be protected.

This seems to me to be logical, and based on the same principle which actuates us all in our every-day work. We know that in making a ground wire connection, for instance, great care is exercised in selecting the point for attachment. We all prefer a water to a gas pipe, because of its better capacity. We make the attachment, if a gas pipe connection, between the meter and the ground if possible, and some of us, who are styled "old fogy" or called too finical, even solder the junction. Why do we do this? To do away with resistance, and make the path for the current as perfect and easy as possible. Why not do the same for lightning?

The system of Melsens, a member of the Belgium academy, carries out this idea quite perfectly. Eschewing one or two huge rods, he covers the building to be protected, with a species of wire cage or netting, running in every direction. At short intervals, short radiating points project from these wires in all directions. Not on the roofs or towers alone, but up and down, and across the building in many places, a hundred perhaps, and the whole connected at every possible place to gas and water and sewer pipes—to everything which can aid in making a ground connection. These are particularly plentiful at all corners and angles, those points where the highest potential is to be found.

As to the expense of this method, it compares very favorably with the older one. The diminution in the size of the wire enables the inventor to cover a far greater area with the same expense.

In the comparative table given by Decharme, the average cost price per meter protected by the former system was about 89 cents, while the cost of the latter averages about 14 cents for the same area protection.

Continuous wire should be used, and perfect connections made at all crossings of wires. High tension currents passing through resistances do not discharge with a single spark, but scatter as we see them in forked lightning. A Holtz machine in good working condition illustrates this when long discharges are made.

Faraday's experiments with small animals and birds in wire cages through which he discharged Leyden jar currents, is adduced as evidence in favor of the cage system of rods. Currents which would have instantly killed these, had they received but a fraction of the charge, did not cause the least inquietude.

I am aware that the Melsens system has met with determined opposition, especially among the English electricians, yet I believe that their objections can be successfully controverted, and that in some form the cage rod will eventually succeed to general favor.

THE MERCURIAL GALVANOMETER OF M. G. LIPPMANN.*

A PAPER was recently presented to the Academy of Sciences, by M. Lippmann, on a new galvanometer, based upon the action of a magnetic field upon a movable current, and on the use of mercury to demonstrate the latter. The following article gives some supplementary details of this interesting apparatus, which is represented in figs. 1 and 2.

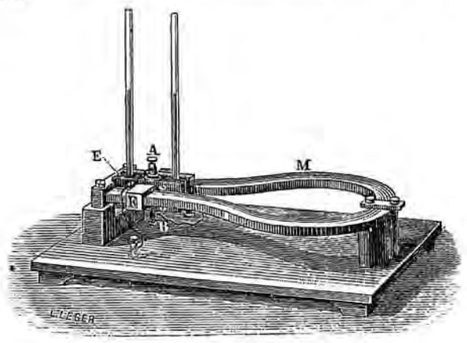


FIG. 1.

The two polar extremities of a powerful permanent magnet, M, are fitted into two pieces of soft iron, F. The exact form of these pieces is represented in fig. 2. Their internal surfaces (well insulated) are approximated to each other to a distance which does not exceed $\frac{1}{10}$th millimetre. This interpolar space which is very thin, forms the middle portion of a manometer, open in the shape of a U, the two branches of which are placed vertically. The current to be measured is introduced at the two extremities, A and B,

* Translated from *La Lumiere Electrique* for *The Telegraphic Journal and Electrical Review.*

communicating with two platinum plates which touch the surface of the mercury enclosed between the polar pieces.

The mercurial chamber is hermetically adjusted with the two limbs of the manometer, and this essential portion of the galvanometer is enclosed between two plates of ebonite, which protect the whole.

If we cause a current to pass through the stratum of mercury placed between the poles of the magnet, M, the mercury rises in one limb of the manometer and falls in the other, the difference of levels being proportional to the intensity of the current. The theory of this new galvanometer is very simple.

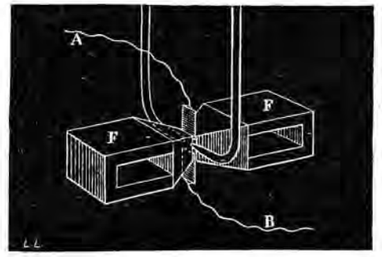


FIG. 2.

Suppose that we cause a current having the intensity I to pass through a parallelopiped of mercury placed in a magnetic field. Suppose that this layer of mercury enclosed between the poles communicates with the two manometer tubes by very small apertures which permit us to consider the liquid conductor as having a form strictly parallelopipedal. In these conditions the conductor will have a tendency to become displaced perpendicularly to the lines of the forces in a determined direction. But as the conductor is liquid, there will result a displacement of the mercury, which will rise in one of the tubes until the pressure resulting from the differences of the levels counterbalances the electro-magnetic pressure exerted in the opposite direction.

But as, in spite of the displacement of the mercury, there is no change in the form of the conductor, nor in its position in the magnetic field, the indications will be strictly proportional to I.

But to render the mercurial galvanometer practical it must be made sufficiently sensitive, and it is in the realization of the conditions of the maximum sensitiveness that we see the essential part—the characteristic of the novelty of M. Lippmann's galvanometer. To render this instrument as sensitive as possible, it is necessary to find under what conditions, as to construction, we may obtain the maximum of hydrostatic pressure, p, for a given current, I. Let A B C D (fig. 3), be the parallelopiped of mercury, the current traverses it in the direction of the arrow, and the lines of force are perpendicular to the surface, A B C D. Let l be the height of the parallelopiped and e its thickness in the direction of the lines of force. The force which tends to move the conductor perpendicularly to the lines of force is proportional to the intensity of the current, I, to the intensity of the magnetic field, H, and to the length of the current, l. It is therefore proportional to I H l.

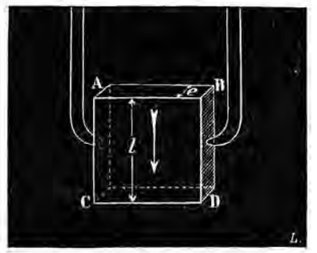


FIG. 3.

This force is exerted upon the surface of the parallelogram of which the height is l and the breadth e, the superficies consequently being $l\,e$. To obtain the pressure, p, per unit of surface, we must divide

I H l by $l\,e$. The pressure, p, therefore $= \frac{\text{I H } l}{l\,e} = \frac{\text{I H}}{e}$.

This equation indicates at once the conditions to be observed to obtain the maximum pressure: 1, we must have a magnetic field as intense as possible, which is effected by using a powerful magnet and by approximating the poles to each other as closely as possible, and 2, e ought to be taken as small as possible, which is also effected by the close approximation of the poles. This coincidence of the two conditions renders it possible to realize a galvanometer which is sufficiently sensitive for practical purposes.

It is evident that this galvanometer is aperiodic. The apparatus presented to the Academy of Sciences gave a difference in the level of the mercury equal to 63 millimetres per ampère. The figures 4 and 5 represent an electro-dynamometer based upon the same principle. The magnetic field is formed by the same current, which before passing through the mercury traverses a solenoid, B (fig. 4),

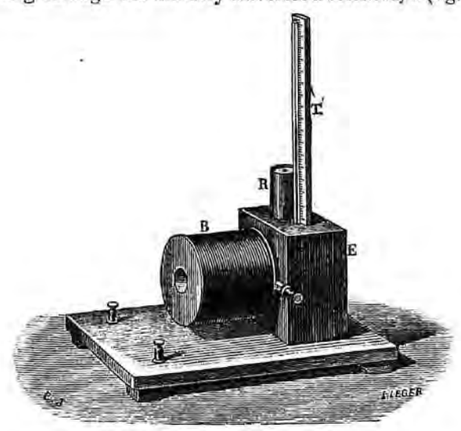


FIG. 4.

in the centre of which is placed the stratum of mercury, L L. For one branch of the manometer there is substituted a reservoir, R, because in the electro-dynamometer the pressure is exerted only in one direction.

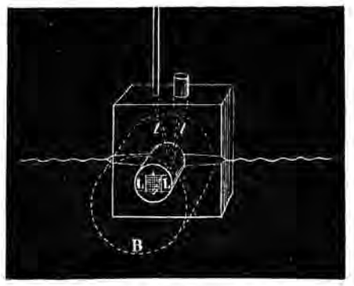


FIG. 5.

The plate of mercury is placed upon a core of ebonite which enters up to the centre of the solenoid, so the current is introduced by two plates of platinum, communicating with the two opposite sides of the layer of mercury.

Two conductors, shown by dotted lines and pierced into the mass of ebonite, place the layer of mercury in connection with the tube on the one side and with the reservoir on the other.

THE ENERGY OF A CURRENT.

PROF. H. S. CARHART.

The well-known formula for the rate at which a current does work is $W = C\,E = C^2\,R$, in which the units are so chosen that the constant of the equation becomes unity. The last term of the formula expresses the time rate of doing work only when the whole work of the current consists in heating the conductor, whose resistance is R. For the present let the work of the current be restricted to its heat producing power, excluding all mechanical work, which is reserved for discussion in the latter part of this paper. The interpretation of this simple formula under different conditions is very instructive.

First, suppose the resistance of the circuit to remain constant while the strength of current varies. Then, since in this case the current and the electromotive force are strictly proportional to each other, it follows that the energy of the current per second varies either as the square of the electromotive force or as the square of the current. If the electromotive force be doubled, for instance, the current will also be doubled, and the product of the two, or the energy of the current, is quadrupled. If we apply this to a battery we get a concrete reason for the proportionality of the energy to the square of the current. Keeping the total resistance constant, to double the current it is necessary to double the number of cells employed. If the energy of the current per second is measured by the weight of zinc consumed in unit time, we shall then have twice as much zinc consumed in each cell with the double current as before, while the number of cells is also doubled. Hence the quantity of zinc consumed in the entire battery to produce the double current is quadrupled. The increase of current implies increase of chemical action, whether it be of electrolysis in a decomposing cell, or of chemical combination in the cell generating the current; and the increase of chemical action is exactly proportional to the increase of the current. The double current, therefore, with constant resistance represents quadruple energy, because the quantity of zinc consumed in unit time is quadrupled.

Second, suppose the electromotive force to be kept constant and the current to be doubled by reducing the resistance to one half. Then the current will be doubled as before, and the energy of the current will also be doubled; or in this case, the heat energy in the entire circuit varies directly as the first power of the current. The zinc consumed in each cell is doubled; but since the number of cells remains the same, the total weight of zinc consumed in unit time is merely doubled. Therefore, doubling the current by reducing the resistance does not quadruple the energy of the current, but doubles it. It follows that the total heat energy is proportional to the square of the current only when the resistance is kept constant, and is proportional to the current directly when the electromotive force is constant.

Third, we may increase the current both by increasing electromotive force and decreasing resistance. The energy will be proportional then neither to the first power of the current nor to the second, but will be intermediate between the two. If the electromotive be doubled and the resistance halved, the current will be increased fourfold. These conditions imply doubling the number of cells of battery while the weight of zinc consumed in each is quadrupled. The total weight of zinc consumed is, therefore, increased eight times, and the energy of the current is increased in the same ratio.

Fourth, we may suppose the current to remain constant, while the electromotive force increases. This may be accomplished in two ways. If the resistance and electromotive force increase proportionally the current is unchanged. This case offers no peculiarities, the energy of the constant current increasing with the electromotive force. The other method of keeping the current constant with increasing electromotive force, while the resistance remains constant, will be understood if we consider what happens when the current is giving up its energy in the form of mechanical work. In the preceding cases we have supposed the current simply flowing through a closed circuit, not embracing any apparatus for the production of motion. If the current simply energizes an electro-magnet and holds a weight, without repeating the operation, then it remains constant after the brief interval required to magnetize the cores, and is not doing any mechanical work, but is giving up energy continuously in the form of heat at the same rate as if no magnet were included in the circuit. But if motion ensues, such as the striking of an electric bell or the functioning of any other apparatus in which the attractive or repulsive force of the magnet causes any mass of matter to move continuously or reciprocatingly, then energy is given up in the form of external work. In such cases a galvanometer inserted in the circuit shows a diminution of the current as soon as the motor (for such it is) begins to work. This reduction of the current is due, not to an increase of total electrical resistance offered by the action of the motor, as Mr. J. T. Sprague asserts in the May issue of this journal (page 103), but to the counter-electromotive force set up by the reaction on the current of the moving parts of the apparatus. The motor becomes a dynamo electric machine, tending to produce a current opposed to that of the source of electric supply. It is important to apprehend clearly that the resistance offered by the machine for converting electric energy into useful mechanical work is not in the nature of electrical resistance at all, but of counter electromotive force. An increase of electromotive force in the electric generator is, therefore, necessary when the motor begins to work, if the current is to be kept constant. The total work per second furnished at the generator is represented as before by the product of the electromotive force and the current flowing through the conductor. But this energy is divided into two parts, as represented by the equation

$$E\,C = C^2\,R + E^1\,C,$$

in which E^1 is the counter electromotive force due to the motor and R is the entire resistance in circuit, including that of the generator and of the motor. The first term in the second member of the equation expresses the rate at which heat is given out in the circuit, while the second term represents the rate at which the motor converts electrical energy into mechanical work. From this equation,

$$C = \frac{E - E^1}{R},$$

which shows that the current will remain constant under the condition of a constant resistance, as we have supposed, if E and E^1 vary in such manner that their difference is constant. The total electrical energy of the motor, however, being E C, will vary directly as the electromotive force of the supply of electrical energy. If this is a battery, the electromotive force is proportional to the number of cells; but the zinc consumed in each cell per second is constant, under the hypothesis of a constant current; so that the entire weight of zinc consumed in the whole battery is also proportional to the electromotive force. Several propositions admit of statement as universally true:

1. The total rate at which electrical energy is given out in the circuit is the product of the current and the electromotive force of the generator.

2. The rate at which work is done in the motor, measured electrically, is the product of the counter electromotive force of the motor and the current.

3. The rate at which the energy of the current is converted into heat in the circuit, is the product of the resistance and the square of the current. If no mechanical work is done this expresses also the total rate at which electrical energy is given out in the circuit; and, generally, for any portion of a circuit of resistance R, the heat generated in that portion of the circuit is expressed by $C^2\,R$ for unit time.

THE CONSTRUCTION OF LINES FOR ELECTRIC CIRCUITS.

BY THOMAS D. LOCKWOOD.

It is usual in dissertations upon line construction to describe first the supports, then the insulating medium, and finally to gently introduce, as it were by slow and easy gradations the conducting wire.

I have deliberately chosen to disregard this procedure, believing that the actual conductor itself is the most important interstation element in an electric circuit, and that the supports and insulators are but incidental adjuncts thereto.

Nearly every one interested in the practical applications of electricity knows in this "so-called nineteenth century" that all substances are really electric conductors, and that the distinction between conductors and insulators is but a difference in degree.

But the difference in degree is greatly in favor of the metals, and very rarely has anyone had the hardihood to propose any other conductor as a substitute for them; with of course the universal and noteworthy exception of the earth return. I do not forget in this connection several trials made, and patents taken out, for a method of telegraphing across extensive bodies of water, by stretching parallel insulated wires along the margin of both sides of the water space, terminating by submerged plates, whereby signals made on one of the wires were reproduced on the other; but these are to be regarded merely as curious and unproductive experiments.

The metals or their alloys, are accordingly universally employed as line conductors; not merely, however, on account of their superior conductivity, but also by reason of obvious mechanical considerations. They are for example reasonable in cost; they are as a rule solid in substance; they are readily susceptible to any necessary change of form; besides being ductile and tenacious, and, therefore, easily joined together or spliced.

Metals or alloys used for the purpose of line conductors must necessarily be in the form of wire.

Metals vary greatly in conductivity, as also in price, in strength and in ductility; and consequently vary also in their suitability for such purposes.

The specific conductivity of some of the best known metals is given in the table below:

COMPARATIVE CONDUCTIVITY OF METALS

Silver being called	100	Palladium is	12.5
Copper is	80	Platinum "	10.5
Gold "	55	Lead "	7.8
Aluminum " about	50	Antimony "	4.3
Zinc "	27	Mercury "	1.6
Tin "	17	Bismuth "	1.2
Iron "	14		

Thus we may see that if conductivity were the only consideration, silver being the best conductor would be used.

Obviously, expense precludes its employment; and it is equally evident that the same objection applies also to gold, aluminum, palladium, platinum and bismuth. Mercury is clearly out of the race, being a fluid; zinc besides being expensive is not tenacious, and has no great amount of ductility, while tin, lead and antimony are also unsuitable.

Copper and iron alone remain among the metals, and these together with steel, and the alloys of phosphor, and silicious bronze, are the only materials which have exhibited any adaptability for electric line wires.

Aluminum wire, and aluminum bronze wire is sometimes a very good material for short temporary lines such as military telegraphs, being very light; and a compound wire consisting of copper electro-deposited upon a steel core is to some extent used, and is much vaunted by its friends. For ordinary telegraphy, it is difficult to find anything better than a good iron wire.

Electric light current conductors should invariably be made of copper; short telephone lines may be constructed generally of iron; and for lines built and maintained by amateurs it is difficult to see why phosphor or silicious bronze is not a good material. Copper when hard drawn promises well as a long line telephone conductor, but has hardly been used sufficiently as yet, to warrant a judgment upon its merits.

In England what I am disposed to regard as a most salutary method in defining the sizes of line wire has been substituted for the use of the gauge which has been discarded, because of the delightful halo of uncertainty attendant upon its use. The two magnitudes of weight and diameter are now stated, all iron wires being known by their weight, and all copper wires by their diameter in mils or thousandths of an inch.

IRON WIRE.

For general use iron wire will always hold the first place. It is not costly, it is readily obtainable; its specific conductivity although not very high is still not particularly low, and it answers very well for telegraph lines where the ordinary Morse system is employed; and also for telephone lines which are not over 50 miles long.

RESISTANCE OF IRON WIRES.

The most common size used in the United States is No. 9, B. W. G. No. 8 is also much used; while Nos. 6 and 4 are better suited for long circuits, and for such lines are being rapidly substituted by the telegraph companies for the smaller gauges.

Nos. 11 and 12 should not be used for lines longer than 20 miles.

						Ohms.
Resistance of No.	4	Gal.	Iron	Wire,	per mile, averages	5.5
"	" 6	"	"	"	"	8.5
"	" 8	"	"	"	"	13.
"	" 9	"	"	"	"	16.1
"	" 11	"	"	"	"	24.42
"	" 12	"	"	"	"	29.60

The resistance of a line wire is directly in proportion to its length, and inversely in proportion to its weight, or cross section. Electrically, there are great advantages to be gained by the use of a large iron wire; much less battery is required; instruments of less delicacy may be used, and there is much less leakage, so that it is always well to use the largest attainable wire.

On the other hand the difficulties are, that stronger supports are required; the first cost is greater, and the wire is much more difficult to handle and erect.

WEIGHT OF COMMON SIZES OF IRON WIRE.

No.	4	iron wire	weight in lbs.	to mile	887.
"	6	"	"	"	570.
"	8	"	"	"	385.
"	9	"	"	"	324.
"	11	"	"	"	200.
"	12	"	"	"	165.

These weights differ with the gauges of different manufacturers.

Both mechanical and electrical tests are used by manufacturers and large consumers of wires, but as these are fully described in all text-books on telegraphy, it is only necessary to refer to them here. Iron wire may be tested for ductility by twisting short pieces between two vises; by bending it to a right angle with itself a number of times; and by winding it round itself a number of times.

It is tested for tensile strength by applying weight, or by applying a constantly increasing strain. Good wire should be capable of elongating 15 per cent without breaking. It is not usual to make any electrical tests for ordinary line wire, except for resistance; and the usual practice when ordering iron wire, is to stipulate that it must not exceed a certain resistance per mile. Iron wire should

always be galvanized; and in very smoky localities should, if possible, be painted also. To insure a good line, no inferior quality should be used; the grade called by the manufacturers "extra B.B." ought always to be employed, and the fewer the manufacturers' splices, the better the wire.

STEEL WIRE.

Steel wire has only acquired importance as a line conductor since 1880, when it was extensively introduced by some of the telephone companies. The virtues claimed for it, are "lightness combined with strength;" and the fact that it is much easier to obtain permission to fasten a light wire to a roof. It is, however, doubtful whether any advantage can compensate for the increased line resistance introduced by the use of a small wire. So long as telephonic communication was restricted to short lines no great harm was done by the use of small steel wires; but at the present time long line telephony is increasing, and although an exchange line itself may be short, it may be at any time connected by a long trunk line with a distant city, and its high resistance thus impairs the efficiency of the whole. The use of steel conductors, when small, is, therefore, by the present writer deprecated, except for long spans where strength combined with excessive lightness is absolutely necessary.

COPPER COATED STEEL, OR COMPOUND WIRE.

This, as already indicated, is a wire with a central core of steel, upon which is deposited by electrolysis a heavy coating of copper. It is at present used almost exclusively by the Postal Telegraph and Cable Co., and has great strength combined with high conductivity. It is not suitable, and in fact is not needed for general use, inasmuch as it is difficult to handle and to string. Owing to its compound nature it requires, moreover, a special form of joint, and time alone will approve or condemn the use of this wire. There would seem to be considerable courage required to make an extended use of any compound conductor, in view of the possibility of galvanic action between the two metals at exposed points.

PHOSPHOR AND SILICIOUS BRONZE.

These materials are sometimes used for telephone lines, more frequently, however, in Europe than in the United States. They are well adapted for short lines, particularly when heavy wires are objectionable to property owners. Their resistance, weight for weight, is less than that of iron, but greater than that of copper, as may be seen from the following list which is taken from Munro and Jamison's pocket book of electrical rules.

RELATIVE RESISTANCES OF MATERIALS FOR WIRES OF EQUAL DIAMETER.

Copper	being taken as	1.
Aluminum is	"	1.9
Silicious Bronze	"	1.08 to 3.
Phosphor Bronze	"	4.
Iron	"	7.

Thus, both phosphor and silicious bronze compare favorably with iron in the matter of resistance, silicious bronze being, however, much the best of the two. The sizes of these wires used for telephone lines have so far been usually Nos. 18 and 20 B.W.G., but these sizes are too small, and much more satisfactory results might be expected from the use of No. 16. The gravest defect of either material is the extreme resiliency which it possesses. If a break occur or if a lineman loses the end of a length, it is apt to roll up for a long way back. It also kinks very easily. Nevertheless these materials have certain advantages. Being light in proportion to iron wires of equal resistance, they are easily handled and are well adapted for short isolated, private or amateur lines, and also for lines in telephone exchanges when no through connection by trunk lines with other towns is expected.

This lightness is a great advantage in inexperienced hands, besides facilitating erection, and permitting a diminution in the number of supports.

COPPER LINE WIRE.

The latest innovation in line conductors, is, however, the hard drawn copper wire. We would not be understood to say that it is only of late that copper has been proposed for this purpose. The high conductivity of copper has always kept it more or less before the public, but until very lately it has not been much used, as its tensile strength is inferior to that of iron, while its intrinsic value is much greater, thus rendering it liable to be cut down and stolen; it is also very susceptible to changes in temperature. Within the last few years, however, there has arisen a demand for a good conductor of small size for use in electric lighting, and copper seems to be the only material at all adapted for this purpose. It has also been demonstrated by experiment that long line telephony is materially improved, if the resistance of the line conductor is reduced. An attempt was made to effect this reduction by utilizing a large iron wire, but it was found that the surface of the conductor was so greatly increased, that the line became very susceptible to inductive disturbances. The perfect line conductor, especially for telephonic purposes, is one which with a high degree of conductivity has a very small size and consequently a very small surface; so that the electrostatic capacity shall be low. Hard drawn copper seems to fulfil most nearly these requirements, and is at the present time being extensively adopted by many telephonic constructors. The important position which copper has assumed at this juncture, is due to several good reasons. Improved processes of manufacture have produced a copper wire, which is much harder and stronger than it has heretofore been possible to make; copper is also at the present time comparatively low in price. These conditions have occurred when a good and strong conductor became necessary; and manufacturers recognizing the demand have tried their best to meet it.

To Thomas B. Doolittle, of Bridgeport, is due the credit of first introducing hard copper as a telephone line wire. Its continued use is, however, still largely a matter of experiment, since the durability of lines already erected is still undetermined. The exact amount of contraction after expansion by heat has been sustained, is still an unknown quantity, and it is still doubtful as to whether or not the normal length is resumed when the normal temperature is again reached, although laboratory experiments tend to the conclusion that the wire contracts, when cooled, approximately to its normal length. So far as the working of such a telephone line is concerned, it is all that could be desired. Lines are at present already constructed between New York and Boston, 240 miles; Pittsburg and Wheeling, 90 miles; and between different points in Michigan. The strength of a wire or strand of hard copper is somewhat over 1½ pounds, per pound weight per mile. That is, a strand or wire of copper weighing 200 pounds per mile would bear over 300 pounds and stretch from 12 to 15 per cent. without breaking. Actual experiment has proved that a wire weighing 212 lbs. per mile, required a breaking strain of 560 lbs.; while a second wire weighing 106 lbs. per mile required a breaking strain of 280 lbs. The conductivity of copper used for electric conductors should not be less than 90 per cent. of that of pure copper. It is not advisable to put up large quantities of copper line wire until its durability has been thoroughly tested. It has been found that both brass and copper wires have become brittle after hanging *without any electricity having been passed through them*; a familiar instance being wire or strands used for hanging pictures.[1]

While, therefore, there is every reason for hopefulness concerning the adaptability of hard copper for electric lines, caution is at present suggested as to its extended use, especially as the testing of small samples and short lengths

1. *Journal of Soc. Tel. Engineers*, Vol. 9, page 40.

affords no criterion of the condition of longer lengths. All wire when purchased to string, should be in as long lengths as possible, compatible with convenience in handling, as joints are prolific causes of trouble.

THE ELECTRIC RAILWAY AT WEST BRIGHTON, CONEY ISLAND.

The only electric railway for commercial purposes in America is now in successful operation on the new iron pier at West Brighton, Coney Island. The extensive experiments in this direction, which have been conducted by Daft, Field, and Edison at their respective laboratories, are more or less familiar to the public. A very thorough practical test of the Daft system was also made on an existing steam railway last November, at Saratoga Springs.

The new railway at Coney Island is operated by the Daft system, and extends for 780 feet along the west side of the West Brighton pier. The track is of 2 feet gauge, the rails being of the T pattern, 20 feet in length, 8 pounds to the foot. These are laid on strips of wood, and all firmly bolted to the pier planking. No attempt is made at insulation, none being needed, as on the wettest days the escape of current would be scarcely perceptible. The dynamo is shunt wound, and capable of furnishing a 6 h.p. current. Like all of Prof. Daft's machines the E.M.F. is extremely low. The intensity of the current varies with the external resistance, and upon this depends the speed of the motor. Its weight is about 650 lbs. and its normal speed 1,100. It is driven by an 8 h.p. vertical engine with boiler to correspond, manufactured by the New York Safety Steam Power Co. The speed of the engine being 250, direct belting was possible.

The motor is of the same model as its predecessor, the Ampère, which made the successful trial test at Saratoga. Its name, Pacinotti, is equally appropriate. The body is built of 2 inch ash, and is 6½ feet long by 3 feet wide. The superstructure is simply a dash-board 20 inches high, to which the switches for controlling the motor are attached; a box on the rear, within which is placed the receiving dynamo. In front of this box and attached to it is the driver's seat. Upon his right is the lever for reversing the brushes on the commutator, and, consequently, the direction of its rotation. The running gear consists of four 12 inch wheels with 4 inch centres. To prevent short circuiting between the rails, the wheels on one side are insulated by the use of wooden centres. A wooden apron on the four sides, extending to within an inch of the rails, conceals the lower part of the motor. The motion is transmitted from the receiver in the box to a counter shaft beneath, and from there to each pair of wheels. The receiver is compound, having a capacity of from 3 to 4 h. p. Numerous variations in its resistance may be made, thus controlling the speed of the motor. Its weight is about 450 lbs., and the speed of the armature from which the best results are obtained, about 1,400. The speed, is of course under control of the driver through his switches. The right-hand switch combines in an ingenious manner, a make and break switch, with one for regulating the flow of the current to the receiver. The destructive results to an ordinary switch by the breaking of a heavy current, have been avoided in this contrivance, as also in the brake switch, without the introduction of useless resistance. Although in use for some time they evince but the faintest traces of fusion.

Two cars are provided for the transportation of passengers, each 12 feet 2 inches long and 32 inches wide, weighing about 400 lbs. and accommodating 20 persons, 10 on each side sitting back to back, making a normal load of 40. As many as 50 people have been carried at one time, a total weight of about 4 tons. The weight of the Pacinotti is about 1,200 lbs., and its maximum speed from 12 to 15 miles per hour, although this is obviously limited on so short a track.

H. McPherson is one of the leading spirits of this enterprise and is always on the ground. It is to be hoped that he will meet with substantial success, as a fine opportunity is now afforded of practically testing the merits of the Daft system. In the transmission of power for mechanical purposes its advantages have already been demonstrated. No doubt this little railway will be the forerunner of many of its kind. It is already one of the permanent institutions at West Brighton for the amusement of visitors, and its extension the entire length of Coney Island is probably but a question of a very brief time, when it will be of actual service as a pleasant and safe method of travel between various points of interest.

1. See January number of ELECTRICIAN AND ELECTRICAL ENGINEER, vol. III., page 10.

ABSTRACTS AND EXTRACTS.

LIGHTNING IN MINIATURE.

A CORRESPONDENT of the *Scientific American* gives a description of an interesting exhibition which may be made by the use of an induction coil. In giving a lecture he desired to make as long a spark as possible, but his coil produced one of but 4½ inches. After numerous experiments he finally adopted the following very successful method. Fasten dry boards together making a plane surface 3x4 feet. Varnish one side, and before it is dry, press upon its entire surface sheets of tin foil. Allow it to dry slightly over night, and then with a sharp knife and a ruler, draw parallel lines across the foil ½ to ¼ inch apart. After allowing it to dry again a short time, pass the knife across at right angles to the former lines, dividing the surface into squares which will be separated only by the thickness of the knife edge. Now connect the poles of the coil to opposite ends of the board, and an effect of dazzling beauty will be produced. At every break of the circuit numerous flashes of miniature lightning will dart across the board, making a brilliant display in a dark room. By connecting a small condenser between the poles, the electricity instead of dividing into devious paths will be concentrated into one single intense stroke directly across the board. An induction coil of much less power would in this manner give very satisfactory results.

A MORSE RELIC.

THE Editor of the *Canadian Electrical News* has in his possession a piece of the original old style white paper that ran through the first Morse instrument at Baltimore, on the first public line built, running from Washington, D. C. It is 2 feet 6½ inches long, torn nearly straight off at each end, and is 1½ inches wide. The raised Morse characters run directly along the centre, from one end to the other, and were transmitted by the hand of Prof. S. F. B. Morse, the father of the telegraph, on the 28th day of April, 1846, from Washington, D. C., to Henry J. Rogers, who was receiving operator at Philadelphia, Pa. The telegraphic characters are well embossed, clear and easily read, and would indicate that the Professor was a fine operator. The translation is part of a telegram from Secretary of the Treasury Bibb, to Mr. H. J. Rogers, and reads as follows: "P. M Yours received I never doubted friend Rogers politeness or his disposition. All is O K."

ELECTRICITY ON THE LARTIGUE BALANCE RAILWAY.

ELECTRICAL locomotion has been applied to the Lartigue balance railway, which claims to be cheaper in material

and working than any other method. The railway system itself has been in use for some years, notably in Africa, for the carriage of agricultural produce; but it is only recently that Messrs. Siemens have supplied an electrical motor for it. The railway possesses only one rail, which is supported by standards at short intervals some feet above the ground. The trucks are hung upon this bar, like the panniers on an animal's back, one side balancing the other. The haulage power required to move the trucks is very much less than if they rested on two rails in the usual manner. For warehouses, contractors' works, and possibly for military purposes, this system is an admirable one, and the expense of laying the railway is only about $1.12 per yard.

THE HAND AS A RECEIVING TELEPHONE.

In order to perform this curious experiment a primary circuit should be arranged comprising a microphone, 3 cells of Leclanché battery and the primary wire of an induction coil; a secondary circuit composed of the secondary wire of the same coil, a Leclanché battery of 12 cells, and 2 metal contact pieces as used for medical purposes. Let two persons each hold a contact piece in one hand, placing their disengaged and gloved hands over the ears of a third person, the latter will hear the words spoken into the microphone as if coming out of the hands. At a recent meeting of the French Physical Society a piece of paper was successfully substituted for the gloved hand, the two persons holding the contact pieces, placing their heads together, their ears separated by the paper. The words spoken were distinctly heard by both.

LITERATURE.

REVIEWS.

Absolute Measurements in Electricity and Magnetism. By Andrew Gray, M. A., F. R. S. E., *Chief Assistant to the Professor of Natural Philosophy in the University of Glasgow.* London: Macmillan & Co.[1]

A want is felt in physical laboratories for a work that may serve a student as a guide through the various departments of electrical and magnetic measurements. Kohlrausch's "Introduction" contains much useful information, but it is put together in a manner that is not always clear and satisfactory. Kempe's "Handbook" is very good for the special purpose for which it was written, for it meets in a complete manner all the requirements of electric telegraphy. It is expected that the forthcoming volume by Professors Mascart and Joubert will in some measure supply our deficiency.

Mr. Gray's book is not introductory; it presupposes a good acquaintance with the laws of electrical and magnetic quantities, and the methods of measurement in general use. Nor is it a complete treatise; it was written for the specific purpose of giving, by a few well-chosen and typical measurements, a clear account of the absolute system of units now universally adopted.

As illustrating magnetic measurements, we have a detailed explanation of the Gaussian method of determining the horizontal, component of the earth's force. This naturally leads to definition of the magnetic units and elements.

The theory of the ring tangent galvanometer follows, nothing, however, being said of the double-coil arrangement of Helmholtz now generally adopted in standard instruments. In developing the theory of the several instruments described, the author does not hesitate to discard unwieldy, elementary methods, and uses where necessary the more rapid and powerful formulæ of the integral calculus.

Due prominence is given to the comparatively new instruments—the graded galvanometers—of Sir William Thomson. The theory of each is explained and several ways are described by which they may be graduated and their accuracy easily verified at any subsequent time.

The comparison of resistance occupies a chapter of 30 pages, in which are discussed such important matters as the sensitiveness of the Wheatstone bridge and Kirchhoff's modified form of it, the elimination of the effects of self-induction, the calibration of wires, the measurement of high resistances the insulation of the electrometer, and the internal resistance of batteries.

1. *Engineering.*

We notice, in connection with this chapter, that no reference is made to Professor Foster's elegant method of calibrating wires, or to the various condenser methods for determining what is called the resistance of a battery.

Another chapter of the book treats of the development of energy in the various parts of an electric circuit. It contains much useful information about many points relating to dynamos and electric motors which one would look for in vain in textbooks published a year back. This information is obtainable from first sources only, being scattered over the proceedings of many societies; and Mr. Gray has done a serviceable work in giving briefly the conclusions of the more important investigations that have been carried on. The efficiency of machines is defined, its relation to speed and resulting potential pointed out, a convenient form of ergometer is described, and a sketch of the theory of alternating current machines is given, including the effects of self-induction.

This latter theory is confessedly a difficult subject, and one could not expect of Mr. Gray more than a brief reference to the several variables which lead up to that very complex integral, viz., the current from a dynamo or an alternating current machine.

The concluding chapters deal with the measurement of intense magnetic fields, magnetic permeability and susceptibility, and the various electro-static and electro-magnetic units.

If we had to point out any part of this excellent little book which appeared to us wanting in clearness, we should indicate the early paragraphs of Chapter X. We think a clearer exposition is possible of the meaning and methods of measurement of the efficiency of dynamos and motors, and also of the precise conditions required for rapidity and economy of working respectively.

Undue importance seems to be attached to the copper voltameter. We may mention that Lord Rayleigh found it unreliable for accurate measurements, and hence the adoption of the silver voltameter for delicate work.

To one who has already a good knowledge of electrical matters generally, and some experience in a physical laboratory, the work of Mr. Gray will be of great help. Written by a man who is practically familiar with his subject, and who enjoys the advantage of every-day intercourse with Sir William Thomson, it is replete not only with theoretical information, but is also very suggestive of "means and ways."

NEW PERIODICALS.

The American Meteorological Journal—Published by W. H. Burr & Co., Detroit, Mich., is a monthly review of meteorology and allied branches of study. The centralization of meteorological observations, which is gradually being perfected through the agency of the signal service, has developed a widespread interest in the various manifestations of nature. The importance of a more thorough knowledge of the mysteries of atmospheric electricity renders this field an appropriate one for investigation by professional electricians, and in order to make their researches effectual it is essential that they should familiarize themselves with all attainable information upon the subject. The establishment of this magazine should stimulate not only the extension of meteorological observations, but the desire to bring them to public notice.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Electrician (London), June 21.—Volta and Magneto Electric Induction (illustr.)—*Willoughby Smith.*

Engineer (London), June 13.—Willan's electrical governor (illustr.)

Engineering (London), June 20 & 27.—Electric lighting at the International Health Exhibition (illustr.). July 4.—Secondary Batteries (illustr.)—*Thomas Wilkins.*

RECENT PUBLICATIONS.

Alglave, Em. and J. Boulard. The Electric Light; its history, production and applications. Translated from the French by *T. O'Conor Sloane.* Edited with notes and additions, by *C. M. Langren.* 250 illustrations, 8°. New York, *D. Appleton & Co.*

Gordon, J. E. H. A practical treatise on electric lighting. New York, *D. Appleton & Co.* 228 p. 4°.

Holmes, A. Bromley. Practical electric lighting, 68 illustrations. Second edition. New York and London: *E. & F. N. Spon.*

Keith, N. S. Schellen's dynamo machinery. With many additional illustrations, and much new matter added. Vol. i.

Kempe, H. R. A hand-book of electrical testing. Third edition. London and New York, *E. & F. N. Spon.* 494 p. 8°.

Lynd, William. The Practical Telegraphist and Guide to the Telegraph service. London, *Wyman & Sons.*

Preece, W. H. and J. Sivewright. Telegraphy, third edition. London, *Longmans, Green & Co.*

CORRESPONDENCE.

NEW YORK AND VICINITY.

Another Telegraph Consolidation Effected.—Reduction in Rates.—How Business Might be Developed.—Suicide of Anthony Arnoux.—St. Clair's Portable Incandescent Lamp.—Compound Wire Again Abandoned.—Electric Lights for Lighthouses.—Obscuring the Pilot's Vision.—An Electric Railway at Coney Island.

The final consolidation of the three leading opposition telegraph companies has practically been effected, and although separate organizations will be maintained, duplicate offices will be closed, and the management centralized. D. H. Bates is to be the chief executive officer, and G. S. Mott general manager. The union of these companies brings together about 16,000 miles of pole lines and 120,000 miles of wire, with the various accessories of the separate companies, including duplex, quadruplex, printing, telephone and messenger instruments, patents and systems. Among other proposed plans it is reported that the low tariff and 20 word basis of the Postal company is to be adopted. If special pains were taken to thoroughly advertise the rate, and also that this charge included free delivery, considerable new business might be developed amongst the non-telegraphing class. Practically, every person knows that an ordinary domestic letter may be delivered in any part of the country for 2 cents, but comparatively few people will learn until they actually have occasion to send a telegram, that its cost has been reduced to 25 cents. If this fact was hammered into people, with the same persistence that ready made clothing is forced upon their attention it might become generally known.

The suicide of Anthony Arnoux on the 3d of July appears to have been caused by mental depression. He was one of the pioneers of the electric lighting business in this city, having been associated with Mr. Hochhausen, whose experiments with dynamos had been carried on for years before the existence of such a machine was generally known in electrical circles. At the time of his death he was treasurer of the Arnoux-Hochhausen Electric Co., with which however Mr. Hochhausen is not personally identified.

Numerous reports have appeared in the scientific papers from time to time, regarding the use of the incandescent electric lamp for surgical and dental purposes. The idea has been developed into practical working shape by Dr. R. W. St. Clair of Brooklyn, and the apparatus is an almost indispensable accessory to the outfit of every medical practitioner. The bulb of the lamp is about the size of a large pea, and is secured to one end of a flexible conductor, the tips at the opposite end being arranged for connection with a small but powerful bi-chromate battery contained in a box about six inches square. This battery may also be used for cautery purposes, to a limited extent. The light produced is in every way adapted for the uses for which it is intended, and it will no doubt come into general use.

The use of compound wire for telegraph lines has probably received its final quietus if "hard drawn" copper does not eventually succumb to the test of practicability, which has entombed so many fine spun theories. The late General Marshall Lefferts was an enthusiastic advocate of compound wire, and during his administration it was extensively used by the Gold & Stock Telegraph Co., for the construction of private lines. Its weakness after long exposure to the weather was made apparent by the general breaking down of the lines during the sleet storm of 1873, and no more was erected by that company. Its use was revived by the Postal Telegraph Co., but in an improved form; the copper being deposited upon the steel core by electrolysis, instead of being mechanically affixed, in the form of a ribbon. The production of this wire at Ansonia, Conn., was quite an extensive industry, but its manufacture is about being suspended, and it is doubtful if compound wire of this character will ever again be extensively used.

The government tests of the electric light for lighthouse purposes, are progressing on Staten Island. It is claimed that it is not sufficiently steady for such use, as any intermission would render it liable to be mistaken by mariners for a flash light and thus mislead them. Before this question is finally settled it would be well to test the efficiency of a higher grade of carbons than is generally used. It is very certain that many of the defects attributed to arc lamps, arise from the inferior quality of the carbons consumed.

Since the new arc lights of the United States Illuminating Co. have gone into use on West and South streets, along the wharves, it is said that the pilots experience some difficulty in discerning the lights displayed by vessels in their vicinity on account of the overpowering brilliancy of the electric lights. If this is really a serious matter it is difficult to see what can be done about it. Nautical men are however celebrated for their extreme conservatism, and this may be but a verification of the old adage that "none are so blind as those who *won't* see."

If an electric railway is to be had, of course it would be brought out for use at Coney Island, therefore it was not wholly a surprise that a Daft motor was installed for that service on the new pier. That appears to be a very feasible method of familiarizing the public with its merits, and will probably pave the way for their more general use next season in different parts of the country.

New York, July 16, 1884.

PHILADELPHIA.

The Exhibition Building Practically Finished.—Boilers being Placed in Position.—The Different Sections of the Board of Examiners.—Starr's Lamp for Dental and Surgical Use.—Another Lightning Arrester.

The buildings for the electrical exhibition are now about finished and ready for the preliminary arrangements to accommodate exhibits. The foundations for engines are completed in some localities, and in others the work is being pushed forward. The boilers, consisting of Babcock and Wilcox, Root and Abendroth, the Harrison boiler, Dickson Manufacturing Co, Burnham, Parry, Williams & Co., and others are in process of erection. In fact, everything is being done to have the exhibition ready for visitors on September 2d. Although the space exceeds that at either the Paris or Vienna electrical exhibitions, it is said that it will all be needed, and the superintendent expects to have to economize the room so that all electrical appliances can be represented. No awards or premiums are to be given, but in place of these a report to the institute will be prepared by a board of examiners. Expert examinations and competitive tests of different displays will be made. The following are to be sections of the board of examiners:

1, Dynamo-electric machines for lighting; 2, dynamo-electric machines for plating; 3, dynamo-electric machines for miscellaneous purposes; 4, dynamo-electric motors and transmission of energy; 5, arc lamps; 6, carbons for arc lamps; 7, incandescent lamps; 8, photometric measurements; 9, dynamometrical measurements; 10, boilers; 11, steam engines; 12, gas engines and other prime motors; 13, apparatus for high electro-motive force—(1) lightning protection, (2) electro-static induction machines and induction coils, (3) igniters; 14, voltaic-electric apparatus—(1) voltaic batteries and accessories, (2) polarization and storage batteries; 15, electro-metallurgy; 16, thermo and magneto-electric apparatus; 17, electro conductors—(1) telegraph and telephone wires and cables, (2) electric light and power circuits, (3) submarine cables; 18, underground conduits; 19, electro telegraphs—(1) Morse systems, (2) printing telegraphs, (3) duplex, quadruplex, multiplex and harmonic systems; 20, telephones, microphones, radiophones; 21, fire and burglar alarms and annunciators; 22, electro-signal and registering apparatus; 23, electro-therapeutic apparatus; 24, electro dental apparatus; 25, applications of electricity to musical apparatus; 26, applications of electricity to artistic effects and art productions; 27, applications of electricity to warfare; 28, instruments of precision; 29, educational apparatus.

One of the newest adaptations of electric illumination is in the shape of a very small lantern, which can be introduced into the mouth, throat, and in some cases the stomach, for the purpose of aiding surgical and dental operations which cannot be carried on without light. Since 1881, Mr. E. T. Starr, of White's dental establishment in this city, has been working at intervals upon minute electrical lamps, and has at last succeeded in getting highly satisfactory results. The lantern has already been used in practice. It consists primarily of a delicate glass bulb, from which the air has been withdrawn, and as nearly a perfect vacuum created as possible. The bulb varies in shape, being spheroidal, flat and compass shaped, and also cylindrical, with a conical termination. It is attached to a handle about 9 inches long, through which run the wires connecting with the battery. The handle and the lamp can be separated, and thus but one handle is necessary for use with the different forms of lamps. Mirrors can also be attached and light reflected to places where the lamp cannot be introduced.

A number of telegraph men witnessed the successful trial of a new lightning arrester at the works of the Maxim Electric Light Co. a few days ago. It consists of two discs, one at each end of a steel axis, and a number of fine steel wires extending between them. One of the wires rests against small steel posts, in which the cable and land wires end, and forms the connecting link between them. When the lightning strikes the land wire it makes its way towards the cable and is conducted through the steel posts to the fine wire on the arrester. The wire is too small to bear anything but a normal current and melts at once, breaking the connection and allowing the surplus to be diffused. The instrument is arranged with a spring which turns the discs or cylinder and at once brings another small wire into position, so that the circuit is at once restored. They are intended for attachment to telephones and telegraph instruments to prevent danger from any extraordinary currents. Mr. John Griffin, an employé of the B. & O. Telegraph Co., is the inventor of this neat little contrivance.

Philadelphia, July 16, 1884.

CHICAGO.

Testing Subterranean Wires.—Delusive Long Line Telephone Tests.—A Sanitary Battery.—Harmless Dynamo Currents.—Convention Telegraphing.—Telephone Securities.—The Street Car Motor Languishes.—Electric Headlights on Land and Water.—An Insulation for Wire Covering Comes to Grief.—A Canadian Clothes-pin Insulator.—More Talk about Official Wire Cutting.

THE custom which now prevails almost universally among wiremen, of testing with a magneto, such as is ordinarily used by telephone companies, recently came near provoking a lawsuit. A piece of underground work was done for a corporation, who refused after its completion to pay for it, on the supposition that the wire leaked to ground. The proof of the statement depended upon the fact that the magneto would ring through the wire, when the distant end was open. It was suggested that perhaps a telegraph relay might work, but it refused. Then a galvanometer was attached in place of the magneto, and this instrument showed an insulation resistance of 1,500 megohms to the mile.

W. W. Smith, of Indianapolis—known among electricians as one who is "always trying things"—sometime since by way of experiment, after having first tested and obtained a well insulated wire, opened it at both extremities of a section a few miles long, and at two points, removed from the terminals, introduced two telephones into the circuit, and was enabled to work perfectly well with these, using no ground at either end of his line. In both instances the static capacity of the wire was sufficient to store either a positive or a negative impulse, which was immediately neutralized by the next, being of an opposite character. All which is given for the benefit of those who test with alternate current magnetos, and to whom I would suggest commutator machines, which, having once filled the static capacity of the wire, will cease to ring provided there is no leak. In several long line telephone tests lately, I notice the terminals of the wire are arranged in the same building. The wire may be very long, but the circuit is metallic, save the short ground connection between the two instruments, and these are frequently on the same general ground wire. Experimenters seem to forget that it makes little difference to a telephone whether the impulses go right or left to line, provided they get back home again.

A novel battery has lately been suggested by a Frenchman, M. Brémond, who proposes the use of the noisome elements of cesspools, sewers and the like, as an excitant of electricity. His plan is to place a cylinder of carbon, surrounded by sesqui oxide of iron in powder, within a porous cell, outside which is a species of iron frame or screen, the whole to be lowered into the receptacle, where sulphureted hydrogen, both as a gas and in solution abounds. The utilization of the waste contained in places of this sort, if these can be made available, would, while being extremely economical, tend also to the purification of cellars and other unventilated places, and open to the demands of electrical science an almost inexhaustible supply in cities where public sewers and drains might be arranged to play the part of huge battery cells, with almost no cost for the production of the current. It is not an entirely new idea which M. Brémond is advocating. Relays and sounders have been operated by batteries of zinc and copper so placed, but the use of these cheaper elements, carbon and iron, I think is a radical departure, under the circumstances.

There are tricks in all trades, and electrical merchandising is no exception. In the course of a discussion a few days since, at which I happened to be present, the question of relative danger from the currents of the various systems was under consideration. "Now, our system," said its advocate, "is so perfectly safe that I can take hold of the two sides of this lamp, burning as it is, without feeling it," and he proceeded to demonstrate by grasping the frame of the lamp. "That's all right," said a bystander, "you hold on, while I raise the upper carbon." He didn't hold on. In this connection the recent experiments of Dr. Stone, as detailed by him before the Physical Society of London, are interesting. Dr. S. claims as the result of many measurements, that the resistance of the human body is usually less than 1,000 and often as low as 500 ohms, and that it is less for currents of higher than of lower potentials. He thinks that an E. M. F. of 100 to 200 volts, under some circumstances, such as contact with moist or tender portions of the body, might produce fatal effects. I have heard of persons who could stand the current from a 50-light machine, but I would rather take their word for it, than to test my capability in that line.

We have just passed through another political convention, with its accompaniments of press, specials, and bulletins. The Western Union, B. & O. and the new coalition, were all represented at the convention, and all did good work, and plenty of it. It is estimated that 1,500,000 words were transmitted.

Telephone stocks are not paying well just now, as a rule. The exceptions are the Chicago and Wisconsin companies, both of which remember their stockholders regularly on quarter day. But the Central Union and the Kansas companies forgot their friends in January and July, and the Great Southern T. & T. company, passed its July dividend. They all claim to be putting their money into extra territorial work, and that the stockholders loss in dividends will be their gain in property. I am not aware that any of these stocks can be had at the present low rates, and I think every holder who can, will continue with the companies until the dawn of brighter days. There is a general faith in the future, when the Drawbaugh squabble shall be settled, and with it all the other "original Dr. Jacobs" are consigned to outer darkness. New inventions and prospective rivals are springing up daily, but I much incline to the belief that any and all these, unless some very radical departure from the electro-magnet principle is discovered, will have to pay the toll of royalty, if ever they cross the bridge to the fields of telephonic installation.

In a recent letter I spoke of a Chicago street car motor, which was in course of construction. Subsequently, I noticed in an electrical journal, a statement that it was in successful operation. The motor was not a success in the first instance, the batteries failing to accomplish the result aimed at. Fauré batteries of 16 plates each were substituted. The first essay with these proved disastrous, and the coils were re-wound. The car when I last saw it, was standing upon a track in a coal yard, and had made many trips as far as the gate and back, but I do not think it has ever been used on other than these brief excursions. The inventor has high hopes of his ultimate success, however, and is earnest and persevering.

Woolley's system of electrical headlights for locomotives is being experimented with on the Chicago, Milwaukee & St. Paul road. One of these lights, on engine 541, running between here and Milwaukee, it is claimed is doing good work. I have not yet been able to see it in operation. It is run by a rotary engine upon the same frame as the dynamo, the whole quite compact, about three feet in length, placed upon the running board of the engine on the fireman's side. From there the wires are carried, without extra insulation, around the hand rail to the lamp, which, save being a little taller, looks much like an ordinary headlight. The glass in the front of the lamp, instead of being a solid sheet, is divided by nine perpendicular cuts, making ten pieces, instead of a plate, to compensate for expansion by heat, I presume, or possibly to break up the rays—it would do both, probably. Mr. Woolley will be remembered as the thermal battery man of Indianapolis.

One of the little excursion steamboats belonging here, is carrying a plant of a half dozen lights, one of which is a powerful headlight, placed near the stern, on the upper deck. The frame is so placed that it can be revolved in a horizontal plane, to direct its rays towards the city at any point of the boat's progress. Recently the rays from this light, when some miles out in the lake, were distinctly seen at the western end of the city, projected on the hazy atmosphere, and bearing a perfect resemblance to a comet's tail. The sight was both novel and beautiful, and the light source could not have been less than 5 miles distant. Very many of the companies here have plants, both arc and incandescent, on river boats from St. Louis to St. Paul.

I mentioned in a late letter, a new insulating substance which was to gladden all our hearts. The promised experiments were made, and I had the pleasure of being a party to them. Never were better materials selected—never manipulations more carefully made—never a result more disheartening! Our insulator was to be flexible, yet solid—impervious to moisture, indestructible by fire. We cooked it by the formula—we tempered and dried it with scrupulous care according to the rule, and waited the requisite time for the action of the re-agents. We tested it. It was hard—hard as a gun-flint. It was not flexible, but broke like gum arabic or raw maccaroni, leaving the wire naked as the life of which we had been the victims. It was thirsty as a drunkard after a debauch, and, while it would not blaze, would char about as readily as a green twig from a tree. Its value as an insulator for wire, to use a phrenologist's expression, "In a scale of 1 to 7," would be about—minus 1. We are still wanting a good flexible insulation for covering wires.

Next to the Evansville man who doesn't believe in insulators of any description for telephone lines, comes a Canadian telephone man who uses a form of line insulator of his own invention, and which certainly, for cheapness, simplicity, and ease of installing, is difficult to equal. It may be called the clothes-pin pattern. A wooden pin has a slot sawed in the direction of its length, at the end of which slot the opening is slightly enlarged. Into this he places a bit of soft sheet rubber, and drops his line wire into the slot. The pin, which has a spreading form, is then driven into the cross arm, and the whole is accomplished. There is no tie wire, no screw, no anti-hummer needed. The mechanical vibrations are all done away with. Now, if the sulphur in the rubber will only let the iron wire alone, contrary to its usual practice, it seems to me he will have a decided improvement on the standard "drawer knob," and the "low-neck-and-short-sleeve" system in vogue in southern Indiana.

The stringing of a few extra overhead wires to accommodate the press during the recent political conventions, has doubtless reminded the city fathers that sundry wires still remain on the surface of the earth, and that it might be a good plan to officially cut them. If they will exercise a little patience, the telegraph companies will comply with the city ordinance, but it is not a job to be completed in a week or a month.

CHICAGO, July 21, 1884.

BOSTON.

Sensational Newspaper Reports of the Shocking Effect of Wires.—The Electric Light Wires Causing Slight Fires.—Reduction in City Electric Lighting and Increase of Private Lights.—New Office of the Baltimore and Ohio Telegraph Co.—Annual Report of the Fire Commissioners.—The Boston Electrical Exhibition.—Historical Display of Telephones at Philadelphia.—The Thomson-Houston Co.—Annual Telephone Convention at Philadelphia.—New Quarters for the New England Telephone and Telegraph Co.

THESE are the days when the fervid heats expand the imaginations and stretch the tongues of the daily newspaper electricians. It is well known that they know all about it now. The most abstruse electrical problems are solved by the newspaper electrical reporter in the easiest, shortest possible manner. We hear how the small boy has been amusing himself in Connecticut by throwing a wire over an electric light conductor, just to see how shocking he could be: and we were treated the other day to a long and minute account of how the denizens of a South Boston ward ill-used themselves with a broken electric light wire, one end of which rested on the ground. Men with pots of beer in their hands were overturned — policemen who handled the "thing" with two sticks had their sensitive natures disturbed, etc. The whole yarn turned out to be a figment of imagination, the conductor being an innocent, but abandoned telegraph wire. But these little trifling "wire stretches" feed the public mind as well as solid truths would and make interesting hot weather items. The real electric light conductors have, however, been on the rampage in several places during the last month. Each case was a cross of conductors in the buildings where the wires were run,—slight fires being the result. Our conservative city government continues to displace electric lamps, and return to the safe and economical gas lamp; meanwhile private users of electric lamps increase, which of course shows the real merits of the two methods of lighting, for when private establishments are at the expense of a change, the proprietors must consider it for their interest to make it.

The Baltimore and Ohio Telegraph Co. are fitting up handsome offices on the corner of Milk and Arch streets, diagonally opposite from the Bankers' and Merchants' telegraph offices; they will soon be ready for occupancy. The situation is central and the rooms are light and convenient.

The annual report of the fire commissioners has been made to the aldermen, and presents some interesting statistics. The number of alarms during the year was 793, the largest for any year since the foundation of the city. The entire losses were $998,554 on which was insurance amounting to $7,981,807. The average loss per fire alarm was $1,258. Although the number of alarms has been so large, yet no fires of magnitude have occurred, and in only 25 cases did the fire extend beyond the building in which it originated. In the assigned causes for fire alarms, none are attributed to electrical causes. Kerosene claims 52, and spontaneous combustion covers 39. Many changes have been made in electrical circuits, particularly at river crossings where new cables have been laid. The telephone service has been extended by the construction of five new circuits and the extension of several which were previously built, so that at the present time, the various houses of the department are, with two exceptions, connected with headquarters—and these two will soon be, which will make the telephone service complete. Fifty-seven telephones are now in use in this department. The telephone is very generally used throughout the departments of the city government.

There has appeared in several papers the announcement of an electrical exhibition to be held in Boston within a year, which may, however, be premature. The Philadelphia enterprise will somewhat shape the course for subsequent ones. Boston will make a fair display at Philadelphia, a particularly novel one in the telephone line. The first telephones of Prof. Bell have been furbished up; the first telephone bell, the first telephone switch, and the first of everything, if not the second, will be there, and contrasts will be made with the last of everything. It will make a remarkable exhibit, and be under the able management of E. T. Gilliland.

The Thomson-Houston Electric Light Co., is in a fair way to cover the country with light; they are pushing rapidly to the front with their lamps. Their installations are very successful in this vicinity.

The annual telephone convention which was to have been held in Providence, R. I., will adjourn to Philadelphia, in consequence of the exhibition, and will meet in Providence (Providence permitting) next year. This will prove a disappointment to many who have had in anticipation the merits of a Rhode Island clam-bake. Such must remember that Eugene Phillips still lives and exercises a persuasive power over the festive clam.

The New England Telephone and Telegraph people are fitting up a new four-story building corner of Pearl and Franklin streets, opposite their present location. The basement will be used for the repair shop and supply department. The first floor will be occupied by the offices of the Boston division; and the second floor by the executive offices of the New England company. The third floor will contain the express department operators and apparatus, and the toll line offices. This exchange has exclusively express telephone lines which are not connected with the general exchange. The toll line offices will be arranged specially for that branch. On the fourth floor will be the general exchange operating rooms, fitted with improved Western Electric multiple switch boards. This will be ready in the fall. The New England company offices will be occupied in the course of a week.

BOSTON, July 17th, 1884.

WASHINGTON.

The Effect of Consolidations on Government Telegraph Schemes.—Local Telegraph Changes.—The District Officials no Longer Compelled to Contract for Gas.—Lighting of Public Squares and Pennsylvania Ave. by Electricity Authorized.—Prosperity of the United States E. L. Co.

Since my last the National Legislature has closed its doors and the members hied themselves away to attend to their private affairs and to look after their re-election. As predicted from the beginning of the session in December last, no definite action looking either to the establishment of a governmental telegraph or the control of existing lines by the Government has been taken. There has been a good deal of talk about the telegraphs, and it has extended beyond the halls of Congress. The people have had their attention called to the subject by the proposed legislation, and understand the relations of the telegraphs and telegraph companies to the public better, in consequence of the agitation. Sufficient feeling has been disclosed to indicate that it would be a hazardous experiment for the two great rivals, the Western Union, the Baltimore and Ohio, *et al.*, to attempt a final consolidation, and a restoration of an overshadowing monopoly. Such a course would, in the present temper of Congress and the people, be almost the only thing to popularize and make certain a system of telegraph constructed by the Government, with a station in every town that can maintain the dignity of a real post-office. There may be a treaty offensive and defensive between the two great corporations, and perhaps a quiet pooling of interests, but there cannot be an actual consolidation. Operators and employees need not, however, anticipate that the rivalry of the two will become so intense as to induce each to offer princely salaries to induce good men to desert the one and enter the employ of the other. Locally the last consolidation has not been carried into effect, although it has been to some extent elsewhere. Some time since the Baltimore and Ohio people had made arrangements for a remodeling of the building in which their railroad and telegraph office is located, corner 14th street and Pennsylvania avenue, but work had not been started. The plans will now be changed and this retained as the main office, as the location is one of the best, if not the very best, for the business in the city. The Bankers' and Merchants' and the Postal companies had already transferred their business to the office of the former, leaving the office of the Postal company, which had but just been fitted up in an elegant and elaborate manner, as a branch office, open only during the business hours of the day. The boasted automatic and harmonic instruments are left in the Postal office on storage, at least for the present.

Mr. F. P. Cox, who was manager of the B. & M., retains the position in the old office. W. H. Allen, manager of the Postal Co.'s office here, has gone north, and is I hear to have a good place elsewhere.

The Brush-Swan Electric Light Co. is pushing vigorously for some of the street and public building lighting. For the first time the officials are free from the power of the Washington Gas Light Co., and can buy where they can buy cheapest, Congress having got in its free trade principles to that extent. Heretofore the appropriations have been made specifically for "gas," "gas lamps," etc., but in the bills for the current fiscal year, beginning July 1, permission is given to substitute other illuminating material, provided it can be obtained as cheaply as gas.

Col. Casey, in charge of public buildings and grounds, has authorized the substitution of electric towers for lighting Iowa circle and Mount Vernon square—both well adapted for the electric light by reason of the absence of large trees. The district commissioners have authorized the lighting of Pennsylvania ave. from the Capitol to the Treasury building, an even mile, by the high light system. Lights will be placed on the Capitol and Treasury building, with two intermediate lights. This work, which is to a certain extent experimental, has been undertaken by the Brush-Swan company, and if mutually satisfactory, will be extended all over the city.

The United States Electric Light Co. is at present doing all the electric lighting that is done, running about 150 lamps for hotels, stores, saloons, etc., and the Maxim incandescent lamps in the *Post* and *Republican* newspaper offices, and a few other private establishments. I should except the Government Printing office, where the Edison lamp has been used most satisfactorily for the past two years.

WASHINGTON, July 20, 1884.

PROVIDENCE.

Successful Test of Delany's Synchronous Multiplex System.—A Telegraph Office Without Wires.—Increasing Business of the Western Union.—The Land Line of the Mackay-Bennett Cable.—Summer Increase of Telephone Business.—The Financial Telegram Co. still Languishes

THE Boston Multiplex Telegraph Co. gave an exhibition, on the night of the 30th ult., of the synchronous system, for the benefit of the members of the Franklin Institute, of Philadelphia, who were present in the Boston office, the line between Providence and Boston being used. Six expert Morse operators manned the tables at either end of the line, and in spite of the interruption caused by a fire in Boston, the experiments were quite satisfactory. In five minutes there were sent over six circuits 798 words, and in the same length of time 806 words were received. In ten minutes 2,244 words were sent, but I have not heard that it was all copied in Boston. The operators report that it worked fairly well, and, perhaps, considering the fact that the men were new to the machinery, the outcome may be said to equal that of the quadruplex. It has not yet been decided when the company will open for public business.

The office of the Baltimore & Ohio Telegraph Co. is emblazoned with blue and gold signs, and a handsome counter has been put up. Everything seems to be ready for business, excepting the wires. There is a gap of a few miles in the line between Taunton and Boston, which is being rapidly closed up by extra gangs of linemen.

The Western Union, secure in its extensive connections, its established trade and its vast resources, can afford to look with equanimity upon the movements of its new rival, for whatever may be done by opposition companies the old company prospers and its business increases. At present it looks as though the B. & O. would be a long time in reaching Boston.

The New England Telegraph Co., said to be the property of the Postal Telegraph and Cable Co., is being built across the upper part of the state, but will not touch Providence. It will be used to connect with the new Mackay-Bennett cable, at Rockport, Mass.

With the advent of the summer season the business of the Providence Telephone Co. has received an immense impetus, and in consequence thereof the usual satisfactory quarterly dividend may be looked for. Although the stock of this company stands a hundred dollars a share less than it did a year ago, it is still a desirable investment.

The Financial Telegram Co., which was to start here under license from the Commercial Telegram Co., is still in embryo. The recent decline in the prices of stocks, the unsettled condition of the market and the scarcity of money, all combine to make the entrance of this concern into the city a matter of the dim future.

PROVIDENCE, R. I., July 17, 1884.

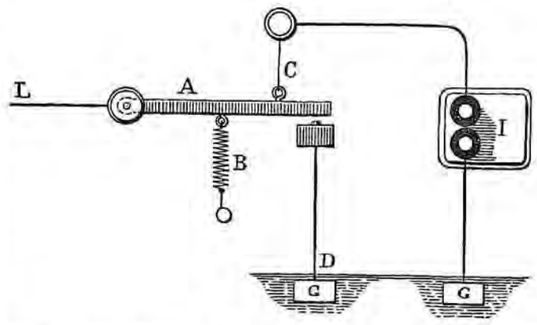
LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper,
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city.*

INSTRUMENT PROTECTORS.

[16]—In the current number of the ELECTRICIAN AND ELECTRICAL ENGINEER, you illustrate and describe "Drake's Automatic Protector." This is another instance of history repeating itself. Those who have access to Tal. P. Shaffner's *Telegraph Manual* will recollect an illustration and description in that work of a French Paratonerre, or lightning arrester, made and acting precisely like Drake's. That is, the attraction of the armature, by the extra current, would close the contact points, and cut out the office, or ground the line. Several have been made since—but the trouble with them all is, that before the core has time to be charged, and, in its turn, move the armature, enough current has passed to do the damage. For this reason they were soon abandoned. I used some of them, with ill success, about 1850. Of course, under these circumstances, the Drake patent is worthless. For atmospheric currents—storms—when the tension is so high and the volume of current so low, they will protect nothing. For crossing with a steady, heavy, comparatively low tension current from a dynamo, they may be useful, although a cheaper form—not patented—is much better. Anyone can make them. L represents the line, A is a flat bar pinned to the binding post, and spring B, pulls on it and keeps a piece of fine relay wire, C, constantly strained. C may be of any



length; D is a ground and I the instruments to be protected. If a current strong enough to melt C passes, the line is instantly closed on D, to earth.

C. H. HASKINS.

MILWAUKEE, Wis., July 5, 1884.

QUESTIONS AND ANSWERS.

[31.] **Arc Light in a Vacuum.**—J. F. D., of New Haven, inquires: "Why is it not practical to enclose an arc lamp in a vacuum, and if it could be done would it not effect a great saving in the consumption of carbon?" Ans.—This principle is adopted in the Baxter lamp which you will find illustrated in our advertising columns.

[32.] **Induction Coil.—Electric Bell Apparatus.—Electric Lighting Circuits.**—T. D. G., Pittsburg, Pa., says:—"I have failed in an attempt to operate an induction coil by a small magneto machine, and have come to the conclusion that the alternate currents reverse the magnetic poles of the wire core. Would placing another circuit breaker on the base and connecting to the top breaker help matters any? 2. Does increasing the extent of an open circuit bell system tend to weaken the battery? 5 Leclanché cells are used to operate 4 bells, with 10 buttons besides a watchman's detector of 8 stations. Of late the bells will not ring steadily for a quarter of a minute, but start off briskly and immediately run down. What is the reason? 3. Does the current from a magneto machine as used in electric lighting, pass and return through the entire circuit while one coil of the armature passes under the brush on the commutator?" Ans. 1. The current from a small magneto machine will not actuate an ordinary induction coil, not only for the reason suggested by you, but also because it furnishes a current of high potential and small quantity or volume, whereas the primary of an induction coil is designed to utilize a current of low potential and great quantity. The modification proposed would be of no advantage. 2. The extent of an open circuit system or the number of keys or buttons has no effect upon the strength of the battery, except in so far that the latter is likely to be used much more frequently in such case. The extent of the time during which the battery is kept in action with a given bell determines the rapidity of its consumption, and it is immaterial whether the circuit of the one bell is closed at one point or at many points. If the bell is in use any considerable portion of the time, a Daniell or gravity battery of about 8 cells would serve your purpose much better than the Leclanché. 3. As we understand your question, yes. The most usual arrangement of circuits in a dynamo machine is that which is exhibited on page 83 of the present volume of THE ELECTRICIAN AND ELECTRICAL ENGINEER.

[33.] **Plate of Electric Machine.—Leyden Jar.—Course of Electrical Study.**—W. A. M., St. Louis, asks:—"1. What kind of glass and of what thickness compared with the diameter, should the plate in a plate electric machine be? 2. What kind of a jar and of what thickness and size should the jar of a Leyden jar be made? 3. What kind of mucilage or cement should be used in sticking on the tin-foil? 4. What would you advise as a course of electrical study? I am a young man and desire a thorough knowledge of electricity, but know nothing of algebra. Please mark out a course of electrical study, from the bottom up. 5. How would you advise a person to go about it to become an electrical engineer?" Ans.—1. It is not important that the plate should be of any particular thickness. They are usually made from 20 to 30 inches in diameter, and from 1-12 to 1-5 of an inch in thickness. Plate glass of good quality is used. 2. The glass of a Leyden jar should be as thin as possible; the size may be from 1 quart to 1 gallon, and a very good one may be made of a wide-mouth candy jar. 3. Any cement which will cause the tin-foil to adhere to the glass will serve the purpose. 4. We should advise a student to commence with Tyndall's *Light and Electricity*, Sprague's *Electricity*, Silvanus Thompson's *Electricity and Magnetism*, and Jenkin's *Electricity and Magnetism*. When he has mastered these he will be able to direct his own future course of study quite as well as any one can do it for him. Any elementary work on algebra will be sufficient for the present. 5. (See answer to Q. 16, p. 93 of present volume of THE ELECTRICIAN AND ELECTRICAL ENGINEER.

ELECTRICAL NEWS AND NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

THE 49th meeting of the society was held at the Cooper Institute on the evening of July 9th.

A paper on "Underground Conduits for Electrical Purposes," was read by Mr. Coggeshall. He advocated the construction, through the principal streets, of subterranean passageways large enough for the access of workmen engaged in repairing or replacing wires. This was followed by a paper on "Atmospheric Electricity," by Lucian J. Blake, which was read by Prof. Keith, in the author's absence. Mr. Blake's theory, although ingenious and supported by past experiments, aroused some adverse criticism.

The proposed Broadway arcade railway system, in which ample provision is made for the various pipe systems, as well as electric wires, was then explained by Prof. Keith, and illustrated by blackboard diagrams. By this plan, a sub-street is contemplated running underneath Broadway, to be used primarily for railway purposes. It was asserted that in time nearly every house would require from 3 to 5 wires, and that provision would be made in this plan to accommodate all future growth.

President Vander Weyde then exhibited what were described as exact reproductions of the original forms of the Reiss telephone, as constructed by him in 1860-'62. He also showed a copy of a telephonic transmitter and receiver, made by him in 1868, with which, he asserted, the words of a song, as well as the melody, were transmitted, on January 7th, 1869, in the room now occupied by the society. He also exhibited and operated a receiver of the same construction as one made by him in 1870. These telephones were, however, intended for the reproduction of musical tones only, and he did not believe they could transmit articulate speech, although he was informed by parties, at the time, that they heard the words of the song as they were rendered, and they have since testified, as witnesses, to that effect. Much interest in this exhibition was manifested by the large audience present. The next meeting of the society will be held on the 8th of October.

TAPPING THE CONEY ISLAND WIRES.

AN attempt to tap the wires of the Western Union Telegraph Co., was discovered at Coney Island on July 14th. The operators noticed that something was wrong, and C. W. Stewart, a lineman, was sent out to investigate. The wires crossed the roof of the Arlington House, which is near the station of the Prospect Park and Coney Island Railroad. Stewart suspected that the mischief was caused there, and took three policemen with him to examine a room near the roof, occupied by two young men whom the proprietor, Capt. Wise, said that he did not know. Under the bed they found two new telegraph instruments and a set of linemen's tools. From the description given by Capt. Wise the police think that the men are the same ones who tapped the wires from the Iroquois House last summer for the purpose of securing advance reports of races, and speculating on the information.

ELECTRIC LIGHTS IN A FOG.

A cable despatch from London, July 18th, conveys the following curious information: The experiments at South Foreland to settle the question of the penetrating power of gas, oil, and electricity through abnormal atmospheres, show that the popular notion of the penetrating powers of the three illuminants is grossly erroneous. For instance, it has been demonstrated that an electric light, so brilliant that it can hardly be looked at on a clear night from a distance of three miles, is but little more penetrating through a dense fog than a very much smaller illuminating power of gas The chief objection to gas is the great amount of heat it engenders, which affects the lenses and makes it necessary to limit the amount of gas used. But for its heat, a sufficient amount of gas to equal the illuminating power of an electric light could be used, in which case the experiments demonstrate that the gaslight would be more penetrating in hazy weather.

DISSENSION IN THE ELECTRIC EXCHANGE.

It has been evident for some time past that the affairs of the Electric Manufacturing and Miscellaneous Exchange in this city were not in a satisfactory condition. Either its establishment was premature, or the line of business it was proposed to encourage, did not equal the expectations of its founders. The original president and his successor resigned, and an adjourned meeting of the stockholders was held on July 16th, to hear the report of a committee appointed to investigate the finances of the exchange. The absence of a quorum prevented the transaction of business in a regular way, but it did not stifle the personal views of the 47 members present. Considerable feeling was expressed against the superintendent and secretary, which finally culminated in a fistic encounter between the former gentleman and Mr. Hochart, in which both were considerably disfigured.

AN ELECTRIC LIGHTHOUSE IN BRAZIL.

AN electric lighthouse has recently been erected on the island of Raza, at the entrance of the Bay of Rio Janeiro. The lighthouse proper is 85 feet high, and is put upon a rock 230 feet in height, so that the focus of the light of the apparatus is fixed at an elevation of 315 feet above the sea. The electric fluid is produced by a continuous-current Gramme machine, working at the rate of 700 revolutions and feeding a light of 2,000 c.p. The Gramme machine referred to is actuated by a stationary surface condensing steam engine; this arrangement being inevitable owing to the want of fresh water. All the fittings are double, so as to prevent interruptions by unforeseen accidents; and, to make assurance doubly sure, an oil lamp is always kept in readiness. The light is revolving; having two white discs and one red one, succeeding one another at 15 minutes' interval, and the light is visible at a distance of about 35 statute miles.

SUIT AGAINST THE COMMERICAL TELEGRAM CO.

Henry C. Gardiner who became a stockholder of the Commercial Telegram Co. on the 19th of January last, has brought suit against that company in the Supreme Court, and asks for the appointment of a receiver on the charges of fraud, conspiracy and collusion in the distribution and manipulation of the stock by the executive officers. The former president of the company, Stephen W. Fullerton, has contradicted most of the statements, and it is very probable that the suit will be settled.

PERSONAL MENTION.

Prof. H. A. Rowland of the Johns Hopkins University, Baltimore, will lecture four times weekly through the coming collegiate year, at that institution.

Sir William Thomson, Professor in the University of Glasgow, will give a course of 18 lectures on Molecular Dynamics, at the Johns Hopkins University in October next.

ELECTIONS AND APPOINTMENTS.

S. S. Bogart, of the Baltimore & Ohio Telegraph Co., has been appointed superintendent of telegraph for the West Shore road, and joint superintendent of the National Telegraph Co. between New York and Buffalo, vice Chas. Lappin, resigned.

The stockholders of the Philadelphia, Reading and Pottsville company has elected the following officers: president, George De B. Keim; directors, J. B. Lippincott, Henry Lewis and E. C. Knight, of Philadelphia, and G. A. Nicholls, of Reading; secretary, Howard Hancock, of Philadelphia; treasurer, John Welch, of Philadelphia.

At a meeting of the directors of the Mexican Telegraph Co., the following named officers were elected for the ensuing year: James A. Scrymser, president; Wm. G. Hamilton, vice-president; Joseph B. Stearns, second vice-president; James R. Beard, secretary; Samuel C. Blackwell, treasurer and Sebastian Comacho, resident vice-president, city of Mexico; executive committee, John E. Alexandre, James K. Gracie and George Blagden.

THE TELEGRAPH.

Edward T. Condon, aged 17, after his discharge from the employ of the Western Union Telegraph Co. in New York, delivered a number of bogus messages to prominent gentlemen, and collected money on them. He was arrested and indicted for the larceny of four receiving blanks worth 1 cent. In the Court of General Sessions, he pleaded guilty and was sentenced to one year in the penitentiary by Recorder Smyth.

During the severe thunder storm of July 12th, numerous telegraph poles in New Jersey, Westchester county and Long Island were shivered by lightning.

A peculiar mode of swindling has been discovered by the Western Union office in Cincinnati. The plan is to prepare blanks and envelopes resembling, but not exactly like, Western Union message blanks and envelopes, prepare bogus messages, deliver them and collect charges. So far as known, the charges have been only 25 cents on each message, and it is estimated that the swindlers gathered not less than $200.

The Baltimore & Ohio Telegraph Co. has placed a cable across the Mississippi river from Bird's Point to Cairo. It is 635 feet long, weighs 10½ tons, and contains eight wires. The Baltimore & Ohio wires will be ready for work from Cairo north by the last of the mouth. They are to extend down the Texas & St. Louis Railroad to New Orleans and Galveston.

Dr. Mell of the Alabama weather service is making an effort to have weather signals exposed at all of the telegraph stations in the state.

The city council of Chicago passed an order, July 21st, directing that the wires of the Mutual Union Co. be cut, the agreement to go underground not having been complied with.

THE TELEPHONE.

The certificate of incorporation of the Drawbaugh Telephone and Telegraph Co., of Canada, has been filed. The capital stock has been fixed at $1,000,000. The lines of the company are to run from New York to Albany, Buffalo, Windsor, Ont., Hamilton, Toronto and Montreal; then to begin again at Albany to run to Rouse's Point, N.Y., Quebec, Halifax, and thence to the different states and territories of the United States and Canada, and across any other countries of the western hemisphere.

The Rogers Telephone Co. has been organized, with a capital of $1,000,000, which may be increased to $10,000,000, to construct, maintain, and operate telephone and telegraph wires throughout the United States. Its incorporators, each of whom holds 10 shares of its stock, are Sigmund T. Meyer, Michael Jacobs, C. Godfrey Gunther, Everett P. Wheeler, Gen Daniel E Sickles, William A Darling, Asher T. Meyer, John Hardy, C. W. Sweet, and John N. Hayward.

In the matter of an application for an injunction by the New York Metropolitan Telephone and Telegraph Co. to restrain the Colwell Lead Co. from digging around certain poles in Thirty-ninth st., near Sixth ave., on which the company's wires are carried, Judge Ingraham, in the Superior Court, decided, July 10, that for whatever damages might be sustained a complete remedy could be found in an action at law, and he denied the motion for an injunction.

Gen. Bradley T. Johnson, of Maryland, has been made the president of a new telephone company known as the Washington Telephone Co., a branch of the Penn company, of which Gen. Joseph E. Johnston is president. The Rogers patent is adopted, and it is stated that prospectuses are to be issued and the company put in motion at once. The Washington company covers Maryland, Delaware, the Virginias and the District of Columbia. It is proposed to establish exchanges in Baltimore, Washington and Richmond, the subscribers to have the use of the telephone in their houses for two years and to get five shares of the stock for a stipulated sum, with the condition that when 500 subscriptions are secured the exchange will be established. The lines will be extended wherever the business will justify, and all the small towns in the state will soon be in communication with the central office in Baltimore.

RAILWAY SERVICE.

It is reported that the Chicago, Milwaukee & St. Paul R R. Co. has decided to adopt electric headlights for its locomotives, and will also experiment with the use of electricity for the illumination of its coaches.

The American Electric Headlight Co. are making 10 lights complete, and will soon have them completed and running on one of the most prominent railroads in the country. They are being built at the works of the Falls River company, Cuyahoga, O., who are largely interested in the enterprise.

ELECTRIC LIGHT AND POWER.

Domestic.

Council Bluffs, Ia., is now lighted by electricity on the Thomson-Houston system, in connection with the Westinghouse automatic engine.

The electric light company in Aberdeen, Miss., starts up with the Brush light and the Westinghouse engine.

An application has been made for a charter for a new lighting company for Philadelphia, the name of which is to be the National Illuminating Company of Philadelphia, and is to have a capital of $200,000.

The Freeport, Ill., Van Depoele Electric Light and Power Co. has been incorporated; capital stock, $25,000; incorporators, James J. Galligan, Frederick Gund and Charles Nieman.

The Van Depoele Electric Light Co. are putting in an additional electric plant in Winona, Minn., and one in the Nee Ban building in Chicago. They are furnishing a number of electric headlights for Lake Michigan steamboats, and have engaged to build an electric railway in the city of Toronto, Canada, on which cars will be propelled by the Van Depoele motor. The road will be several miles in length.

The Merchants' Electric Light and Power Co. has been incorporated at Aurora, Ill.; capital stock, $4,200; incorporators, John J. Davis, A. G. Case and George Hanna.

An electric street railway, one mile in length, went into operation at Cleveland, O., July 26th. The opening was entirely successful, and has made quite a sensation in railroad and electrical circles. It is operated by the Brush in combination with the Bentley and Knight systems.

The commissioner of public works, New York city, has declined to allow the gas posts to be removed from the section of the city to which the electric light is now being applied. Whether they will be similarly employed for street names does not yet appear. The commissioner's argument is that, if for any reason a return to gas illumination should be necessary, and the posts had been removed, to replace them would only result in repeated tearing up of the streets, and, of course, corresponding inconvenience to the traveling public.

Portland, Oregon, will shortly be lighted by electricity. The initiatory plant consists of three, 50-light United States dynamos, driven independently by 3 Westinghouse automatic engines of 65 h.p. each, which will also on occasion each drive an additional 20-light dynamo. The boilers are on the ground floor, the engines on the second, and the dynamos on the third floor. For compactness it is doubtful if there is a better designed station in the country.

The Augusta Electric Co. has been organized at Augusta, Ga., with a capital of $10,000, by Wesley W. Neal and William A. Robinson, for the purpose of establishing electric lights, etc.

The Brush Electric Light Co., have just received an order for one of their largest dynamos, a 65-light machine, for the city of Mexico. A representative of the company has made arrangements for lighting the city of La Plata, Argentine Republic, and expects to complete arrangements soon for lighting a part of Buenos Ayres. The recent exhibition of Brush lights at Rio Janeiro by the company's agent, Pedro Kuczyn, was a decided success and won the praise of all present. As this is one of the best gas lighted cities in the world, the success was all the more gratifying. Mr. J. Potter, the company's representative at Yokohama, Japan, will return to Cleveland in a week or two, via Europe. He has been exceedingly successful in introducing the light in Japan and China. He has established and has in successful operation, a plant for lighting the settlement of Shanghai, has recently contracted for the lighting of several Japanese cities, and has also supplied a great deal of apparatus to the Japanese government for use in its arsenals and navy. Business at the home shops is very good for this season of the year.—*Iron Trade Review.*

Richfield Springs, N.Y., is illuminated during the season by Remington arc lights.

Foreign.

An English writer asserts that the opinion that the electric light may hasten the growth of plants and the ripening of fruits is a delusion. He bases this declaration on the results of experiments with potatoes, a lot of which vegetated in total darkness, and another which was exposed to the glare of the electric arc throughout each night having shown no difference in growth or general appearance.

An experiment is now being made along the Suez canal for lighting it by electricity, and it is expected that mail steamers will shortly be able to pass through the canal by night. Hitherto night traffic in the canal has been entirely suspended.

Messrs. Siemens, Brothers & Co , of Berlin, have recently constructed some small arc lamps which will work in parallel, and do not require more than 2 ampères of current and an electromotive force of 40 volts.

An electrical installation of much interest has lately been inaugurated at Colchester, England, where the south-eastern Brush company have laid a house-to-house communication of 2,000 incandescent lights, supplied with current from 5 storage stations charged by dynamos at a local centre. The dynamos are worked by a Davey-Paxman 25 h. p. nominal steam engine, and the machines send off a high-tension current of about 1,800 volts electro-motive force to the accumulators, from which low-tension currents, suitable for the domestic supply of each respective district, are taken off by separate leads.

The Thomson-Houston Electric Light Co. has nearly completed its new model station at Lynn, Mass. The plant at the start will consist of 4 dynamos driven on the independent system by 4 Westinghouse automatic engines of 50 h. p. each.

The McKeesport (Pa.) Electric Lighting Co. has started its new station, in which the power is furnished by 2 Westinghouse automatic engines of 50 h. p. each.

The Marshalltown (Iowa) Electric Light and Power Co. is now in successful operation. The power is furnished by a Westinghouse automatic engine of 65 h. p.

MISCELLANEOUS.

Domestic.

Prof. John Trowbridge is conducting an interesting series of observations upon atmospheric electricity. His special object at present is to ascertain whether it is advisable for the Signal Service to institute simultaneous observations.

Foreign.

The International Electrical Exhibition, held in connection with the Italian National Exhibition at Turin, was opened on May 28. The electrical exhibition is not large, but its quality makes up for quantity.

SUBTERRANEAN LINES.

The Underground Electric Wire Co. filed articles of incorporation in New York on July 9.

SUBMARINE CABLES.

The certificate of incorporation of the North America Insulated Cable Co. was recently filed. The capital stock of the company is $1,000,000. Its objects are to construct lines of electric telegraphs and lines of electric cables in the United States and Canada, and to run the cables to the coast of Europe.

The first of the two Atlantic cables of the Commercial Cable Co. has been successfully laid. The splice was made at mid-ocean on board the Faraday at 6:35 P. M., July 20th. The second cable will now be laid, and the company will be ready for business in September.

MANUFACTURING AND TRADE NOTES.

The Union Switch and Signal Co. of Pittsburg, has made a general reduction of 10 per cent. in the wages of all the employees connected with the company. An order has been received from the Chicago, Burlington and Quincy R.R. Co. to equip 5 points in the Chicago yard with the pneumatic signal switch.

Durkee & Keffer of Chicago, are building a high-speed engine for electric lighting purposes designed to run 1,500 revolutions per minute. An especial feature of this engine is a very ingenious rotary automatic steam balance valve.

The Armington & Sims Engine Co. of Providence, R. I., publish an elegant illustrated catalogue of their steam engine, which will be of interest to all who are engaged in electric lighting.

The Palmer (Mass.) Wire Co., which entered only a little over a year ago upon the manufacture of standard and special brands and qualities of wire, have met with the most pronounced success. So rapidly has their business grown during the past year that they have been led to double their capacity in some of their departments, notably in the galvanizing department.

The Western Electric Co. has on display in its office at Chicago, a huge photograph album containing representations of many of the various multiple switch boards they have furnished, with the name of the town where the exchange is located. These are arranged for from 600 wires all the way up to 4,900 wires, the last named being for Baltimore; 23 of the largest exchanges in the United States are using this board, while London, Liverpool, Götenborg, Buda Pesth, Melbourne and Toronto, in foreign countries, have also adopted them.

The American Automatic Lightning Arrester Co., Exchange Court, New York, manufacture and supply Drake's Automatic Protector, of which a description was given in our July number.

The Westinghouse Machine Co. of Pittsburg, Pa., have recently shipped to the government of New South Wales, Australia, 1 of their 160 h. p. automatic engines, to be used in electric lighting.

The Western Ontario Electric Light & Power Co. of Windsor, Ont., have purchased a Westinghouse automatic engine of 65 h. p. from Inglis & Hunter of Toronto, who are the licensed builders of this type of engine for Canada.

Fairbanks, Morse & Co. of Chicago, have contracted with the Westinghouse Machine Co. of Pittsburg, Pa., to control the entire sale of the Westinghouse automatic engine in the Western States and the Territories for a term of years. This contract, which is exclusive, took effect July 1, and being closed only after a thorough investigation as to relative merit, becomes a very practical endorsement of the engine in question.

The Van Depoele Electric Light Co. of Chicago, is looking about for a location for new works, which they shortly propose to erect, their business having outgrown their present establishment.

The business of the Union Electric Manufacturing Co., at No. 9 Bond street, has been discontinued, the machinery and tools sold out, and moved to Boston.

FINANCIAL.

NEW YORK, July 18, 1884.

The pooling agreement between the three telegraphs now competing with the Western Union appears to have exercised no important influence upon the market price of their securities. There was a slight decline in Western Union, but it more than recovered on the following day. Other electrical shares are very quiet. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	153 00	155 50	Molecular	3 00	10 00
Am. Speaking	90 00	120 00	New England	20 00	23 00
Currier-Tele. Bell	3 00	—	New York	—	60 00
Colombia & Pan	24 50	25 00	New York & N. J.	—	58 00
Continental	10 00	—	N. Y. & Penn	—	65 00
Dolbear	5 00	10 00	Peoples	5 00	9 00
Erie	18 00	18 75	do. N. E.	1 00	2 00
Globe	3 50	4 50	Southern Bell	—	125 00
Hudson Riv.	40 00	75 00	Southern N. E.	—	175 00
Inter-Cont.	25	1 50	Tropical	1 00	2 00
Mexican Central	—	2 00	W. I. Tel. & Telph.	1 00	1 25

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Rapid	30 00	50 00	Manhattan Telegraph	10 00	85 00
Bankers' & Merchants'	—	30 00	Mexican	125 00	147 00
Com'l Tel. Co., common	25 00	80 00	Postal	4 85	5 13
Harlem Dist. Tel. Co.	2 00	2 50	do. bonds	58 00	30 00
Bankers' & Merchants' 1st m. bonds	21 00	25 00	Western Union	51 75	65 00

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
Brush	50 00	80 00	Excelsior	8 00	—
Brush Ill	30 00	50 00	Swan	15 00	40 50
Edison	80 00	100 00	U. S.	60 00	90 00
Edison Ill	30 00	75 00	do. Ill. Co.	—	90 00
Edison Isolated	—	90 00	United Globe	60 00	70 00
Edison European	9 00	15 00			

The Maine Telegraph Co , has declared a dividend of $2,25 per share.

According to the Boston *Herald*, the debt of the Erie Telephone Co. on July 1st was $200,000. It is earning $228,000 per year—about 6 per cent. on the stock. About $90,000 is required for construction. It is probable that a dividend of 50 cents per share will be declared, and the remainder of the surplus devoted to a reduction of the debt. The last dividend was $1 per share.

The U. S. Electric Light Co., of Washington declared an annual dividend o 8 per cent. on its capital of $300,000, July 1st.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

Northern District of Illinois—*Curran et. al.* v. *Burdsall.* Blodgett, J., held that where a patentee after selling all his rights under a patent, and subsequently purchased an older patent to defeat his assignee's rights, the proceeding is unjust and inequitable, even if the older patent clearly anticipates the patent for the device sold, and that the assignee cannot be thus dispossessed of the full benefit of what has been acquired from the patentee; also that the prior sale operates as a license as against all others associated with the patentee in the purchase of the prior patent; they must look to the original seller for compensation. *Burdsall* v. *Curran et. al.* The answer admitting the validity of the patents sued on, and one of the defendants being the original patentee, their validity cannot be disputed on a suit for infringement brought by an assignee of the patents. Slight mechanical deviations from the specific directions given in the patents considered when the main features are incorporated, will not avoid the charge of infringement.

Southern District of New York—*The Atlantic Milling Co.* v. *Robinson.* Wallace, J., (1) The right to the exclusive use of a word or symbol as a trademark is inseparable from the right to make and sell the commodity to which it has been appropriated to designate the same as the production of the proprietor, and would seem to be incident to the place or establishment to which it owes its origin, and without which it can have no independent existence. It should be deemed to pass with a transfer of the business; such implication is presumably the intention of the parties. (2) The complainant's damages are measured by the extent to which the unlawful use of the word "Champion" has interfered with the sale of its flour. (3) The right to an injunction is not affected because the appropriation of the trademark has been a limited one. (4) It is sufficient if the trademark has been imitated to an extent calculated to mislead purchasers. *National Wire Mattress Co.* v. *New York Braided Wire Mattress Co.* Wheeler, J., (1) Decrees having been made sustaining certain claims of a reissue patent when much less strictness in comparing reissued patents with originals was required, they are disregarded, and the claims held to be too narrow to embrace the defendant's invention, or too broad for the original invention and claim. (2) A difference of construction perfectly obvious to any

ompetent mechanic is not a patentable invention. (3) If that which in the reissue covers the defendant's structure is an expansion of the original patent, defendant does not infringe anything that is valid in the patent in this suit. *Roemer* v. *Simon*. Wheeler, J. A structure embracing all the elements of the patented invention, and also an additional feature not found in the latter constitutes an infringement of the patent. *Wooster* v. *Muser, et. al.* Wheeler J. An answer in equity is required for discovery and evidence, as well as for grounds of defence, and evidence cannot be given by attorney; therefore, an answer so made is wholly irregular, but as the orator did not move to have the answer taken off the file, nor to have the bill taken *pro confesso* for want of an answer, nor except to the answer for insufficiency, by replying to it he admitted it to be sufficient. The production of a patent shows *prima facia* that all preliminary steps necessary to the grant have been taken. The law would presume damage from infringement but there must be proof of the latter. *Felter, et. al.* v. *Newhall*. Motion for punishment of the defendant for a violation of the injunction granted on final hearing denied, for the reason that the device employed by the defendant is not the equivalent of the patented device. *Weston Dynamo Electric Machine Co.* v. *Arnoux, et. al.* Wallace, J. It appearing from the evidence that the machines relied upon to anticipate the complainant's invention, did not arrive in this country until after the date of complainant's invention, held that such machines have no bearing upon the question of novelty. *Brush, et. al.* v. *Condit, et. al.* Suit brought by complainants as exclusive licensees under two patents of C. F. Brush, one for metal-plated carbons and the other for regulating mechanism for electric lamps, alleging infringement by defendants of each patent. Infringement was charged of second claim of carbon patent, and all claims of the lamp patent except the fourth and eighth. After testimony was taken and closed, defendants moved for discontinuance of so much of the bill as related to the carbon patent. Two disclaimers were filed by complainants during the proceedings, embracing the claims 2, 7 and 8 of the lamp patent, and otherwise limiting the invention to the specific ring clamp used by the patentee when raised by a lifter secured to the core or armature. Shipman, J., in his opinion gave such a construction to the remaining claims that defendants' apparatus would necessarily constitute an infringement. Upon the question of novelty, it was held that the claims as construed were not anticipated by the English lamp of Slater and Watson, which had been set up in defense, but that the combination of the first and third claims was contained in a lamp made by one Hayes, in June, 1876, and frequently used by him for miscellaneous lighting purposes during that year. It was, therefore, held, in view of the decision of the Supreme Court in *Coffin* v. *Ogden* and other cases cited, that such use by Hayes constituted a prior public use of the invention within the meaning of the statute. The bill as to both patents was accordingly dismissed.

Northern District of New York—*Field* v. *Ireland, et. al.* Coxe, J., (1) A decision in a prior case construing a patent held to be controlling. (2) Where the form of the defendant's device is different from the complainant's, its mode of operation different, and the result of its operation is somewhat different, it cannot be said to be the same or substantially like the complainant's invention, and there is no infringement.

Eastern District of Pennsylvania—*Sewing Machine Co.* v. *France.* Butler, J., (1) A change in an old device, though simple, if it is effective and produces a new and useful result, involves invention. (2) The correction of a patent by reissue is proper, when the patent is invalid or inoperative for want of a full and clear description of the invention. (3) The judgment of the patent office as to the necessity of a reissue is entitled to great weight when there is doubt as to whether the description in the patent will be misunderstood. (4) A structural difference in form and size does not avoid infringement if the same work is done by substantially the same means. The manner of using does not characterize a machine. *Becker* v. *Hastings, et. al.* Butler, J. McKennan, C. J., concurring. The court cannot consider whether a claim might have been made broader in view of the invention described in the specification and drawings. If it fails to cover all the patentee intended, his remedy is through reissue. The court cannot enlarge the patent by construction.

Acting Commissioner's Decisions—*Ex parte Kew.* Dryenforth, A. C. By the words "persons skilled in the art," as used in the statute, is not meant persons who excel their fellows in particular arts or sciences, but merely men who have ordinary fair information in that particular line. The capacity of the inventor or the attorney should not be the standard by which to measure the ability of others skilled in the art to comprehend the specification. When the gist of the invention lies in the construction and arrangement of certain parts, it is not permissible in the claim to mention the parts in a general manner and then add words of reference to the specification as a definition of such construction and arrangement.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From June 17 to July 15, 1884 (inclusive).

Alarms and Signals:—*Annunciator*, R. J. Hewett, June 17, 300,507. *Combined Fire Alarm and Time Detector*, J. A. Tilden, July 8, 301,645. *Electric Stock Indicator*, A. B. Smith, 301,763.

Clocks:—A. S. Crane, July 8, 301,560. *Means for Operating Secondary Clocks*, C. A. Jackson, 301,601, *Transmitter for Primary Clocks and Means for Actuating Secondary Clocks thereby*. C. L. Clarke, 301,805.

Commutators:—*Automatic Cut-Out*, W. M. Thomas, June 17, 300,532. *Circuit Breaker*, E. Weston, June 24, 301,023.

Conductors, Insulators, Supports and Systems:—*Wire Covering Machine*, H. Splitdorf, June 17, 300,403. *Conductor*, A. C. Tichenor, 300,410; E. Weston, June 24, 301,031. *Conduit for Wires*, M. P. Hathaway, June 17, 300,470. *Conduit for Conductors*, L. Bannister and L. Blodget, July 1, 301,203. *Connector for Conductors*, E. Weston, June 24, 301,026. *Junction Device for Circuits*, E. Weston, 301,029. *Safety Strip for Circuits*, E. Weston, 301,030. *Cable*, A. Wilkinson, July 1, 301,417. *Insulator*, A. W. Hale, 301,446. *Apparatus for Forming Underground Conduits of Plastic Material*, B. Williams, July 8, 301,547. *Binding Post*, John Young, 301,655.

Dynamo Machines and Motors:—*Regulator for Dynamos*, J. E. Watson, June 17, 300,420. *Motors*, C. A. Jackson, July 8, 301,602; H. B. Sheridan and H. A. Gorn, June 17, 300,648; W. Adams, June 24, 300,827. *Dynamos*, C. J. Van Depoele, June 17, 300,535; J. A. Lannert, 300,615; J. B. Blair, June 24, 300,885; E. Weston, 301,025, 301,027; C. J. Van Depoele, June 17, 300,535. *Armatures for*, S. P. Van Choate, July 15, 302,092; E. A. Edwards, 301,872.

Galvanic Batteries:—*Carbon*, J. B. Wallace, June 17, 300,537. *Electric Battery*, J. C. Vetter and S. G. Putnam, 300,666.

Ignition:—*Gas Lighting Apparatus*, W. H. Sawyer, July 1, 301,393.

Lamps and Appurtenances:—*Arc*, F. Bain, June 17, 300,433, 300,676; F. M. Newton, June 24, 300,999; E. Weston, 301,076; C. M. Ball, July 8, 301,550, 301,551; S. F. Van Choate, July 15, 302,061. *Cut-Out for Lamps*, C. Lever, June 17, 300,489. *Mouth Lamp*, E. T. Starr, 300,528. *Mouth Illuminator*, same, 300,524. *Electric Light Speculum*, same, 300,525. *Manufacture of Carbon Conductors*, E. Weston, June 24, 301,024. *Regulator for Lamps*, E. A. Sperry, July 1, 301,175; A. & T. Gray, July 15, 302,221. *Carbon for Incandescent Lamp*, N. S. White, July 1, 301,152. *Manufacture of Carbons for Electric Lights*, A. Smith, July 15, 301,929. *Manufacture of Carbon Filaments*, G. W. Hickman, July 15, 302,135. *Incandescent Filaments for Lamps*, same, 302,134. *Incandescent Lamps*, G. W. Hickman and J. F McCoy, 302,133.

Metallurgy:—*Process of and Apparatus for the Separation of Metals from Ores and Alloys*, H. R. Cassel, June 24, 300,950. *Process of Chloridizing Ores by Electrolysis*, same, 300,951.

Miscellaneous:—*Regulator*, E. Weston, June 24, 301,028. *Valve for Regulating Temperature*, W. Johnson, 301,050. *Governor for Steam Engines*, E. H. Amet, June 17, 300,338. *Method of and Means for Generating Currents*, P. H. Vander Weyde, July 15, 302,175. *Producing and Utilizing Induced Currents*, same, 302,176. *Temperature Regulator*, C. A. Tucker, 302,215.

Railway Appliances:—*Motor for Railway Cars*, A. W. Adams, June 24, 300,828. *Automatic Time Indicator and Block Signal*, E. F. Bard and G. G. Wagner, 300,843. *Railroad Signal Apparatus*, A. W. Hall, July 1, 301,301; C. A. Scott, July 8, 301,837. *Railway Switch and Signal Mechanism*, C. H. Jackson, 301,369.

Storage Batteries:—G. L. Which, June 24, 300,933; D. G. Fitzgerald, July 1, 301,351.

Telephone Systems and Apparatus:—*Telephone*, W. A. West, June 17, 300,422; N. Parks and P. J. Callanen, July 8, 301,749. *Mechanical Telephone*, A. A. Knudson, 300,713. *Annunciator*, C. W. Howard, June 24, 300,976. *Conducting Cord for Telephones*, M. G. Kellogg, July 8, 301,499. *Telephonic Switch Board and Connections*, E. W. Smith, 301,520. *Telephone System*, W. A. Jackson and W. R. Cole, 301,603, 301,604.

Telegraphs:—*Printing*, C. L. Buckingham and W. B. Van Size, June 17, 300,341, 300,417. *Transmitter for Unskilled Operators*, J. N. Farrar and C. W. Morse, June 17, 300,353. *Static Compensator for Telegraphs*, F. W. Jones, June 24, 300,781. *Transmitter for Printing Telegraphs*, S. D. Field, 300,850.

THE ELECTRICIAN

AND

ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[Entered at the Post Office at New York, N. Y., as second class mail matter.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of the* ELECTRICAL PUBLISHING CO. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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NEW YORK, SEPTEMBER, 1884.

NOTICE.

The issue of this number has been delayed, for the purpose of giving our readers a report of the opening of the Electrical Exhibition, which occurs immediately after our regular publication day.

THE ELECTRICAL EXHIBITION.

OUR readers have been so thoroughly informed as to the unusual importance of the electrical exhibition now in progress at Philadelphia, that they should be fully prepared to judge of their personal interests in the matter. There may be those, however, who do not fully realize the lifelong benefits which may be derived from a thorough study of such an exhibition, when, as in this instance, it is devoted especially to an industrial field with which they are, or may become identified. There is not a single individual, however thoroughly versed he may consider himself, however highly he may be rated as an electrician, scientist, or electrical engineer, but that may add to his accumulated fund of theoretical knowledge, or practical experience, by a thorough examination of the exhibits at Philadelphia. The humblest workers in the numerous divisions and sub-divisions of the electrical field, may here be aroused to a more perfect realization of the magnitude of the interests with which they are intimately connected, for however widely the branches may appear to diverge, all spring from one common root. It is but a few years since the practical telegrapher was the corner-stone of electrical science in this country; to-day he finds himself occupying an entirely different position. Scientific text-books and publications, even when entirely devoted to electricity, almost wholly ignore telegraphy, as an art which, although not perfect, does not appear to offer the scope for enterprise and investigation that may be found in other directions. Here, then, is an opportunity for each individual to observe the general progress which has been made throughout the civilized world; to broaden his views; to obtain new ideas, and bury old ones. Not only is it for the welfare of every electrical employé to visit this exhibition, but it is for the interest of his employer—we might say it is his duty—to encourage him to do so, at least to the extent of offering the necessary leisure for that purpose. However indifferent an individual may consider himself as to the various productions displayed, the æsthetic features alone will be attractive beyond description, and entirely different from anything heretofore witnessed on this continent. The organization of this exhibition has been placed in the hands of gentlemen whose scientific ability is generally recognized, and their plans have been quietly executed without that suspicion of questionable transactions which too often gives an event of this character the appearance of a grand scheme for pecuniary gain. This policy has been pursued to the extent of dispensing with the customary prizes which have been usually awarded to successful competitors, and much to the surprise of many, no doubt, this action has apparently not diminished the number of exhibitors. At all events, the available space has been taken to an extent which exceeded the expectations of the promoters, and we trust that for the interests of the public, the visitors, the exhibitors, and the Franklin Institute, the exhibition will surpass the fondest anticipations of its originators.

THE COMPARATIVE SAFETY OF ELECTRIC LIGHTING.

RECENT developments seem to have practically settled the fact that instead of being a dangerous illuminant, electricity is really the safest one in use. Already it has been introduced in one of the largest powder manufactories in Germany, and has attracted the attention of the European millers to such an extent that at a recent convention of the British millers at Stockton-on-Tees, a special paper on "The Electric Light in Flour Mills" was read by Mr. J. H. Greenhill. The essay was the outcome of practical experience, and its details evinced thorough familiarity with the subject treated. Flouring mills are considered by underwriters the most hazardous risks, and for that reason their owners are using every possible device to assure safety from fire, in order to effect a reduction in the exorbitant premiums they are now required to pay. In conclusion, Mr. Greenhill said:

"I have only to direct attention to the safety of electricity from fire, with properly erected installations, compared to gas. Personally I do not consider there is one-fourth the risk of fire from the electric light. Matches and naked lights are not required, and besides these points, the air remains perfectly pure in the mill, thus adding to the health and activity of the workmen."

One of the noticeable features which have distinguished the few incipient fires caused by electricity, is that in nearly all cases the brilliancy of the light where the mis-

chief was going on, has attracted attention to the spot, while the slow process of starting a fire from such cause, has been most favorable to its immediate extinction.

In this respect its great advantage over gas is fully demonstrated by the destruction of the passenger station of the Pennsylvania Railroad Company at Jersey City. This building, although of wood, was adequately provided with fire extinguishing apparatus, and the employés were thoroughly familiar with its use, being under the training of a professional fireman, while the nature of the traffic was such that it was under constant supervision. The fire originated from the ignition of gas from a broken pipe, and from the rapidity with which the flames spread it is probable that a considerable amount had escaped before the explosion took place. Under these circumstances it was impossible to get the flames immediately under control owing to the headway gained by the prevalence of so inflammable a substance. It is fairly safe to assume that had this conflagration originated from any other source, the fire service immediately available would have been fully adequate to cope with it, and prevented a loss of property amounting to $500,000.

Such a fire caused by electricity, through the advertising it would have been given by the daily press, would have been a serious blow to the electric lighting industry. Whatever else may be said against it, electricity carries with it no explosive power by which the work of the fire fiend may be scattered instantaneously throughout a building. It cannot feed the flame, and thus facilitate the work of destruction. On the contrary it may automatically convey the alarm by means of another system, from the innermost recesses of the most crowded warehouse, directing the fire department to the entrance of a building before its occupants are aware that a fire exists on the premises.

PATENT OFFICE AFFAIRS.

The annual report of the Commissioner of Patents for 1883 shows an increase in every department over the business of the preceding year. The total number of applications filed was 34,576, an increase of 3,054; caveats, 2,741, an increase of 188; patents and re-issues granted, 22,383, an increase of 3,116. The net profits of the bureau were $471,005.14, an increase of $145,653.36. The grand total of the accumulated surplus of the patent office now reaches the sum of $2,676,476.24, which amount was on deposit in the United States Treasury on January 1st, 1884. Notwithstanding the fact that this fund has gradually increased from year to year since 1875, the different commissioners who have been in office have all experienced the same difficulty in securing an authorization for the employment of a corps of experts sufficiently large to efficiently transact the business of the office as fast as it accumulates. The natural consequence of this short-sighted policy is that different branches of the work are from six to nine months in arrears, with little hope of any improvement in its despatch.

This being a practical rather than an ornamental bureau, its employés have little leisure to devote to political matters. The fact that skill and experience are necessary in order to secure valuable results, renders permanency of tenure of great importance. It is for these reasons no doubt that political influence is not so potent as in other branches of the civil service where the duties are purely clerical. One of the greatest obstacles which the commissioner has to contend with is the resignation of experts whose knowledge of patent affairs becomes of such value as to create a demand for their services in private employ. In his report he says: "The Government, I submit, can afford (especially when inventors provide the funds) to pay as full compensation for first-class ability and strict integrity, as a private individual or corporation."

The division of electricity is now the most important in the patent office, not only because of the number of applications filed, but for the reason of their numerous ramifications, and the skill required to act upon them intelligently. The state of the art in European countries is also more closely abreast of our own progress in this branch than of any other, approaching it in magnitude, and for this reason a more thorough acquaintance with the world's progress is absolutely essential. Considering the inadequate facilities of the office, the business has been most creditably done, as we can testify from personal experience, but the shameful manner in which applications for increased appropriations have been ignored is not complimentary to the intelligence of our legislators. It is very probable that if applications for patents could be acted upon promptly, the increased business would go far toward defraying the additional expense incurred by larger appropriations. That the delay is far-reaching in its results may be seen from the fact that the commissioner is appealed to daily by senators and members to give preference to certain applications, on the ground that if examinations are deferred until the case is reached in its regular order, the value of the patent may be in large measure lost to the inventor.

Fortunately the evil results which might attend such favoritism, were these requests complied with, are prohibited by a rule of the bureau which must remain inviolate. The fact that the influence of congressmen is unavailing in securing precedence for the cases of those who are in their confidence, may eventually lead to more careful consideration of the rights of inventors in our national legislature.

COMPETITION BETWEEN THE TELEGRAPH AND THE TELEPHONE.

The British people are considerably exercised over the restrictive measures enforced against the extension of telephonic facilities by the postmaster-general, acting in the interest, as he believes, of the established system of government telegraphs. So effectually has this policy been carried out that on the 31st of March there were in use in Great Britain but 11,415 telephones as against 123,533 in the United States. It is evident that the matter will eventually receive more liberal treatment at the hands of the government, but enough has been done already to prove that the interests of the public are not properly considered by the administration. It was a master stroke of policy on the part of the American Bell Telephone Company, that in its contract with the Western Union Telegraph Company, no limit was placed upon the territory

of the former, excepting that the business was to be confined to such transmission as could be effected by the lips of the corresponding parties. There is, consequently, no restriction upon telephony proper; yet it is doubtless being developed to an extent that was not anticipated by the representatives of the telegraph company at the time the agreement was discussed. There is little reason to believe, however, that, speaking broadly, the telegraph revenues have been diminished by the introduction of the telephone. Although there are doubtless many cases in which the telephone has superseded the telegraph, they are no doubt more than offset by the accretion of business from interior villages, which have been connected by telephone lines with the general telegraphic system. Experience has demonstrated repeatedly that an old established service of any nature, is far more likely to be stimulated by a rival system, than it is to be either weakened or superseded. If there be any superior merit in an invention of this kind, the public should be permitted to profit by it, and it is by no means creditable to the enlightenment of the nineteenth century, that an attempt should be made to deprive the people of any improvement which will facilitate intercommunication. Such a policy is short-sighted in the extreme, and if the minutest details of cause and effect could be determined with exactness in tabulating the revenue of a telegraph company, it would no doubt be proved that the extremest liberality in the introduction of telephones was actually beneficial, rather than detrimental.

AUTOMATIC RAILWAY SIGNALS.

Scarcely a month passes by, in which railway accidents do not occur, involving serious losses of life or property, which might have been prevented by the use of automatic signals. While the ordinary system of flagging in general use, has been so improved and amended that it appears theoretically equal to any emergency, its occasional failure points to the fact that it is not reliable. Two cases have recently occurred which show the marked superiority of the automatic over the manual system. The boiler of an engine exploded on the Lehigh Valley Railroad while it was running without a train. Four men who were riding in the cab were instantly killed. Of course there was no person to send back with a flag, and it being a lonely spot in the mountains, nothing was known of the accident until a following train came suddenly upon the wreck. Twenty cars were thrown off the track and demolished, and damages incurred amounting to $40,000. Had a reliable electrical block system been in use, the second accident would have been prevented. A system of automatic drawbridge signals is being introduced on the New York, New Haven and Hartford Railroad, by which in case the two successive warnings are unheeded by the engineer, the train is automatically switched upon a sidetrack, and is harmlessly brought to a standstill in a friendly sandbank. The use of these signals has been so far approved by the Connecticut railway commissioners, that trains are now permitted to cross drawbridges without stopping, provided the signals indicate safety. The engineer of a way train recently neglected to stop at the Cos Cob draw, when warned by these signals, and his engine was consequently derailed and stopped without damage. It was his intention to stop at the station and discharge his passengers, forgetting for the moment that the location of the automatic switch prevented his reaching it. By being allowed to run drawbridges under the protection of automatic signals, about 15 minutes will be saved in a run of 73 miles. There appears to be no doubt that the adoption of automatic signals is now the most important step to be taken in the direction of perfecting our modern railway systems. The question of cost should be entirely eliminated from consideration of this subject, for the reason that the prevention of loss in property will in all probability outweigh the expense of the plant; while the safety of human life is a matter of supreme importance.

IS THE ARC LIGHT DOOMED?

Probably the most important step recently made in the progress of electric lighting is the improved incandescent lamp, which has just been brought out by the distinguished inventor, Edward Weston. This is the result of two years experimenting, in which the durability and power of the new lamp have been fully tested. While the ordinary incandescent lamp has been found perfectly well adapted to ordinary interior illumination, the extraordinary illuminating capacity of the arc lamp has rendered the latter most desirable for street and general out-of-door lighting. The new lamp, as at present developed, while, perhaps, but a third of the power of the ordinary arc lamp, possesses many other advantages over it, which certainly indicate that it is destined to supersede the latter, or at least lead the way for the general adoption of incandescent lighting. The clumsy devices of double arc lamps for all night work; the daily consumption and replacing of carbon points; the hissing and flickering of the glowing arc; the deep black shadows; the thousand and one complicated feeding devices, all are recognized as objectionable features, which have been tolerated simply because of the great advantages which were incumbent upon them. The question of economy, although, perhaps, not fully determined, is in favor of the large incandescent lamp, as against the smaller size, considering the greater illuminating capacity, while the saving in labor and in the consumption of carbons give it a decided advantage over the arc lamp. There can be little doubt that if the new lamp stands the crucial test of practical work, which all experiments must finally undergo before being pronounced successful, we are on the eve of a revolution in the electric lighting industry.

THE UNDERGROUND QUESTION IN BROOKLYN.

New York and Brooklyn are the only cities in the state in which the underground law is supposed to be operative. Mayor Low questions the wisdom of the act, at least so far as Brooklyn is concerned, and the superintendent of the municipal wires estimates that it will cost the city $322,360 to bury them. If the provisions of the law are strictly enforced against the telegraph companies, the facilities which they have heretofore afforded the public will be greatly curtailed. This is a question of considerable importance in a city covering so much territory, and when the true situation is fairly appreciated, it is very probable that the citizens and authorities will allow the law to become a dead letter.

ARTICLES.

A REVIEW OF THE ARC LAMP CONTROVERSY.

BY F. L. POPE.

THE extent and importance of the interests involved in the litigation respecting electric lighting apparatus, which was terminated by the decision rendered by Judge Shipman, of the United States Circuit Court for the Southern District of New York, render it desirable that the public should be furnished with a history of the case and an intelligible explanation of the points which have been decided, and of the relation of these to the general business of electric lighting, or rather to the use of the so-called arc lamp for that purpose.

In 1813 Sir Humphrey Davy discovered that a brilliant luminous arc was produced by the passage of a powerful current of electricity between two carbon electrodes, first placed in contact, and then separated by withdrawing them to a short distance from each other. This discovery may be regarded as the foundation of the art of electric arc lighting.

An arc having thus been established, the points of the carbon electrodes are gradually consumed, so that the distance between them increases until it becomes so great that the current is no longer able to traverse it, and the light is extinguished. Hence it is necessary, so as to maintain a uniform light, that the electrodes should be moved forward as fast as they are consumed, in order to maintain the arc at a constant length. In the crude experimental apparatus of Davy this was effected by mounting the carbons in sockets or holders which could be moved towards each other by hand as required.

The next step in advance consisted in the application of a clock-work mechanism driven by a weight or spring, and so adjusted or regulated as to cause the electrodes to approach each other at a uniform rate of motion approximating as nearly as possible the rate of consumption of the electrodes.

Such an organization of mechanism for moving the electrodes towards each other as they are consumed, together with the electrodes themselves, constitutes an electric arc lamp.

In the apparatus last referred to, it is obvious that as the movement of the electrodes is in no manner dependent upon the strength of the electric current, any variation in the latter must necessarily tend to render the light unsteady and irregular. It is apparent, therefore, that a practical system of electric arc lighting was not possible prior to the invention of an automatic lamp, in which the distance between the electrodes is controlled by, and therefore dependent upon, the strength and illuminating capacity of the operative current itself.

The earliest automatic arc lamp appears to have been invented in England by William Edward Staite,[1] as early as 1847. Since that date all lamps which have been produced embodying the automatic principle may be divided into two classes. In the first class a positive motion of one or both the electrodes, causing them to approach towards or recede from each other as required, is derived from clock-work mechanism impelled by a weight or spring. The direction of the motion to be communicated to the electrodes is determined by the greater or less degree of magnetic attraction developed by the current traversing the circuit in which the luminous arc is included. In the second class the clock-work is dispensed with, and the necessary movements are effected by the direct action of the electric current itself. The electrodes constantly tend to approach each other by the action of gravity or of a spring. This tendency is opposed by the electro-magnetic action, which tends to resist the movement of the electrodes towards each other, or to separate them. These opposing forces are designed to be in equilibrium when the electrodes are at a proper distance from each other to produce the maximum development of light with a given electric current. Nearly all the practically successful automatic lamps of the present day are comprised within the second class. The first automatic lamp of this latter class was that of Archereau,[2] which was invented in Paris about the year 1850. In this lamp as well as that of Staite, already referred to, the electro-magnetic system consisted of a core moving within a solenoid, a device which is sometimes termed an axial magnet.

The next essential improvement in the art related to the mechanism for advancing one or both of the electrodes, which is technically termed the feeding mechanism. It consisted in the interposition of a clamp between the movable member of the electro-magnetic system—that is to say, the armature or core—and the electrode, whereby after the electrode has been fed forward a certain distance the clamp is caused to release its hold upon the carbon, to recede, and to grasp the carbon anew at another point, thus enabling carbon electrodes to be employed having a length greatly exceeding the range of movement of the electro-magnetic apparatus. This improvement was of great importance, in that it enabled a continuous light to be maintained for a much longer period without renewing the carbon or readjusting the lamp than had before been possible. This improvement appears in the British patents of Martin John Roberts, [3] and of Slater and Watson[4] in 1852.

It will be seen that all the essential features of the electric arc lamp were invented more than 30 years ago, and various more or less successful attempts were made even at that early date to bring this method of illumination into practical use. But it was soon found that the great inconvenience and enormous expense of the powerful galvanic batteries required to produce an efficient light, virtually precluded its use except in certain very special applications.

In 1863 the French Minister of Public Works decided to illuminate one of the principal coast lighthouses, that at La Heve, by the electric arc lamp, as an experiment, the current being furnished by a large magneto-electric machine. The experiment having proved successful, the system was regularly established toward the end of 1865. This may be regarded as the commencement of the modern era of electric lighting by power driven generators. The lamp used in the French lighthouses is that of Serrin, in which the feeding is effected by clock-work, the motion of which is controlled by an electro-magnet. For many years the arc lamp was but little used except for lighthouses, and to a limited extent in manufactories.

The great improvements which were made in the dynamo-electric machines by Siemens, Gramme, Wilde and others between 1870 and 1876, had the result of attracting renewed attention to the subject of electric lighting. In this country a number of dynamo machines were built by Wallace & Sons, of Ansonia, Conn., mainly upon the plans of Prof. Moses G. Farmer, who was at that time connected with the United States Naval Torpedo Station at Newport, R. I., some of which were shown at the Centennial Exposition in Philadelphia in the summer of 1876. As a part of the same exhibit some electric light arc lamps, devised by Le Roy S. White, an ingenious Connecticut mechanician, were also shown by Wallace & Sons. This may be considered the first electric light installation in this country of any particular note.

On the 23d of October, 1877, a patent was granted to Charles F. Brush, of Cleveland, Ohio, for an improvement in metal plated carbons for electrical illuminating points, and on May 7, 1878, he received another patent for an improvement in electric lamps. The last named patent was reissued with some additional claims on May 20, 1879. A number of other patents relating to electric lighting were granted from time to time to the same inventor, but as the two above referred to are the only ones involved in the controversy under discussion, it will not be necessary to further refer to them.

1. British Patent, No. 11,783, of 1847.

2. Du Moncel. *Exposé*, second ed., vol. iii., p. 217.

3. British Patent, No. 14,198 (o. s.) 1852.

4. British Patent, No. 212 (N. S.), 1853.

The subject-matter of the first patent is simply the coating of the carbon electrodes with metal, usually copper, by the process of electrolytic deposition, whereby their conductivity is materially increased, and the arc is prevented from traveling away from the point of the electrode, thus increasing both the economy and the efficiency of the light.

The second patent embraced a complete automatic arc lamp, two different forms of which are described in the specification. The first form is shown in the accompanying illustration, figure 1, and is constructed as follows:

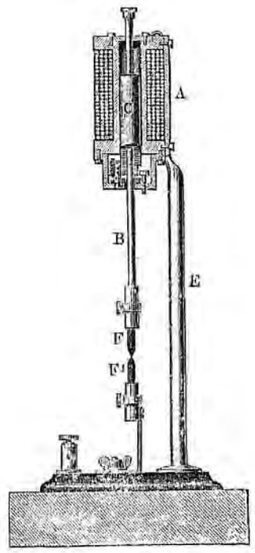


FIG. 1.—BRUSH'S PATENTED LAMP.

A hollow cylindrical helix or solenoid, A, of insulated wire, is supported upon a standard, E, through the cavity of which helix a smooth cylindrical brass rod, B, passes, and is capable of sliding freely up and down. A soft iron core C (shown partly cut away at its lower end in figure 1), is also placed within the helix, and is constructed to move freely up and down upon the rod B, which passes axially through it, and which carries the upper carbon electrode F, secured to its lower end by a suitable carbon holder or clamp, as shown in the figure. The weight of the core is partially sustained by spiral springs, one of which is shown at the left of the lower end of the core in figure 1. Immediately beneath the lower end of the core is a flat ring of metal, D, best seen in the detail view, figure 2, loosely surrounding the rod B. One edge of the ring D rests upon a finger or lifter C', which is attached to the core C, while the opposite edge of the ring is situated a short distance below the crown of an adjustable set-screw or stop D' while below it is a stationary table or floor D_2.

The electric current passes from the binding screw shown on the base of the lamp to the lower carbon electrode F', thence to the upper electrode F and carbon holder or rod B, thence through the helix A to the standard E, to which the other conducting wire is attached. When no current is passing, the electrodes F and F' are in contact, as seen in figure 1; the ring D lies flat upon the floor D_2. When the current begins to flow, the axial magnetism developed by the coil A draws the core C upward within its cavity, and at the same time, by means of the lifting finger C' raises one edge of the ring D, until by the angular impingement of the latter against the rod B, it grasps the rod and raises it, thereby separating the upper from the lower electrode, and forming the luminous arc. The gradual consumption of the carbons by the continuous combustion of the arc increases the resistance and gradually weakens the current traversing the helix, and consequently its magnetic attraction, so that the core, rod and upper carbon gradually descend by the action of gravity, until the lowermost edge of the tilted ring D comes in contact with the stationary floor D_2, as shown in figure 2, when the rod is released and permitted to slide through the ring until checked by the upward movement of the core caused by the diminished resistance in the arc and the consequent augmentation of the current.

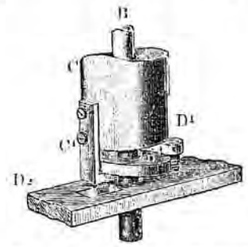


FIG. 2.—DETAILS OF CLAMP. BRUSH'S LAMP.

In the other form of lamp described by Brush in his patent, and which is stated to be applicable to a lamp which moves both carbons, the core is rigidly connected with the carbon rod, which latter receives its motion directly therefrom. The annular clamp surrounds the carbon rod as in the other form, and is lifted as the rod is lifted, while it is tilted or held in its angular clamping position by a spring which is not attached to the core. The patentee states that this form also contains his invention, and is substantially like the other in construction and operation. The reissued patent of Brush contained eight claims, as follows:

1. In an electric lamp, the combination, with the carbon holder and core, of a clamp surrounding the carbon holder, said clamp being independent of the core, but adapted to be raised by a lifter secured thereto, substantially as set forth.

2. In an electric lamp the combination of the clamp D and adjustable stop D', or their equivalents, by means of which the carbon points are prevented from becoming so far separated as to break the electric current and extinguish the light, substantially as specified.

3. In an electric lamp the combination of the core or armature C, the clamp D, and adjustable stop D', or their equivalents, whereby the points of the carbons are separated from each other when an electrical current is established, prevented from separating so far as to break the current, and gradually fed together as the carbons are consumed, substantially as described.

4. In combination with the core C, one or more adjustable sustaining springs, c, substantially as and for the purpose shown.

5. In an electric lamp, the combination, with a carbon holder of an annular clamp surrounding the carbon holder, said clamp adapted to be moved and thereby to separate the carbon points by electrical or magnetic action, substantially as herein set forth.

6. In an electric lamp, an annular clamp adapted to grasp and move a carbon holder, substantially as shown.

7. An electric lamp provided with suspending or attaching hooks, loops, or their equivalent, representing and placed in electrical connection, respectively, with the positive and negative poles of the lamp, substantially as shown.

8. An electric lamp provided with suspending or attaching hooks, loops, or their equivalent, representing and placed in electrical connection, respectively, with the positive and negative poles of the battery, dynamo-electric machine, or other source of electric current, said stationary hooks or loops being located at the place where the lamp is intended to be used, substantially as specified.

In his specification the patentee said:

I do not limit myself narrowly to the ring D, as other devices

may be employed which would accomplish the same result Any device may be used which, while a current of electricity is not passing through the helix A, will permit the rod B to move freely up and down, but which, when a current of electricity is passing through the helix, will, by the raising of the core C, operate both to clamp and to raise the rod B, and thereby separate the carbon points F F' and retain them in proper relation to each other.

It will be seen that this reissued patent, in its original form, is capable of the broadest possible construction, covering every form of clamp operated by electro-magnetism, capable of grasping, raising and releasing the movable carbon.

Subsequently Mr. Brush granted to the Telegraph Supply Company, of Cleveland, Ohio, the exclusive right to manufacture and sell the articles and apparatus constituting the subject-matter of the two patents referred to. The name of the corporation was soon afterwards changed to the Brush Electric Company. This company commenced making commercial sales of apparatus constructed under the Brush patents in the early part of 1878. The business was thenceforward pushed with a remarkable degree of enterprise and energy. The managers of the company chose a limited field of operations, mainly the lighting of large mills, machine shops, foundries and railway stations, which they worked up with great thoroughness, thus establishing within a short time an extensive and very profitable business.

One of the earliest manufacturers of dynamo-electric machines in the United States was a young man named Edward Weston, a native of England, who came to this country in 1870, and carried on business in New York city, for a time, but removed about the year 1874 to Newark, N. J. Soon after the Centennial Exposition, in 1876, he commenced to work upon the subject of electric arc lighting, and in 1877 was engaged as electrician by the Weston Dynamo-electric Machine Company, which was formed for the purpose of manufacturing electrical apparatus, including electric arc lighting apparatus. The commercial lamp eventually developed by Mr. Weston, made use of an ordinary electro-magnet instead of a solenoid for moving the upper carbon electrode, and an annular ring clutch embodying the same principle of action as that of Brush, which has already been described. The Weston lamps were well proportioned in an electrical point of view, and were constructed with care and skill, and their performance was, on the whole, considerably more satisfactory than any which had previously been offered to the public.

Although there could be no doubt that the Weston lamps were a palpable infringement of the broad claims of the Brush patents, they had been on the market some two years, finding a large and constantly increasing number of purchasers and users, before the Brush Company undertook to assert their exclusive rights under the patents. Proceedings were finally commenced in December, 1880, against Messrs. Condit, Hanson & Van Winkle, who were then the New York agents of the Weston company, for the sale of machinery and lamps. The United States Electric Lighting Company of New York, who had succeeded to the business of the Weston company, assumed the defense of the suit, which, being regarded as a test case by both parties, was tried after the most careful and elaborate preparation. The counsel employed by the Brush company were Messrs. Gifford & Gifford, E. N. Dickerson, W. C. Witter and W. H. Kenyon, of New York, Causten Browne, of Boston, George H. Christy, of Pittsburg, and Leggett & Leggett, of Cleveland; and by the United States company, Edwin H. Brown and Wetmore, Jenner and Thompson, of New York, and Chauncey Smith, of Boston. The experts employed by the Brush company were Prof. Henry Morton of Hoboken, Prof. Charles R. Cross, of Boston, Prof. Cyrus F. Brackett, of Princeton, and W. C. Hicks, of New York; and by the United States company, Frank L. Pope, of Elizabeth, Edward E. Quimby of Orange, and Edward Weston, of Newark, New Jersey. The complainants commenced to take testimony in October, 1881. The evidence on both sides was exceedingly voluminous and was not finally completed until November, 1883. Judge Wallace being unable to hear the arguments at the succeeding term of court, as had been arranged, both parties agreed to have the case heard by Judge Shipman, at Hartford, in March last.

It was conclusively proved by the defendants that metal plated carbons had been used by Mr. Weston and others at a period long anterior to the date when the invention was claimed to have been made by Mr. Brush. Printed publications and prior foreign patents were also put in evidence, in which the invention was fully described. The complainants, in view of this evidence, applied to the Court for leave to discontinue so much of the suit as related to the carbon patent, but Judge Shipman, in his decision, required them to pay the costs as well, and to agree to permit the defendants to use the same testimony in any subsequent suit.

The evidence produced by the defendants showed that Brush was not the first to make use of a clamping device for grasping, raising and releasing a carbon holder operated by electro-magnetism, and accordingly, on October 14, 1881, he filed a disclaimer, canceling the paragraph of his specification relating to the use of substitutes for the clamp D, which we have already quoted, the legal effect of which was to limit Brush's invention to the specific form of clamp which he describes, that is to say, a clamp operatively surrounding the rod and grasping it by angular impingement.

Further evidence introduced by the defense, after the filing of the above mentioned disclaimer, proved that the lamps of Le Roy S. White, exhibited at Philadelphia in 1876, by Wallace & Sons, of Ansonia, Conn., embodied a clamp acting by angular impingement in combination with an adjustable stop (D' of figure 2), being, according to the testimony of the experts, identical in its principle and mode of operation with the alternative form of lamp described in Brush's patent as one of the modifications embodying his invention. A French patent of Gramme and a British patent of Werdermann were also put in evidence by the defense, containing full anticipations of claims 7 and 8 of the Brush patent. In view of this evidence the patentee, on April 6, 1883, filed a second disclaimer, canceling claims 2, 7 and 8 (the last two being for details of no essential importance), and restricted claim 3 "to a combination consisting of the core or armature C (see figure 2), the clamp D, "when the core or armature raises the clamp by a lifter (C') secured to such core or armature, substantially as described in said patent." In filing this disclaimer the patentee abandoned all claim to the alternative form of his lamp, and confined his invention specifically to the devices and combinations which are illustrated in figures 1 and 2, and embraced in the remaining claims 1, 3, 4, 5 and 6.

In his opinion, Judge Shipman defines the invention of the patentee as follows:

> The invention of figure 1 consisted in the described means of moving the rod, holding it by the angular impingement of the clamp, and continuously regulating the distance between the carbons by a continuous and gradual feed through the annular clamp. The means by which the effect is produced are the lifting of the clamp, which is not fixed to the core, and which surrounds the rod, by a lifter secured to the core, so that the clamp will angularly impinge against, bite and arrest the upward movement of the rod, and then, as the current diminishes and the core drops, the consequent descent of the clamp and the loosening of its grasp upon the rod by its contact with the floor.

The construction placed upon the several claims of the patent by the Court is as follows:

The *first* claim is construed to mean "a clamp independent of, *i. e.*, not fixed to the core, but adapted to be raised by a lifter secured to the core." Further, "this claim is not limited to the described solenoid and core [see figure 1] and to no other motor, but by the words solenoid and core are meant an armature or 'any magnetically moving part whose property or law of motion is substantially that of a core in a solenoid.'" This is substantially the construction contended for by the complainants, which would include a constrained armature moving across the poles of an electro-magnet, as in one form of the Weston lamp.

The *third* claim requires no interpretation.

The *sixth* claim is construed as follows:

> The clamp of the sixth claim is not any annular clamp adapted to grasp and move a carbon holder. If it was, the claim would be larger than the invention and larger than the patent with the disclaimers. On the contrary, the claim means to describe, in general terms, the clamp of the first claim, which raises, clamps and feeds downwardly the rod, preserving a practically uniform length of arc by the described means, or an annular clamp surrounding the carbon holder, independent of the core, but adapted to be raised by a lifter secured to the core or magnetic motor and some suitable agency to allow the clamp to be tripped.

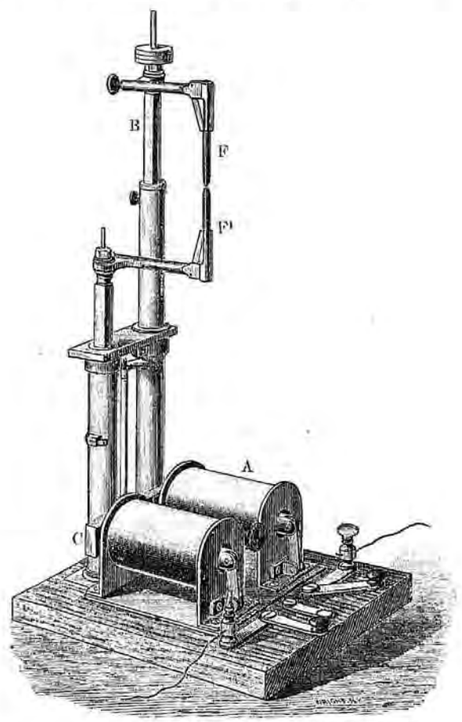


FIG. 3.—HAYES'S LAMP OF 1876.

The fifth claim is construed to include "the clamp of the first and sixth claims, the carbon holder, the motor and the tripping device."

Referring next to the question of novelty, the Court holds that the arc lamp of Slater and Watson, shown in British and French patents of 1852, which was much relied on by the defendants, does not anticipate either of Brush's claims as thus construed, for the reason that, while these patents show a ring clamp acting by angular impingement to bite, raise and release the rod, the clamp does not have "the gradual, intermittent feeding motion produced by the contact of the clamp with the floor."

But the case is different with another arc lamp put in evidence by the defense, referring to which the Court says:

> The clamp, in combination with the other necessary elements, which was made by Charles H. Hayes, of Ansonia, Conn., and was a part of a lamp which he constructed about the end of June, 1876, as an improvement upon the White lamp, *is the combination of the first and third claims of the Brush patent.* The carbon rod was square or rectangular, and therefore was surrounded by a rectangular clamp, which was independent of the core. It is not denied that this clamp is the equivalent of an annular clamp. It was raised by a lifter secured to the core, and was tripped by coming in contact with a floor, while the ascent of the rod was checked by the contact of the clamp with an adjustable stop.

Figure 3 is an engraving made from the original lamp made and used by Hayes in 1876, which was one of the defendants' exhibits in the case. For convenience of comparison, the same letters of reference are employed to designate the corresponding parts, as in the Brush lamp already described. A is the hollow helix or solenoid, which is double, and is placed in a horizontal position upon the base. C is the movable core, having two arms or branches extending through the two coils. By means of a bell crank or angular lever, not seen in the drawing,

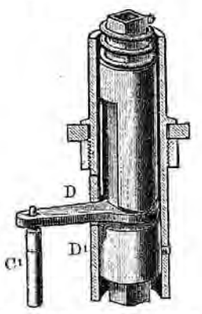


FIG. 4.—CLAMP OF HAYES'S LAMP.

the lifter C' (see figure 4) is made to raise the clamp D, which grasps the rod B, carrying the movable carbon electrode F. This rod, as well as the opening in the clamp, is rectangular. It is enclosed within a cylindrical case or shell, which is provided with an opening as shown, through which projects the tail of the clamp D. Below the clamp is a hollow cylinder, D', secured in a fixed position within the case, which serves as a floor for tripping the clamp D. The lower carbon electrode F' is fixed, as in the Brush lamp.

In the brief filed by the complainants' counsel, Messrs. Browne and Witter—which it is but simple justice to say is one of the ablest productions of the kind which the writer has ever had occasion to examine—the invention claimed by Mr. Brush is summed up as follows:

> Brush's advance in the art consisted in so interposing an annular clamp between, and combining it with, a solenoid core or similarly moving magnetic member and a movable carbon rod or holder, that such carbon rod or holder was allowed to advance or feed through such annular clamp into the arc, under the influence of a constant force, such as gravity, etc., with a gradual motion, substantially equal to and proportioned to the waste of the carbon points by combustion, and according to the requirements of the arc, whereby a uniform length of arc was *continuously maintained* for an indefinite length of time and carbons of indefinite length consumed, with the added capacity of being, by such annular clamp connection, positively seized and drawn back out of the arc whenever and to the extent that the arc was to be formed, as at the start, or corrected, as when it accidentally becomes too short.
>
> The underlying principle was the operation by a balance or equilibrium of forces acting upon the movable carbon, of which forces the current, as expressed in the magnetism of the helix, was the variable factor, and therefore the regulating factor, this having for its object the continuous control of the arc, and the continuous feed of the carbon into the arc, all attained by the use of an adjustably balanced core or other similarly moving magnetic element, and a single and simple annular clamp connection between the core and rod, perfectly simple and cheap in its construction and more delicate in its operation than the finest ratchet that could be cut.
>
> No electric lamp ever existed before in which the regulation of the arc was *continuous* by means of a *gradual feed through an annular clamp*, whereby the same arc which was originally established was continuously maintained and carbons of indefinite length could be used.

Thus it will be seen that the Court, while substantially adopting the final position of the complainants in respect to the scope of the invention and the interpretation of the claims, nevertheless found that not Brush, but Hayes, was the original and first inventor of the mechanism and mode of operation embodied in the lamps of both the complainants and the defendants.

The complainants, however, contended that the Hayes lamp was nothing more than an abandoned experiment, and never was a perfected invention.

The testimony introduced by the defense showed that Mr. Hayes was in 1876 and since an employé of Wallace & Sons, of Ansonia, who in 1876 were searching for a successful arc lamp. Hayes himself testified that he designed his lamp to overcome the defects of the White lamp, and constructed it in June, 1876, and ran it from time to time whenever an electric light was needed about the works, until the 16th of September following, when a fellow workman named King obtained permission from Wallace & Sons to substitute in the same lamp a clamp devised by him for the one which had been used by Hayes. It appeared also that the Hayes clamp was afterwards used on a number of so-called "plate lamps" made by Wallace & Sons, but not upon a lamp using carbon pencils.

In view of this state of facts, the Court says:

Two facts are manifest: 1st, that the Hayes clamp was the clamp of the Brush patent; and 2d, that it became after September 16, a disused piece of mechanism in connection with carbon points. The question then is, was it a perfected and publicly known invention, the use of which was abandoned prior to the date of the Brush invention, or was its use merely experimental, which ended in an abandoned experiment on September 16?

After a careful analysis and discussion of the evidence on this point, the Court reaches the following conclusion:

The facts that the anticipatory device was the device of the patent, and did do practical work, and was put to ordinary use, and that it does not appear that the Hayes clamp was the cause of the neglect with which Wallace & Sons treated the Hayes lamp, seem to me to outweigh the doubts which arise from the shortness of its existence and its permanent disappearance from a carbon pencil lamp.

The case is that of the public, well-known, practical use in ordinary work, with as much success as was reasonable to expect at that stage in the development of the mechanism belonging to electric arc lighting, of the exact invention which was subsequently made by the patentee; and although only one clamp and only one lamp were ever made, which were used together two and one-half months only, and the invention was then taken from the lamp, and was not afterwards used with carbon pencils, it was an anticipation of the patented device within the established rules on the subject.

With a strong disinclination to permit the remains of old experiments to destroy the pecuniary value of a patent for a useful and successful invention, and remembering that the defendants must assume a weighty burden of proof, I am of the opinion that the patentee's invention has been clearly proved to have been anticipated by that of Hayes. (*Coffin* v. *Ogden*, 18 Wall, 120; *Reed* v. *Cutter*, 1 Story, 590; *Pickering* v. *McCullough*, 18 O. G., 818; *Curtis on Patents*, secs. 89-92.

The bill, so far as it relates to the clamp patent, is dismissed.

By the results of this, therefore, unless the decision of Judge Shipman should hereafter be reversed by the Supreme Court of the United States, a contingency of which there would appear to be but little probability, two of the patents upon which the Brush Electric Company have principally relied are thrown open to the public within the limits of the United States, inasmuch as the statute making two years' public use a bar to a patent will prevent the prior and original inventor, Hayes, from securing to himself the benefits of his invention.

Thus terminates, at least for the present, a cause "which," in the language of Mr. Dickerson, one of the complainants' leading counsel, in his argument before Judge Shipman, "has been prepared and presented with more labor, and probably with greater expense, than any other patent cause which your Honor has ever heard."

DIRECTION OF CURRENTS IN ELECTRICAL MACHINES.

BY CARL HERING.

To determine the direction of the currents in any part of an electrical machine, the following three rules will always be sufficient: The first is Ampère's well-known law in regard to the action between a current and a magnet. It may be easily remembered by remembering the word *nose*, the letters of which are the initial letters of the important words of the law, viz: If the current passes from the North over the magnetic needle to the South, the deflection of the North pole will be to the East. It need hardly be necessary to add that if the current is in the opposite direction the deflection will be toward the West; while if the current is under the needle the deflection will be the reverse of what it would be if it were over the needle. This law is not limited to magnetic needles, but applies equally well to the action between the magnets and currents in a machine.

The second rule is, that, in looking at a North pole of an electro-magnet, the currents must pass in the direction contrary to the movement of the hands of a watch; while at a South pole it must pass in the same direction as that of the hands of a watch. It can easily be remembered, as the direction is the same as the direction of rotation of the earth as seen from the North and South poles. For instance, as the earth turns from West to East, at the South pole the direction of rotation will be like that of the hands of a watch, while at the North pole (looking at it from outside of the earth), the direction will be the contrary of this.

The third rule is Lenz's law, and has reference to the direction of induced currents. In regard to the currents in a machine, the law may be briefly stated as follows: If a current is produced by moving a conductor near a magnet, the direction of that current will be opposite to what it would be if (by Ampère's law) the motion were produced by the attraction or repulsion of the current and the magnet.

To illustrate this, suppose a wire be laid North and South, and the North pole of a magnet be passed under it from West to East, what will be the direction of the current produced? According to Ampère's law, to produce this motion by the action of current and magnet, the current must pass from North to South; therefore, by Lenz's law, the induced current will be opposite to this, that is, from South to North. If the magnet had been moved from East to West, or if it had been a South pole, the current would have been from North to South.

There is another short rule which may often be found useful. In a machine like the Gramme, Edison, Brush, etc., if we look at the armature in the direction of the axis and if it rotates to the *right* (like the hands of a watch), the current at the end of the armature turned toward us, will pass in the direction from the South pole of the electro-magnet toward the North pole. If the rotation is to the *left* the direction will be from the North to the South pole. Following one wire to the collector and brushes, the proper connections with the magnet circuit, and the direction in the external circuit can easily be determined.

NEWSPAPER SCIENCE.

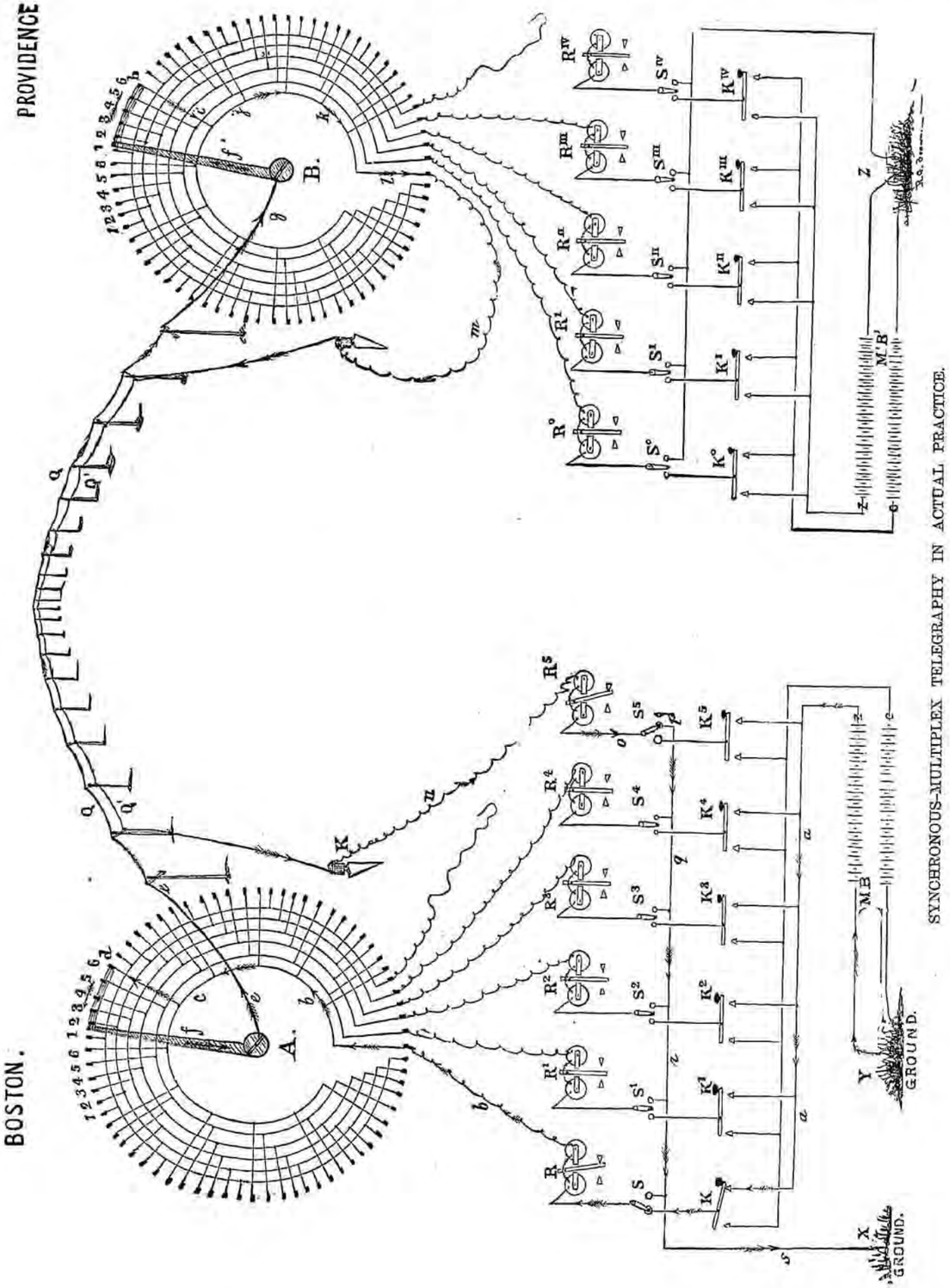
PROF. DOUGLASS, of the State University, it is said, produces amateur cyclones at will. He does it by suspending a large copper plate by silken cords. This plate is charged heavily with electricity, *which hangs down like a bag underneath, and is rendered visible by the use of arsenious acid gas, which gives it a green color.* The formation is a miniature cyclone, as perfect as any started in the clouds. It is funnel-shaped and whirls around rapidly. Passing this plate over a table, the five-cent cyclone snatches up copper cents, pens, pith balls, and other objects and scatters them on all sides.—*Adrian (Mich.) Times.*

SYNCHRONOUS-MULTIPLEX TELEGRAPHY IN ACTUAL PRACTICE.[1]

BY PROF. EDWIN J. HOUSTON.

It will interest the public generally to learn that Mr. Patrick B. Delany has successfully put into active operation his synchronous-multiplex system of telegraphy between the cities of Boston and Providence, R. I., a distance of about 50 miles. The line is constructed of No. 6 galvanized iron wire. For the purpose of securing one wire for operation in case of the accidental interruption of the other, and with a view to extension of the system, two wires have been strung. It will of course be understood that each of these wires is intended for separate use under any of the divisions which the synchronous-multiplex system is capable; viz., any number from a single circuit up to 72 separate and distinct circuits over one and the same wire; or, as these are generally used in actual practice, into 6 fast, or 12 slower Morse circuits; or into 36, or 72 printing circuits. When the possibilities of the Delany synchronous-multiplex system were first brought before the public, grave doubts were expressed by some, if not by a majority of the leading electricians of the country, as to the possibilities of its actual operation under the conditions of commercial practice. Many believed that although it might be operative under the conditions of an artificial line, established in the laboratory by means of resistance coils and condensers, that when put into actual operation the conditions necessary for continuous working could not be maintained. It may be interesting, briefly to review some of the many objections that at the outset were urged against the practical workings of the system. As is, of course, understood, the possibility of the successful operation of the synchronous-multiplex system is dependent on the continuance of the synchronous rotation of the distributing wheel at the transmitting and receiving ends of the line. In Mr. Delany's system, as the reader will probably recall, the synchronous rotation of the discs at each end of the line is maintained by timed, electrical impulses, thrown into electro-magnetic motor devices, by the vibration of similar tuning forks placed one at each end of the line. Now it was urged, and perhaps with some show of reason, that although it might be possible to maintain the synchronous vibration of these forks in a room, where any necessary adjustment of their rate of vibration could be made by an attendant, yet it would clearly be impossible to maintain such synchronous vibrations at stations widely separated from each other, since the mere difference of temperature at the two stations would, unless automatically compensated for, be sufficient to throw the two forks out of synchronism. Another difficulty that in the opinion of many presented an insuperable obstacle to the practical application of the system was the static charge of the line. It was thought that the line could not in practice be discharged with sufficient rapidity to permit the transference thereon of the numerous separate and distinct electrical impulses necessary in this system. It was feared that before the line could be freed from the charge given it by one impulse, another would be sent over it by the distributor, and that these two would necessarily interfere with each other. These, and many other difficulties, were urged as necessarily fatal to the success of the system. It is to the credit of Mr. Delany that he has so ingeniously met and overcome all these difficulties, and has established his invention on a commercial basis. But let the actual facts of the case speak for themselves. Dividing one of the wires between Boston and Providence into 6 separate circuits, it was worked for long periods at the rate of 40 words per minute on each of the circuits so established. Dividing the line into 12 Morse circuits, it was similarly worked at the rate of 20 words per minute on each line; 36 printing circuits have been worked between the two cities at the rate of from four to five words per minute; while 72 printing circuits were similarly worked at the rate of from two to three words per minute. The circuits above referred to have all been operated in one and the same direction at the same time, or have been operated one-half in one direction and the remaining half in the opposite direction, or other combinations of the same number of separate and distinct circuits have been employed. In order to practically note the effect produced by increasing the length of the line, the two wires were joined together at Providence, thus providing one continuous circuit from Boston to Providence and back again to Boston, with separate grounds at each end in Boston. Over this double distance of about 100 miles, the circuits were operated, as above mentioned, without any diminution of speed. Further experiments introducing artificial resistances of 3,000 ohms, or an equivalent of about 300 miles of line, and of 2½ microfarads of static charge, demonstrated the entire success of the system, under these conditions, with only a slightly diminished speed. Employing the line as a sextuplex, on Saturday, July 12, 1884, 1,000 words were transmitted over one of the sextuplex circuits Boston via Providence to Boston, and received, at the rate of 35 words per minute, by sound, by Morse operators, who had never seen the system before that week. Employing the line as a duodeciplex, 1,100 words were transmitted over one of the 12 lines so provided, at the rate of 20 words per minute and perfectly received by sound. An increase in the resistance of the line of 9,000 ohms, in addition to the normal resistance of the 100 miles of wire, in the two wires joined as one, did not affect the synchronism, or prevent the perfect transmission of the messages. The synchronous-multiplex system of telegraphy has now been in actual operation between Boston and Providence, under the various conditions above mentioned, during the last 30 days. During that entire time, the synchronism has been maintained between the Boston and the Providence instruments without ten minutes interruption, excepting, of course, when the instruments were purposely stopped, or were interrupted for the purposes of experiment, or were disturbed by crosses or breaks in the wires of the main line. When thrown out of synchronism by any of these causes, the instruments at the ends of the line, in all cases, came automatically into synchronism within one and a half minutes, without the intervention of the operator at either the Boston or the Providence end of the line. Mr. Delany has availed himself of the opportunity which the additional line afforded him of trying practically things for which he believed his system adapted, and for which he originally intended it. One of the many purposes to which he showed the applicability of the synchronous-multiplex system would seem to add so greatly to its commercial value when in actual operation, that it may be well to explain it at length. Connecting at Providence one of the sextuplex circuits established in one of the wires, to the end of the second wire at Providence, a message transmitted from Boston, over the sextuplex circuit so connected, was received in Boston on the second wire clearly and perfectly transmitted. This experiment would seem to show that the synchronous-multiplex system is applicable not only to the connection of terminal stations, whereby the wire may be divided into the numerous circuits claimed for it, but that the six circuits, for example, obtained from a single wire, may be connected at the terminal stations at the two ends of the main line where a distributing instrument is situated, by independent wires run so as to reach the outlying cities beyond. In this manner each of these cities will be furnished with an exclusive circuit through the divided wire. With, for example, a distributor in New York, connected by a single wire with one in Boston, and divided into say six Morse circuits, a single wire, extending to Providence, could be connected at Boston to the No. 1, of the six multiplex circuits, while Lowell, could be connected to the No. 2, of the multiplex circuits; Portsmouth to the No. 3, of the multiplex circuits; Worcester to the No. 4, of the multiplex circuits; Lawrence to the No. 5, of the multi-

1. From advance sheets of the *Journal of the Franklin Institute.*



plex circuits; and finally Lynn to the No. 6, of the multiplex circuits, thus affording each of these six cities direct circuits over one and the same wire to New York, through the medium of the distributor at Boston, without any repetition of the despatches. In like manner, if so desired, six cities adjacent to New York, within distances, of say from 75 to 100 miles from New York, might be connected with Boston, through the medium of the New York distributor, or the outlying cities themselves might be put into communication with each other. Under the present system of telegraphic communication, nearly all these outlying cities are compelled to send their messages on to Boston or New York, from which places they are repeated to their destination. The connection above referred to may be better understood by reference to the figure. A and B represent the synchronized distributors situated at Boston and Providence respectively and connected with the main line wire Q Q. The second wire Q' Q', which ordinarily has no connection with the distributors A and B, is for the purposes of this experiment connected in the manner shown. In the figure the contacts are connected in groups of six, or in other words the main line Q Q is divided into a sextuplex. The trailing arms at A and B are shown in contact with one of the No. 6 contacts at *d* and *h* respectively. Polarized relays R^6, R^1, R^2, R^3, and R^4 are connected respectively to five of the six circuits so provided. The sixth circuit in this case, it will be observed, is left unconnected to the polarized relay R^5. The relays are connected by means of switches S, S^1, S^2, S^3, S^4, and S^5 with the keys K, K^1, K^2, K^3, K^4, and K^5, whose front and back stops are connected with the split battery M B, grounded at Y. It will also be observed that the polarized relays R, etc., can be connected with the keys, or with the ground at X, and can therefore be used either for transmitting or receiving. The station at Providence is similarly provided with the polarized relays R^6, R^1, R^2, R^3, and R^4, switches S^6, S^1, S^2, S^3, and S^4, keys K^6, K^1, K^2, K^3, and K^4, and main battery M^1 B^1, split and grounded at Z, and all connected as shown. If now, the circuits being as described, the switch S, at Boston, be placed so as to connect the relay R with the key K, a message may be sent over the main line Q Q to the Providence end, where it may be connected with a receiving relay and received. Instead of this, however, this circuit is in this case connected by means of the wire *m* with the Providence end of the second wire Q' Q'. The Boston end of Q' Q' is connected by the wire *n* with the relay R^5, which we have referred to as not being connected with the remaining circuit of the sextuplex circuits. Under these circumstances the message sent from Boston to Providence by the key K, through the relay R, is received at Boston by the receiving relay R^5, the latter relay being connected as shown by the switch S^5 to the ground at X.

When the key K, at Boston, is connected to its front stop, as shown, an impulse goes out from the main battery M B, and traverses the following circuit, viz., through the conducting wire *a*, *a*, to key K, switch S, relay R, conducting wire *b*, *b*, *c*, contact *d*, trailing arm *f*, conducting wire *e*, *e*, main line Q, Q, conducting wire *g*, trailing arm *f'*, contact *h*, conducting wire *i*, *j*, *k*, *l*, and the remaining seven contacts to *m*, second main line wire Q', Q', and conductor *n*, from which it passes through the receiving relay R^5, where it is received, and finally to the ground at X, through *o*, S^5, *p*, *q*, *r*, and *s*.

Now the practical value of this experiment, as has already been pointed out, consists in the very evident fact that if the message can be sent from Boston to Providence over the sextuplex circuit and received back clearly and distinctly in Boston over an independent wire, then, since it makes no difference in what direction this independent wire may extend, no matter how far its distant end may be from the synchronized distributor, within say the limit of 75 or 100 miles, important cities lying within that distance of New York can be readily placed in independent connection with Boston, and the outlying cities of Boston can be placed in independent connection with New York, by the operation of the two synchronized distributors A and B.

Though the leg Q' Q' in this case was but 50 miles in length, yet, from what we have already said, it is evident that much greater distances could be successfully operated in this manner. With printing instruments, since 72 separate circuits can be maintained, the number of cities that can be connected with one another by means of but two synchronized distributors is clearly very great.

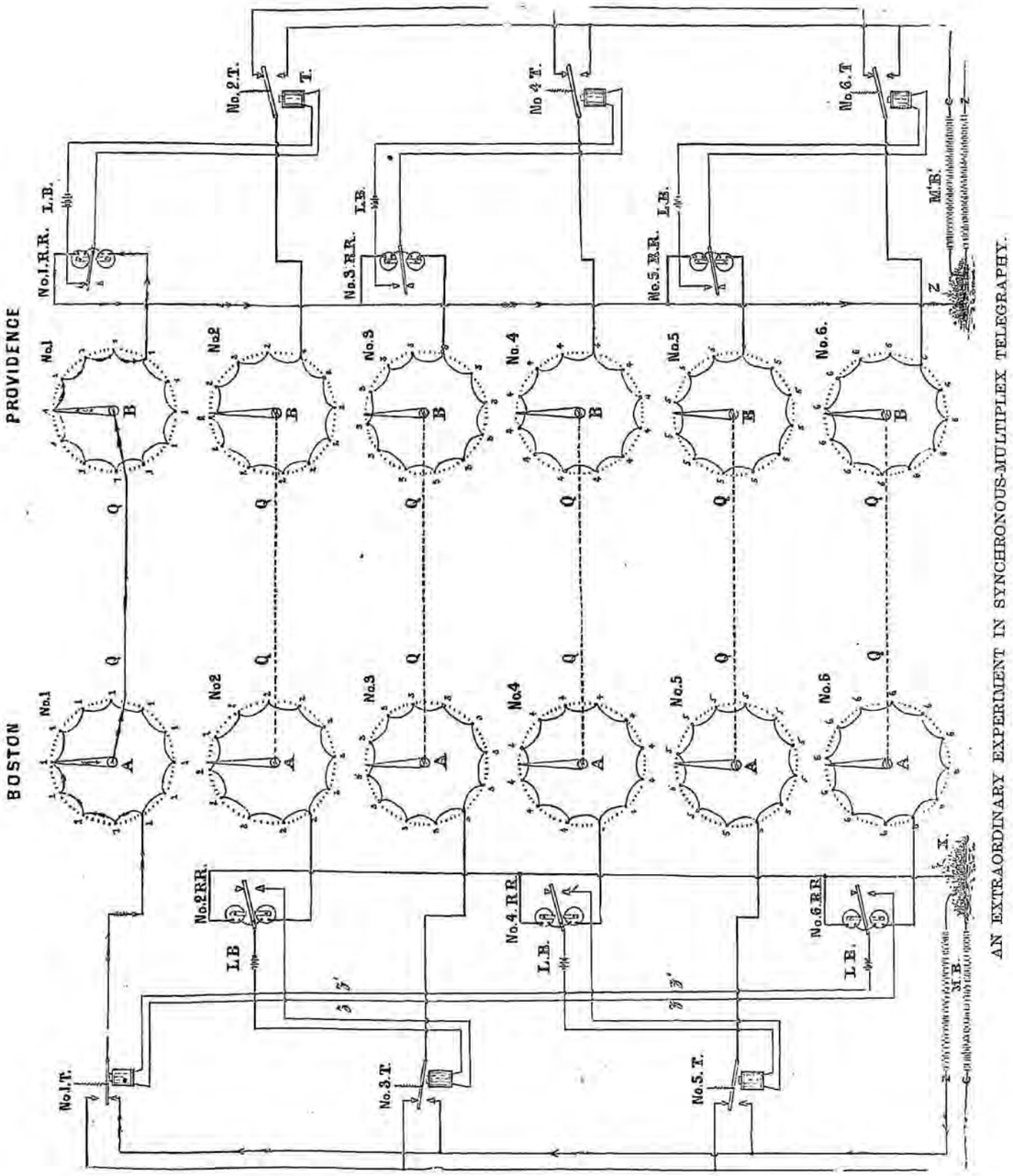
CENTRAL HIGH SCHOOL, Philadelphia, July 17, 1884.

AN EXTRAORDINARY EXPERIMENT IN SYNCHRONOUS-MULTIPLEX TELEGRAPHY.[1]

BY PROF. EDWIN J. HOUSTON.

A most extraordinary experiment, which is not devoid of practical bearings, has quite recently been made by Mr. Patrick B. Delany with his synchronous-multiplex telegraphic system, which is now in operation between Boston and Providence, a distance of about 50 miles. As the experiment about to be described almost challenges belief in its possibility, I desire to state that I have seen it myself and can vouch for the accuracy of the facts herein stated. Wishing to try the adaptability to the synchronous system of the automatic repeaters employed by other telegraphic systems, whereby great distances are overcome, Mr. Delany, on three different occasions during the past two weeks, successfully employed such repeaters with his system, the last trial, viz., that on Monday, the 14th of July, being witnessed by myself. One of the two wires erected by the Multiplex Company between Boston and Providence was divided into six separate and distinct Morse circuits. The first of these circuits, which we will call No. 1, was operated to Providence, at which place the receiving relay, on that circuit, was connected to the transmitting instrument on No. 2 circuit. In Boston the receiving relay of No. 2 circuit was connected to the transmitting instrument of No. 3 circuit. In Providence the receiving relay of No. 3 circuit was connected to the transmitting instrument of No. 4 circuit. In Boston the receiving instrument of No. 4 circuit was connected to the transmitting instrument of No. 5 circuit. Finally, in Providence the receiving relay or instrument of No. 5 circuit was connected to the transmitting instrument of No. 6 circuit. Under these arrangements, the transmitting instruments at both stations were operated by the receiving relays on the other circuit the same as if worked or operated by an operator; in other words, the six separate and distinct circuits, established by the synchronizing apparatus between Boston and Providence, were arranged so as to form in reality a continuous wire stretched six times between Boston and Providence, with both of its free ends in Boston. Mr. Delany then transmitted a message on the No. 1 circuit from Boston to Providence, which was automatically retransmitted from Providence to Boston on No. 2 circuit; again automatically retransmitted from Boston to Providence on No. 3 circuit; again automatically retransmitted from Providence to Boston on No. 4 circuit; again automatically retransmitted from Boston to Providence on No. 5 circuit, and finally automatically retransmitted from Providence to Boston on No. 6 circuit; or, in other words, the message sent from Boston on the first circuit went to Providence, came back to Boston, again went to Providence and came back to Boston, when it again went to Providence and came back to Boston, at which final station it was clearly read by an operator without the loss of a single character, or the slightest impairing of its original clearness, and without the aid of any

1. From advance sheets of the *Journal of the Franklin Institute.*



AN EXTRAORDINARY EXPERIMENT IN SYNCHRONOUS-MULTIPLEX TELEGRAPHY.

person except the transmitting operator on the No. 1 circuit in Boston and the receiving operator on the No. 6 circuit in Boston. All this was done over one and the same wire, so that the message traveled in its back and forth journeys between the two cities about three hundred miles, or six times the distance between the two cities. A reference to the drawing will render the preceding explanation clearer. The synchronized distributing instruments, A and B, situated at Boston and Providence respectively, are connected by the single main line Q Q. The line is divided into six circuits, which we will call respectively No. 1, 2, 3, 4, 5, and 6. For the purpose of rendering the connections clearer, these six circuits have been separately represented with the synchronized distributing instruments connected therewith. It will of course be understood that but a single main line, Q Q, furnished with but two distributing instruments, viz., one, A, at Boston, and the other, B, at Providence, exists between the two cities.

This being premised, an inspection of the drawing will show that the main battery, M B, at Boston, split and grounded at X, is connected with the No. 1, No. 3, and No. 5 transmitters, which are respectively connected with the No. 1, No. 3, and No. 5 sextuplex circuits of the single main line, Q Q. At Providence the main battery, M' B', split and grounded at Z, is connected with the No. 2, No. 4, and No. 6 transmitters, which are respectively connected with the No. 2, No. 4, and No. 6 sextuplex circuits of the single main line, Q Q. At Providence the No. 1 receiver is connected with the transmitter of No. 2 circuit, so that a message sent from Boston by No. 1 transmitter would be received by the No. 1 receiving relay in Providence, when, by means of the local battery L B, would have its message repeated by No. 2 transmitter, and sent to Boston over the No. 2 sextuplex circuit of the main line Q Q. This message would be received in Boston by the No. 2 receiving relay, when by means of the local battery L B, connected with No. 2 receiving relay, would have its message automatically repeated by the No. 3 transmitting instrument at Boston, over the No. 3 sextuplex circuit of the main line circuit Q Q, to Providence, at which place it would be received by the No. 3 receiving relay. This relay, in its turn, through the aid of the local battery connected with it, automatically transmits the message through the No. 4 transmitter, over the No. 4 sextuplex circuit of the main line Q Q, to Boston, at which place it is received by the No. 4 receiving relay. This relay, in its turn, through the local battery L B, connected therewith, automatically repeats the message to the No. 5 transmitting instrument, over the No. 5 sextuplex circuit of the main line Q Q, to Providence, where it is received by the No. 5 receiving relay. Finally this relay, in its turn, through the intervention of the local battery L B, connected therewith, automatically repeats the message to No. 6 transmitter, over the No. 6 circuit to Boston, at which place it is received by the No. 6 receiving relay, by the operator stationed at the Morse instrument connected with that relay. This receiving relay is, in reality, shown in the drawing as connected with No. 1 transmitting instrument at Boston. The purposes secured by means of this connection will be hereafter explained. Briefly, the course taken by the message in its journeys to and from the two cities, is as follows, viz.:

From Boston, by No. 1 transmitter over main line to No. 1 receiving relay at Providence.

From Providence, automatically repeated to No. 2 transmitter, and sent over main line through No. 2 sextuplex circuit to No. 2 receiving relay at Boston.

From Boston, automatically repeated to No. 3 transmitter, and sent over main line through No. 3, sextuplex circuit to No. 3 receiving relay at Providence.

From Providence, automatically repeated to No. 4 transmitter, and sent over main line through No. 4, sextuplex circuit to No. 4 receiving relay at Boston.

From Boston, automatically repeated to No. 5 transmitter, and sent over main line through No. 5, sextuplex circuit to No. 5 receiving relay at Providence.

Finally, from Providence, automatically repeated to No. 6 transmitter over the main line through No. 6, sextuplex circuit, to the No. 6 receiving instrument at Boston, where it is received by the operator.

It is not necessary, as might be supposed from the drawing, that the characters received on the group of segments comprising No. 1 circuit must, necessarily begin to return on the next adjoining segment of No. 2 circuit. Suppose, for example, that a character concluded on the segments of No. 1 circuit, where the trailing contact indicates on the drawing. By the time the armature of the relay has moved in response to this character, and has placed No. 2 circuit in connection with the battery for return transmission, the trailing contact may be on the second or third contact of the No. 2 circuit. This, however, will make no difference, since both the distributing arms are synchronous, so long as the rotating arms pass over two or three of the No. 2 segments, while the armature of the transmitting magnet is in contact with either of the poles of the battery. When we consider that a message made up of many words, each word containing numerous letters, each letter consisting of numerous separate and distinct characters, and each character, under the synchronous-multiplex system, consisting of numerous impulses, was transmitted with certainty over a single wire, back and forth, this number of times, without the slightest interruption the one with the other, the fact almost challenges belief. While these results may appear almost incredible, what I am about to describe may at first thought seem impossible. I will endeavor, however, to give such a description of this experiment as I saw it actually made, as will persuade the reader, that so far from being impossible, its possibility must necessarily follow as a natural result of the exquisitely maintained synchronism secured by Mr. Delany's ingenious inventions. After having successfully established by actual trial, the possibility of the use of repeaters in his synchronous system, Mr. Delany connected the relay of the sixth circuit in Boston, where the message was received, with the transmitting instrument on No. 1 circuit. Now under these conditions, on making one dot on No. 1 instrument, this dot started on its zig-zag way, to and from Providence, in the manner already described, only, instead of terminating on the sixth circuit in Boston, as in the previous experiment, the same dot was automatically retransmitted into the first circuit, and again sent on its journeying between the two cities, only on its arrival at the sixth circuit, in Boston, to be again automatically retransmitted over this same winding route. An inspection of the drawing will render this connection clearer. Instead of the message being received by an operator stationed at the No. 6 receiving relay at Boston, this instrument is furnished with a local battery, L B, and connected by means of the conducting wire $z z$ and $z' z'$ with the No. 1 transmitting instrument at Boston. By this means, therefore, the operator at the No. 6 receiving relay is dispensed with, since this receiving relay again automatically sends the signal by means of the No. 1 transmitting instrument on its zig-zag way between the two cities, until the No. 6 transmitter at Providence again sends it to the No. 6 receiving relay at Boston, which again automatically repeats it by the No. 1 transmitter over the six circuits between the two cities, and so on indefinitely. In this manner, then, the original signal kept passing from city to city over the different circuits in perfect rotation, without the intervention of any operator, save the one who first started the signal on its ceaseless journeyings. Timing the intervals of the returns of the original signal between the two cities over the sextuplex circuits, it was observed that it traveled between Boston and Providence over these six circuits 300 times, or covered the distance between Boston and Providence 1,800 times in each minute, thus making an entire distance of 1,500 miles a second, or

90,000 miles a minute, or for five minutes that a dot was kept going the original signal in that short time traveled no less than 450,000 miles, or eighteen times as far as the entire distance around the world at the equator. Of course it will be understood that most of this time was taken up by the automatic movements of the armatures of the receiving relays and the levers of the transmitting instruments. The experimental figures so obtained, however, furnish interesting data as to the rapidity, precision, and certainty with which these masses of matter may be influenced by the electric current. An observer, noticing the progress of this experiment, and reflecting on the numerous complex conditions requisite for its successful accomplishment, cannot but be singularly impressed by its extreme wierdness. Bearing in mind the exceeding complexity of structure of the synchronous-multiplex message, and the necessity for maintaining practically absolute synchronism between the distributing and receiving instruments at each end of the main line, a feeling of incredulity almost unconsciously arises in the listener's mind. Surely this wierd traveler must miss some of his numerous connections, and once missed, his journeys are at an end forever. But when the signals are heard recurring with their automatic regularity, as though tossed to and fro between the cities by a mighty juggler; when they are heard as mysterious whisperings in the air, that follow too rapidly on one another to permit more than a part to be intelligently received, we almost lose sight of the actual conditions of the experiment, and begin to vaguely doubt whether Mr. Delany has not received a visit from Puck, who is bewildered by the rapidity with which he is forced to travel; and when the strange repetitions of the original signal follow one another with such rapidity and regularity as to produce a kind of a prolonged but mysterious murmur, we are almost disposed to believe that these sounds are the plaints of the Wandering Jew, as he ceaselessly speeds on his never-ending journey.

CENTRAL HIGH SCHOOL, Philadelphia, August, 1884.

EDUCATIONAL METHODS OF THE SIEMENS & HALSKE ELECTRICAL WORKS.

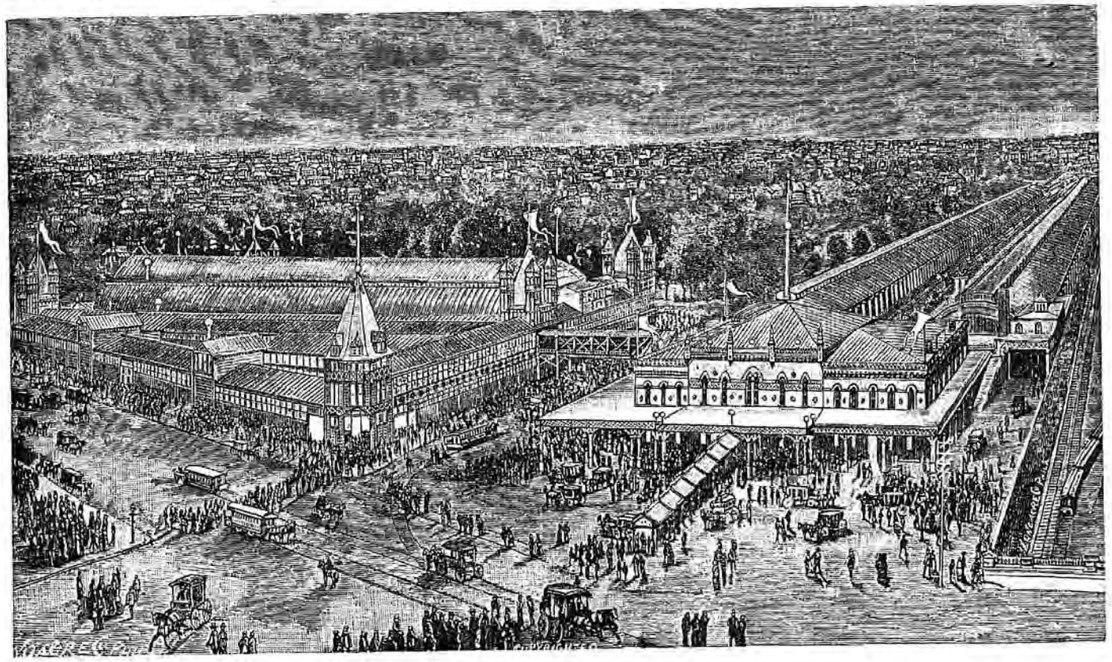
THE following is an extract from the official report of the Royal Commissioners on Technical Instruction, under direction of the British government:

"At the works of Siemens & Halske, electrical engineers, Berlin, from 800 to 900 men are employed, and the firm have other works employing 1,600 men, thus making a total of 2,400. Electrical machinery of all kinds was being made, and some very remarkable rotary steam engines for driving the former. The men work ten hours a day, and nearly all the work is done by piece.

Most of the heads of departments have received a theoretical training in schools or classes outside the shop, and the high and deserved reputation of the firm, their great success as electrical engineers, and the liberal wages paid to their workmen (probably the highest that were being paid in any establishment that we visited), all testify to the technical efficiency of at least the superior workmen and foremen, in an industry which necessarily requires high scientific knowledge. We were conducted over the works by Dr. Werner Siemens, brother and partner of the late Sir William Siemens. There is in the works, which in mechanical arrangements and appliances are remarkably complete, a large physical laboratory, where important experiments and tests of the greatest delicacy are carried on. Dr. Frölich, a distinguished physicist, who is associated with Dr. Siemens in business, is at the head of this department. The manager of the works was educated at the University. In the course of an interesting conversation, Dr. Siemens favored the commissioners with his opinions upon education as it relates to young men intended for mechanical pursuits. His own education at school was neither technical nor scientific. He joined the Prussian army and became an officer, but as a military man he worked at science for amusement, with great energy and enthusiasm, as also did his brother, Sir William Siemens. He was of the opinion that in Germany there are more Polytechnic schools than are necessary. Their number was due to the educational rivalry of the several German States, each of which had aimed at achieving technical superiority over the rest. The motive was excellent, but the result had been costly; yet, considering that the standard of education throughout Germany had thereby been raised, the people felt that their sacrifices had been more than justified. The number of Polytechnic schools might wisely be reduced, and the money thus saved might be devoted to the establishment of intermediate schools, which are much needed. As to the education of workmen, everything depended upon the means and natural abilities of the student. He would give, first, a sound elementary education up to fourteen. At that age it was natural that the workman's son should be required to earn wages and learn a trade, but he ought to attend a night school. After two or three years he should enter, if he could dispense with wages, a foremen's school (like that at Chemnitz), from which, by showing remarkable ability, he would be able to pass to the highest technical schools. If a young man were compelled to work for wages in order to maintain himself, the above course would be impossible. The night school, however, was still open to him, and the highest possibilities were accessible to perseverance and ability. In his own works he selected young men of promise, and paid their expenses at these schools, in some cases dividing the year between school and work, so as to enable the students to keep up the connection between the school and the shop. The great problem with him had been to find and train the most promising youths. Although it too often happened that he lost the services of the men after they had been improved, yet in the main the advantages compensated him for the sacrifices. Dr. Siemens said that workmen in other trades very commonly save up their money in order to have a course of schooling and attend classes in the slack times of winter. Many employers assist their young men in this endeavor to improve themselves, and consider that the gain in increased efficiency is worth the outlay. Dr. Siemens considers it well worth the while of the State to seek out talent wherever it can be found, and to develop it for the benefit of the State as well as of the individual. The foundation of bursaries for this purpose, uniting the shops and the schools, would be very useful, for it often happens that a young man's talent is only brought out by the practical application of scientific principles at the bench or forge. For the sons of employers, and for really clever boys of any class who could afford the time, he considered that the old classical education, as a grand and broad foundation, was best after all as the foundation of subsequent training. But for ordinary boys it was a pity to waste time on dead languages which they seldom mastered. There was no direct good in Latin and Greek, but there was always direct good in chemistry."

THE WORLD'S PLATINUM.

THE platinum diggings of Russia are near Bogoslowsk, Miask, Newjansk, and Nischnei Tagilsk, in the Ural Mountains. They were discovered in 1824; and at six places—in 1868, 1869 and 1870—from 494,000, 367,000, and 263,000 tons of sand, 6,675, 7,770, and 6,455 pounds of raw platinum were obtained respectively. The metal contains always some other substances; thus LePlay found, in a sample from Nischnei Tagilsk, 75.1 platinum, 1.1 palladium, 3.5 rhodium, 2.6 iridium, .6 osmiridium, 2.3 osmium, .4 gold, 1 copper, and 8.1 iron. The raw metal is almost entirely sold to England and Paris, at a price of about £14 per pound of pure metal. It is there refined before it can be worked up into manufactured articles.



THE EXHIBITION BUILDING AND ITS SURROUNDINGS.

THE INTERNATIONAL ELECTRICAL EXHIBITION AT PHILADELPHIA, SEPT. 2, 1884.

THE active preparations for the International Electrical Exhibition at Philadelphia, which have been in progress during the past six months, have successfully terminated, and the grand result of all this toil, anxiety and expense now awaits the coming multitude of visitors. Such an aggregation of electrical devices—experimental, useful and ornamental—has never before been seen in America; and vast as it is, it may be considered but the threshhold of the coming electrical era, when schemes which are now but visionary, shall become important, and we may add indispensable, factors of civilized life. This exhibition, as is now generally known, has been organized under the auspices of the Franklin Institute, of Philadelphia, and having received appropriate recognition from the national government, its results will be generally looked forward to with the belief that they will be not only authoritative, but trustworthy. The Electrical Commission appointed by the President of the United States, upon the authority of an act of Congress, is composed of the following gentlemen: Professors Henry A. Rowland, M. B. Snyder, George F. Barker, Simon Newcomb, William H. Wahl, C. F. Brackett, R. A. Fisk, J. Willard Gibbs, Edwin J. Houston, John Trowbridge, Francis C. Van Dyke and Charles A. Young. The commission met at the Franklin Institute, August 7, and formally organized. The following officers were elected, who will also act in similar capacities for the National Conference of Electricians: Prof. H. A. Rowland, chairman; Prof. M. B. Snyder, recording secretary; Prof. George F. Barker, corresponding secretary. Professors Newcomb and Wahl in conjunction with the officers named form the executive committee. The meeting was continued on August 8th and a list of conferees prepared who have since been officially invited to participate in the conference, the opening session of which is to be held at 3 p. m., September 8th, in the Lecture Hall. The following rules have been adopted to govern the deliberations of the conference: First, the officers of the commission shall be corresponding officers of the conference. Second, all questions which are proposed for discussion shall first have the approval of the commission. Third, a general invitation shall be extended to the conferees to present papers at the sessions of the conference, it being understood that all papers thus presented shall first have been submitted in abstract to the executive committee and approved by them.

The following gentlemen constitute the Board of Examiners of the exhibition:

M. B. SNYDER, Prof. of astronomy, Central High School, Phila., *Chairman*.
A. V. Abbott, New York.
Dr. Harrison Allen, Philadelphia.
Lieut. James Allen, Washington, D. C.
Prof. William A. Anthony, Ithaca, N.Y.
Prof. Luigi d'Auria, Philadelphia.
Col. C. H. Banes, Philadelphia.
F. A. P. Barnard, pres. Columbia College, New York.
George H. Barrus, Boston, Mass.
Dr. Roberts Bartholow, Philadelphia.
Hugo Bilgram, Philadelphia.
Prof. C. F. Brackett, Princeton, N. J.
David Brooks, electrician, Phila.
Prof. Gould H. Bull, Philadelphia.
Charles Bullock, chemist, Phila.
Prof. Henry S. Carhart, Evanston, Ill.
C. Chabot, Philadelphia.
Cyrus Chambers, jr., Philadelphia.
Prof. Pliny E. Chase, Haverford College, Penn.
Luther E. Cheney, Philadelphia.
Charles L. Clarke, electrical engineer, New York.
Hugh A. Clark, prof. of music, Phila.
R. E. Crawford, mechanical engineer, Philadelphia.
Dr. Charles M. Cresson, Philadelphia.
Prof. Charles R. Cross, Boston, Mass.
Prof. John B. DeMotte, Greencastle, Ind.
Prof. J. E. Denton, Hoboken, N. J.
Prof. Amos E. Dolbear, College Hill, Mass.
Prof. Daniel Draper, New York.
Dr. William Drysdale, Philadelphia.
Dr. C. B. Dudley, Altoona, Pa.
Louis Duncan, ensign U. S. N., Baltimore, Md.
G. Morgan Eldridge, Philadelphia.
Prof. Moses G. Farmer, New York.
Lieut. Bradley A. Fiske, Washington, D. C.
Dr. J. Foster Flagg, Philadelphia.
Prof. Charles H. Fisher, Boston, Mass.
Prof. William E. Geyer, Hoboken, N. J.
Frederick Graeff, Philadelphia.
Dr. William H. Greene, Philadelphia.
Prof. William H. Harding, Bethlehem, Pa.
Prof. William H. Harkness, Washington, D. C.
Prof. Mark W. Harrington, Ann Arbor, Mich.
Prof. C. S. Hastings, New Haven, Ct.
Carl Hering, electrician, Phila.
Major D. P. Heap, Washington, D. C.
Emanuel Hildebrandt, librari'n, Phila.
Dr. Walter M. James, Philadelphia.
Washington Jones, mechanical engineer, Philadelphia.
N. S. Keith, consulting electrician, New York.
C. J. Kintner, examiner in electricity U. S. Patent Office, Wash'gton, D.C.
Dr. George A. Koenig, Philadelphia.
Prof. A. L. Kimble, Baltimore, Md.
Prof. S. P. Langley, Allegheny, Pa.
Prof. Gaetano Lanza, Boston, Mass.
W. Barnet LeVan, mechanical engineer, Philadelphia.
J. H. Linville, mechanical engineer, Philadelphia.
Dr. James H. Lloyd, Philadelphia.
Col. Wm. Ludlow, hydraulic engineer, Philadelphia.
Prof. Wm. D. Marks, University of Pennsylvania.
Prof. T. C. Mendenhall, Columbus, O.
Prof. M. Merriman, Bethlehem, Pa.
Capt. O. E. Michaelis, Philadelphia.
Lieut. John Milliss, New York.
Dr. Chas. K. Mills, Philadelphia.
Prof. Henry Morton, pres. Stevens Institute, Hoboken, N. J.
Lieut. James B. Murdock, Phila.
Prof. Simon Newcomb, Wash'ton, D.C.
Prof. F. C. Nipher, St. Louis, Mo.
Dr. Isaac Norris, Philadelphia.
John Nystrom, mechanical engineer, Philadelphia.

A. E. Outerbridge, chemist, Phila.
Prof. H. M. Paul, Washington, D. C.
C. B. Penrose, Harvard physical laboratory, Philadelphia.
Prof. E. C. Pickering, Cambridge Mass.
Dr. S. M. Plush, electrician, Phila.
Frank L. Pope, electrician, New York.
W. J. Phillips, Philadelphia.
T. W. Rae, mechanical engineer, N.Y.
Theodore D. Rand, Philadelphia.
Prof. R. E. Rogers, Philadelphia.
Prof. William A. Rogers, Cambridge, Mass.
Prof. H. A. Rowland, Baltimore, Md.
Prof. S. P. Sadtler, No. 204 North 34th street, Philadelphia.
Samuel Sartain, engraver, Phila.
E. Alexander Scott, electrician, Phila.
Dr. Carl Seiler, Philadelphia.
Samuel Smedley, city surveyor, Phila.
H. W. Spangler, engineer U. S. N., Carlisle, Pa.
Louis H. Spellier, clock maker, Phila.
Horace W. Sellers, mechan'l engineer.
Wm. P. Tatham, pres. Franklin Institute, Philadelphia.
Prof. B. F. Thomas, Columbia, Mo.
Prof. R. H. Thurston, Hoboken, N. J.
Prof. F. C. Van Dyck, New Brunswick, N. J.
P. H. Van Der Weyde, pres. N.Y. Electrical Society, Brooklyn, N. Y.
Dr. William H. Wahl, sec. Franklin Institute, Philadelphia.
Prof. Leonard Waldo, New Haven, Ct.
D. R. Walker, city electrician, Phila.
Lewis S. Ware, chemist, Philadelphia.
Prof. C. K. Weed, Ann Arbor, Mich.
Prof. J. Burkitt Webb, Ithaca, N. Y.
S. Lloyd Wiegand, mechanical engineer, Philadelphia.
Dr. Horatio C. Wood, Philadelphia.
Lieut. A. B. Wyckoff, Philadelphia.
Prof. Chas. A. Young, Princeton, N. J.
Joseph Zentmayer, optician, Phila.

A meeting of section D of the American Association for the Advancement of Science, which is also to be held at Philadelphia, Sept. 4–10, will present several features of interest to electricians. The annual address will be delivered by the president, R. H. Thurston. Among the papers to be read before the body will be the following: "The Economy of the Electric Light," A. Stirling, New York; "The Giant's Causeway and Portrush Electric Tramway," with working model of the same, W. A. Traill, Portrush, Ireland. Among the subjects to be brought up for discussion will be "Modern Applications of Electricity From a Mechanical Standpoint."

The main building of the Electrical Exhibiton, at the corner of 32d street and Lancaster avenue, at its junction with Market street, is readily accessible from all parts of the city. The station buildings of the Pennsylvania Railroad, immediately adjoining and connected to it with a foot-bridge, have been arranged as an annex.

Here the waiting room has been utilized as a grand lecture hall. It has been tastefully fitted up and is admirably adapted for its proposed use. Its lofty ceiling has afforded an opportunity to display on the side walls mammoth charts of the world, in stereographic and Mercator's projections. Upon these are clearly depicted the existing systems of international electric communication. The routes of abandoned and projected cables are also delineated by lines of different colors, while tables of appropriate statistics are conspicuously displayed, thus giving practically a bird's-eye view of the immense electrical network which is thus graphically presented to the mind. The room is beautifully and appropriately draped, and the platform encircled with potted plants, the whole presenting a cheerful and comfortable hall in which to listen to the various interesting exercises which are to form some of the most important features of the exhibition.

THE OPENING CEREMONIES.

At noon on September 2d the lecture hall was filled with invited guests from various parts of America and Europe, who were assembled to witness and participate in the opening ceremonies. The scene was enlivened by appropriate airs rendered by the Germania Orchestra, and the formal exercises were opened by the introduction to the audience of Mayor Smith, by Hon. George H. Boker. The mayor, in behalf of the city, welcomed the guests in appropriate phrase, after which they formed and marched in procession across the bridge leading to the gallery of the main building, where the exercises were continued. Prayer was then offered by Rev. J. S. McIntosh, D. D., after which President William P. Tatham of the Franklin Institute was introduced, and delivered the following opening address:

LADIES AND GENTLEMEN:

When our first parents were in the Garden of Eden they received the primeval command to increase and multiply; to replenish the earth and subdue it. After the fall, mankind could do little to subdue the earth by their unaided strength, and even after subjecting the lower animals to their service, their life was merely a precarious struggle for existence. When, however, in process of time, through the increase of their knowledge they were able to avail themselves of the forces that exist in the other elements, they made some progress in subduing the earth. When they called in the aid of fire to extract metals from the ores, and of water to furnish them with mechanical power and to float their ships, and of air to drive their sails, their general course was advancing, but their progress was not assured and was liable to reversals. But after they had been able to combine the forces which exist in fire and water, and to avail themselves of the magnificent energy of steam, the progress of the race became assured, steady and comparatively rapid. During all this time there was a force pervading all nature which was little understood and of which no use was made. In the early ages of Greece it was observed that a piece of amber upon being rubbed acquired the power of attracting light substances, and this attractive force was called electricity. Subsequently it was found that other substances besides amber acquired the same power by friction, and in process of time machines were invented by which the force thus created could be separated from its original sources and collected together. Its properties were examined, its attractions and repulsions weighed and measured, and its methods of discharge observed.

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It was near the spot where we now stand, about 100 years ago that Dr. Franklin raised his kite to the clouds and drew down their fire on the string. He examined its properties and found them to be identical with those of the electricity of his laboratory, and proved that the disruptive discharge of the lecture room was exemplified on a large scale in nature by the lightning and thunder; and it was here, in Philadelphia, about 50 years ago, that Dr. Robert Hare taught us that the convective discharge of the lecture room had also its example in nature, on a magnificent scale, in which the air, mingled with the vapor of water, acted the part of the pith ball and conveyed the electricity to the upper regions of the atmosphere; that this convective discharge of electricity from the earth produced an ascending column of air which successively caused the low barometer, the in-blowing of the winds, the vortex and the whirlwind. We have thus traced electricity from the slight influence exerted by rubbed amber to the lightning and the whirlwind; those wild and mighty powers which from the beginning—by saint, by savage and by sage; by poet and by prophet—have been recognized as marking the visible presence of God. Witness the thunder and lightning of Sinai, when the law was delivered to Moses; witness the voice by which God answered Job out of a whirlwind; witness the thunderbolt of Jupiter, which clothed his arm with invincible power and made him sovereign of the gods; witness, in short, the poetry of all ages. But electricity in this form was too wild and mighty to be used by man in his efforts to subdue the earth. About the beginning of the present century, however, a tame variety of this force was discovered in chemical electricity, and subsequent discoveries revealed to us magnetic electricity, which is now the most copious source of supply of this force, and in this form it has been harnessed and made obedient to the will of man. It illuminates his path with a radiance excelled only by the surpassing glory of the sun. It carries his messages with a celerity which the boldest imagination has never dared to describe. It reverses the action of chemical affinity and performs miracles in chemistry and metallurgy. In a thousand ways it serves the convenience and comfort of man, and by adding velocity to all his powers before possessed, it has increased, immeasurably, his capacity to execute the primeval command to subdue the earth. The use of electricity is still in its infancy. We may not predict the future, but we may examine what is going on among us at present, and to this end the managers of the Franklin Institute, deeming that the time had arrived when the present state of electrical science, and the practical applications of it should be shown to the American people, have undertaken the present exhibition. If any one desires full information on this head, I would say to him "Look around you." We have invited the nations; they are here by their ambassadors, their commissioners, their philosophers, their artisans, and their works. The electrical world of the United States is here fully represented—nay, it may be said it is here *en masse*. The Governor of Pennsylvania is present and has kindly consented to open the exhibition, and for that purpose we await the pleasure of his Excellency.

Governor Pattison then came forward amidst hearty applause from the vast assemblage which had now gathered on the main floor, and after pleasantly alluding to the vast industrial interests of Pennsylvania, and its consequent appreciation of all improvements, he formally pronounced the exhibition open. Immediately the vibration of an electric bell intimated that the practical work would now begin, and sparkling jets from the central fountain mingling with the bright sunbeams from the clear autumn sky, fittingly announced to the waiting spectators that matter had been put in motion.

THE EXHIBITION.

Passing through the main entrance a busy scene is at once presented, for although great progress has recently been made in bringing order out of chaos, several days must elapse before the mass of exhibits will be in a completed condition, The Edison Electric Light Company, offers a very comprehensive display of its interesting productions, which occupies the most conspicuous location in the main building. A bronze bust of the great inventor, is here seen, which illuminated by his incandescent lamps will be gazed upon by thousands, to whom his name has become as familiar as that of electricity itself. Upon two large tables may be seen the various conductors and couplings used in his subterranean system, the different sizes symmetrically arranged, while farther along quietly repose six dynamos which may be closely examined by the curious. The Edison exhibit extends across the entire eastern end of the building, and in addition to the attractive display of incandescent lighting; the automatic chemical telegraph, district systems and printing instruments, with other ingenious devices, give a partial idea of the extensive field which has been cultivated by Mr. Edison in leading up to the present stage in electrical progress, with which he has been so closely identified. A sparkling truncated cone supported by a complete cylinder of tiny crystal tubes, the entire structure brilliant with scores of glowing bulbs is perhaps the most attractive and conspicuous feature of the Edison department. The dynamo machines from which the electricity is derived for the various systems, are located along the northern side of the building, along which are also ranged the steam engines and boilers by which they are driven. The United States Electric Lighting Company makes a grand display of the various branches of the Weston system, and occupies a large space at the north and south sides of the building, immediately adjoining the Edison department. With its arc and incandescent systems, the improved and powerful incandescent lamp just brought out by Mr. Weston, the cataract of illuminated water dashing through an artificial grotto, it is safe to say that this exhibit, embracing also the laboratory of Mr. Weston will be one of the most attractive in the building. Along the northern boundary of the section is emblazoned in letters composed of Maxim lamps the words "The United States Electric Lighting Co., Weston System." A large collection of fine dynamo machines will also be a conspicuous feature. This company furnishes a large proportion of the general lighting of the building. The Brush Electric Company illuminates the exterior of the building with arc lamps, besides occupying two of the arched girders, by which it assists in the general lighting of the interior. In order to demonstrate the beauty of the Swan incandescent system, two connecting apartments have been elegantly fitted up and neatly furnished forming a very attractive exhibit. The arrangement of rooms for the purpose of practically illustrating the adaptability of the incandescent light for domestic use, is a very pleasant feature of various exhibits. The Thomson-Houston system is exhibited in very thorough detail, by practical working apparatus, as well as by models, and skeleton forms of dynamo machines which enables a visitor to gain considerable insight as to the marked peculiarities of the various lamps and generators here shown.

The Van Depoele electric lighting system of Chicago has the material on the ground for a large display, including locomotive headlights. All of this apparatus is very handsomely designed, and will, no doubt, be tastefully arranged. Practical telegraphy is so far demonstrated only in the branch offices of the Western Union and United Telegraph lines. The Delany Synchronous Multiplex system, which is elsewhere fully explained in our columns, has plenty of space, in which the instruments have been so placed as to be readily accessible to those who desire to examine one of the greatest inventions in the telegraphic field. Separate instrument tables have been provided for the accommodation of the necessary operators, should a practical demonstration of its capacity be required.

The American Bell Telephone Company's extensive display is on hand, but not thoroughly arranged. It forms a very complete history of telephonic progress, and many of its parts are now fulfilling perhaps the most useful period of their existence, as curiosities in an electrical museum. Here may be seen a model of the Reiss telephone, and the original Bell telephones, exhibited at the Centennial, which have been repaired and brightened up for the occasion. The original hand telephone is here, resembling a stone-cutter's mallet, and nearly as large. Various samples of the Edison, Gray and Phelps telephones are shown, and these are the combined inventions upon which the great telephone monopoly has been founded. The latest model of the multiple switch-board is in position, and in a few days the "Hello" girls will render complete the inside view of a modern telephone exchange. Within this space the Western Electric factories of New York, Chicago and Boston also give a splendid display of their wares, perfect in finish and design, and embracing every possible requirement for a telephone or telegraph outfit. The Standard Electrical Works, of Cincinnati, display a very complete collection of magneto call-bells, designed for telephone service, with other appliances, which will merit the special attention of all who are interested in that line. This exhibit appeared to be the only one of equal extent which was in entire readiness at the opening, although many others were sufficiently advanced to interest all visitors; indeed the mysterious character of the mechanical labor involved in "getting ready" appeared in itself to be an attraction to those who are not familiar with such work. The Time Telegraph Company dispenses its usefulness throughout the building, and the headquarters are tastefully fitted up with ingenious apparatus which is deserving of close examination. The standard electric regulator, manufactured at the company's establishment in Brooklyn, is an elegant specimen of workmanship, and, being mounted in a case fitted with plate glass on all sides, every part may be closely scrutinized. There are "second-beating" clocks, and "minute-jumpers"; working dials of beautiful design ranging from 36 inches in diameter down to 6 inches. These are located in various parts of the exhibition, and as the close inspection of dynamos by visitors makes it prudent for them to leave their watches outside of the building, the universal distribution of absolutely correct time will be heartily appreciated. A special wire will convey to this department the time signals from the Washington observatory. A beautiful parlor time-piece with a pendulum of unique design, also samples of regulators for business offices, the synchronizing and electrically driven clock systems, complete this very interesting display. The Clay Commercial Telephone Company occupies a very conspicuous location, tastefully fitted up with a complete outfit of its apparatus. This will no doubt receive the lion's share of attention from those who are interested in telephonic progress.

An apparently complete array of the numerous models of Daniel Drawbaugh's inventions accompanied by patent office drawings, is another attraction to telephonists. This is believed to be the first opportunity which has been afforded the general public to examine this collection, which we believe has not, as yet, been put into actual commercial operation.

In the tower over the main entrance may be found the headquarters of the American Institute of Electrical Engineers. A light cheerful room has been courteously assigned to them by the management, and here the tired member may retreat to a quiet restful spot which he will find well equipped with tables, writing material, and the appropriate literature of the day.

The Telemeter Company shows in actual operation the novel inventions of Charles L. Clarke, by which the readings of any description of dials or gauges may be duplica-

ted at distant points. By the use of this system the manager of an establishment may be kept constantly informed of the temperature in different departments, or the pressure of air, gas, or steam as registered by the ordinary gauges used for those purposes, to accomplish which a single wire is led from each dial to the office. Variation in the height of water, deep sea temperature, also warning of the heating of cargoes on board vessels, are a few of the many uses to which this system may be adapted.

Among the many useful devices exhibited for the utilization of the electric current for household and manufacturing purposes, is the electro-pneumatic valve, recently patented by Prof. W. S. Johnson, and manufactured by the Milwaukee Electric Manufacturing Co., of Milwaukee, Wis. It is adapted to a great variety of uses, the regulation of steam and hot air heating systems being, perhaps, the most important. It is obvious that any attempt to manipulate an ordinary steam valve by magnetism would require the use of a very powerful current. By this system compressed air is utilized to furnish the requisite force to operate the valves, which is merely controlled by electro-magnetism, consequently a very feeble current is sufficient to actuate the largest valve. The air is stored in a reservoir where it is forced under pressure of a small air pump. For ordinary buildings sufficient air for a day's use may be compressed in one minute. The air is conveyed from the reservoir to the valves by small pipes, one-eighth inch gas

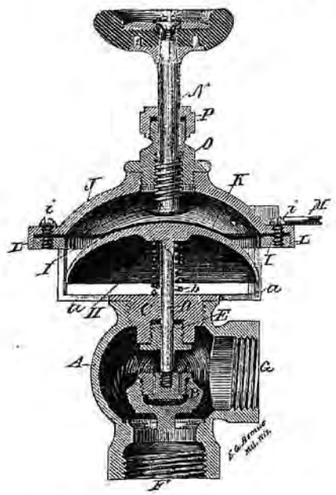

FIG. 1.—DIAPHRAGM VALVE.

pipe being suitable. Figure 1 is a sectional view of the diaphragm valve which is suitable for steam, water or brine systems. It consists of an ordinary valve body, with an expansible diaphragm which serves to close the valve. A is the valve body; B the valve disc; C the packing box through which the stem passes; D is a saucer-shaped piece, fastened to the upper end of the stem D. The valve is held open by the steel spring *b*, which presses upward on the saucer H. Above this saucer H is the umbrella-shaped piece J, held by the standards *a*, *a*. Upon the under side of the piece J, and fastened firmly to its edges to produce an air-tight joint, is the flexible diaphragm K made of cloth and rubber. There is an opening through the pipe M into the chamber formed between the metal piece J and the diaphragm K. It is easily seen that if air, under pressure, is admitted through the opening M, that the valve will be pushed downward to its seat. When the air is allowed to escape from above K, the spring *b* will open the valve B to its full extent. To show with what force the valve is seated, suppose that 60 pounds of steam are being carried, and that B is an inch valve. In this case the area of B is .78 of an inch, and the steam pressure upon it is 47 pounds, the area of the diaphragm K, as made for inch valves, is 9 square inches. If the air pressure is 10 pounds per square inch, the valve B will be seated with a force of 90 pounds, which is 43 pounds in excess of the steam pressure. Allowing 10 pounds as a sufficient excess of pressure of air it will be seen that a 10 pound air pressure will operate the valve B against 100 pounds of steam. As both the area of the diaphragm K and the air pressure may be increased at pleasure, it is evident that the valve B may be operated against any pressure of steam. For low pressure steam heating, where no more than 10 pounds of steam are carried, as little as 1½ pounds of air pressure is said to operate the valve perfectly. A pipe leads from M to the electro-pneumatic valve proper, which is shown in figure 2.

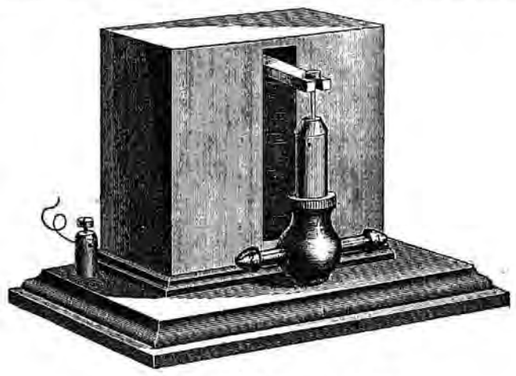

FIG. 2.—ELECTRO-PNEUMATIC VALVE.

Here it is connected by means of a piece of soft rubber tubing to the nipple 2 at the end of a tube which is connected with the chamber of the air valve. Upon the opposite side is a similar tube and nipple from which the air is conveyed from the reservoir to the valve. The stem of the valve is connected with an armature lever of a simple electro-magnetic instrument similar to an ordinary Morse sounder. The small hole near the top of the valve allows the air to escape when the diaphragm valve opens. Where this device is used for controlling temperature, a thermostat is used which may be adjusted to any desired degree of heat. This opens and closes the battery circuit as the temperature fluctuates, thus actuating the electro-pneumatic valve, as will be readily understood. It is believed that the use of these valves, which may be operated by a few cells of gravity battery, will obviate most of the defects which now exist in steam heating systems. When the electric valves are applied to a system of heating they are always all open when the steam is down. There is no need of going about a building to see to them, for the pipes are all free and no water can collect to freeze. When the fires are started the steam passes freely to all parts of the system. A feature of the electric valve that is especially valuable for offices is the fact that after the fires are started in the morning and the room is warm enough, the steam will be shut off, although no one has yet arrived in the office. With the ordinary valves the temperature of the office is usually unbearably hot when the occupant arrives at 8 or 9 o'clock. Not only does the electric valve shut the steam off from rooms that are warm enough, but since it shuts off the radiating surface that is not needed the pressure rises accordingly and distributes the heat to rooms which are not yet warm enough, thus acting as an equalizer. It is thus possible to keep up a sufficient pressure to warm the coldest room in the building without in the least overheating any other room.

THE ELECTRIC RAILWAY PATENTS.

THE application of electricity as a motive power for the operation of railroads, seems destined to become at no distant day, an important factor in the solution of the problem of an economical, convenient and safe means of intercommunication, not only in cities and suburban towns, but in sparsely settled and mountainous districts, where the conditions are such as to forbid the advantageous employment of the ordinary steam locomotive. The electric system is already in successful operation in several places in Europe, and a number of experimental plants have been fitted up and satisfactorily operated in the United States, although no extensive and permanent installation has yet been made in this country, a circumstance which is perhaps due to the hitherto unsettled question of priority of invention in respect to certain controlling features of the invention. After a protracted contest of more than four years, a decision has been rendered by Examiner of Interferences McArthur, in the United States Patent Office, in which Stephen Dudley Field is adjudged to be the prior inventor of the essential features of the electric locomotive, and to be entitled to a patent therefor.

The history of this case, as disclosed by the testimony which has been taken in the interference proceedings, is of much interest. Applications for patents were filed by three different inventors, viz.: Stephen D. Field, then of San Francisco, Cal., March 10, 1880; Ernst Werner Siemens, of Berlin, Germany, May 12, 1880, and Thomas A. Edison, of Menlo Park, New Jersey, June 3, 1880. The Examiner, in the course of his elaborate opinion, says:

> The evidence discloses the fact that the parties are independent inventors. Neither had any aid or suggestion from the other. One resides in New Jersey, another three thousand miles westward, in California, the third as many miles eastward, in Germany. Each one has independently demonstrated the feasibility of the invention by building a track and running an electric locomotive over it.

The first and most important question which arose was as to what constituted the invention. More than thirty years ago several inventors, among whom we recall John F. Boynton and Frederick Coombs, had proposed electric railroads for the conveyance of mails and light parcels, consisting of a car driven by an electric motor, running upon metallic rails, through which the electric current was conveyed to the motor from a stationary galvanic battery at the terminus. Working models of such apparatus were constructed and were exhibited in various parts of the country, as many of our older readers will no doubt recollect. It has been argued that the modern electric railway system, as set forth in the applications of these inventors for letters patent, merely consists in substituting the dynamo-electric machine for the galvanic battery employed by the early experimenters, and that no invention whatever is required to make this substitution. This, however, is a very superficial view of the question. The careful analysis of the Examiner clearly shows that a real invention is involved, and that this invention is a *system*, and must be considered apart from the particular mechanical constructions in which it has been embodied. These constructions and devices, separately considered, present no novelty whatever; they are all old and in common use in the art. "The invention," says the Examiner, "consists in combining them in the manner set forth, for the purpose described. Such being the case, a conception of it must involve all the elements of the combination." The Examiner found that there were two distinct subjects of invention embraced in the claims of the contestants taken collectively, giving rise to a like number of separate issues necessary to be decided. These are defined in his own language as follows:

> To satisfy the *first issue*, five conditions must be met: *First*, there must be one or more stationary dynamo-electric machines; *second*, conductors extending along the whole line of the railway and formed partly or wholly of the rails; *third*, a vehicle running on the rails; *fourth*, a dynamo-electric machine fixed on the vehicle for imparting motion thereto; *fifth*, the electrical connection between the two dynamo-electric machines must be maintained continuously by the wheels of the vehicle with or without the aid of contact-rollers, springs or brushes.
>
> In the *second issue*, the *first* element is the stationary power-driven dynamo-electric generator; the *second*, a conducting circuit formed wholly or in part of suitable insulated rails; *third*, a wheeled vehicle; *fourth*, an electro-dynamic motor impelling the same; *fifth*, one pole of the motor must be in connection through one line of conductors with the generator, and the other pole similarly connected through the other line of conductors, completing a closed metallic circuit through the generator and motor.

The principal distinction between the two issues is that the first requires the connection between the rails and the motor which propels the vehicle to be made *through the wheels*, while the second is not so limited. Divested of technicalities, it may be said, therefore, that the distinguishing principle of the invention is *the transfer, by means of an electric current, of mechanical energy from a stationary source of power to a traveling motor for utilizing the power thus produced.*

The invention having thus been defined, it remained to be considered which of the contestants was entitled under the law to priority. The evidence taken in the case is quite voluminous, but it will only be necessary to give an abstract of the essential points proved by each contestant in order that the merits of the case may be understood.

It appears from the testimony of W. H. Milliken—an engineer who was engaged in erecting machinery for propelling street cars by an endless cable, on a San Francisco street railway in the winter of 1877—that at that time Field had fully matured the plan of his invention in his own mind, and had also determined, in part at least, upon the details, substantially as the apparatus was subsequently constructed by him. Milliken testified that Field then said to him that he would dispense with the expensive traveling cable and substitute electric conductors. He said in reference to the details of the invention:

> His first plan was to use a slotted tube, similar to the one used in rope roads, with the conductors laid in that tube, and the idea that he showed me, making sketches on cards, was to put the wires on poles, and running a contact car or carriage on these wires, running to the car, connected with the dynamo-electric machine to be placed in the car, this dynamo machine to be connected with the wheels of said car.

Referring to some sketches made by Field in September, 1878, Milliken said:

> These sketches illustrated the slotted tube with conductors, and the using of the rails that the cars run upon, as conductors. In these sketches he described the manner of connecting the rails so as to make a continuous conductor of each rail.

About May 1, 1879, Field described his plans, so far as he had then matured them, to Milliken, in considerable detail. The latter further testifies:

> His plan was to form one or more stations along the line of the road, with stationary engines or other motive power to drive one or more dynamo-electric machines, with conductors to transmit the current generated by the dynamo-electric machine to a second dynamo-electric machine in a car; the same car mounted on wheels; this second dynamo to be arranged to transmit the motion to the wheels of the car in which it is mounted. We discussed the several plans and made drawings or sketches of the plans of using the rails as conductors, or using the slotted tubes with the conductors laid in them; also the placing of the conductors on poles like telegraph wires.

The evidence, therefore, shows that as early as 1877–'78 Field had devised several methods of conducting the electric current to the traveling motor, viz.: by the rails of the track, by suspended conductors, and by conductors laid in a tube beneath the roadway, the latter being the preferred plan for the particular application upon which Field was then at work, the propulsion of street cars. Similar explanations of his plans were made by him to George S. Ladd and others in 1879, as appears by the evidence.

Owing to an error on the part of the Patent Office, since corrected, Field was not permitted, in this proceeding, to avail himself of any of the foregoing testimony to prove his

invention at an earlier date than May 10, 1879, at which time he applied to an attorney in San Francisco to prepare a caveat describing his invention. This caveat was filed in the Patent Office on May 21, 1879, and the Examiner holds that it "clearly describes and illustrates the subject matter in controversy."

At this period Field's means were quite limited, and he soon after left San Francisco and removed to his native town, Stockbridge, Mass., where he continued to prosecute his experiments as his finances and opportunities permitted. A model of his apparatus was completed October 10, 1879, and an application for a patent was duly filed on March 10, 1880, although his first actual working embodiment of the invention does not appear to have been made until a later date.

The evidence brought forward in behalf of Mr. Edison, consisting mainly of the testimony of his employés and assistants at Menlo Park, shows that in the latter part of 1878 he had in mind an electric railroad system, comprising at least the following features, viz.: A central station with dynamo machines driven by steam or water power, a track built upon a wooden trestle-work, serving to insulate the rails, and a car carrying an electric motor geared to one of its axles, and receiving its current through the rails of the track from the dynamo at the central station. None of the witnesses were very explicit as to the details of the system as disclosed to them by Mr. Edison, and the explanatory sketches and diagrams said by them to have been made at the time, were not preserved, although the Examiner suggests that if this had been done it might have had an important bearing upon the conclusion. In this connection he says:

This fact operates rather in favor of the belief that the alleged conception of the invention in September, 1878, was not complete and full, because it is Mr. Edison's habit to date and keep his sketches, and that these were not kept, seems to indicate that they were not of sufficient importance or clearness to warrant their preservation.

A number of rough sketches were produced in evidence, bearing dates of May 18 and 21, 1879, which were made by Mr. Edison in the presence of John Kruesi, as testified to by the latter, but the Examiner holds that "they do not disclose any further details than those gleaned from the conversations prior to this time." But a drawing carefully made, to scale, of an electric railroad, locomotive and car, was also produced, which was made by Kruesi, and was dated May 18, 1879. This drawing shows a direct and return conductor separate from the rails, the connection being made by brushes. On May 24, Kruesi made 2 other drawings of electric locomotives, in which the conductors are shown as consisting partly of the track rails, and he testified that between May 18 and 24 it was decided to dispense with special conductors and make use of the rails alone for that purpose. The Examiner, in view of this testimony, holds that on May 24, 1879, Edison "not only had a full and complete conception of the invention, but had intelligently disclosed it to others." In the spring of 1880 Mr. Edison constructed at Menlo Park, a railway track of considerable length, a quarter of a mile or more, upon which he made a successful experiment with his electric locomotive on May 13, of that year, and shortly after, on June 3, 1880, he filed his application for a patent.

The invention of Dr. Siemens having been made in a foreign country, he necessarily labors under the legal disability imposed upon him by the provisions of section 4923 of the Revised Statutes, viz.:

Whenever it appears that a patentee, at the time of making his application for the patent, believed himself to be the original and first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery, or any part thereof, having been known or used in a foreign country before his invention or discovery thereof, *if it had not been patented or described in a printed publication.*

No evidence was adduced to show that either Field or Edison had any reason to suppose that he was not the original and first inventor of the contested invention at the time of filing their respective applications. Hence no proof of the prior completion of the invention, or of its reduction to practice, or even of its commercial use in Germany, could be of any avail, in a legal point of view, as against the dates of Field and Edison, whose inventions were both made in the United States. It follows that Siemens cannot establish for himself date of invention anterior to the date of a patent or of a printed publication describing the invention, and it has repeatedly been held by the Supreme Court that such a description must contain so full and explicit a description of the invention as to enable any person skilled in the art to which the invention appertains to construct and practice the same without the exercise of more than ordinary mechanical skill.[1]

At the Industrial Exposition held in Berlin in the summer of 1879, the electric railway of Dr. Siemens was shown in actual operation upon an endless railway, and attracted great attention in scientific circles, as well as among the visitors to the exposition. On June 9, 1879, a meeting of the Association for the Promotion of Industry in Prussia was held in Berlin, on which occasion Dr. Siemens who was present, at the request of one of the members explained, at some length, his electric railway in the exposition. A stenographic report of the proceedings at the meeting was published immediately afterwards and was produced in evidence. A translation of the remarks of Dr. Siemens on this occasion will be found of much interest, and we accordingly insert it.

The arrangement, as shown at the exposition, is as follows:—It is a small narrow-gauge railway, in which the rails return into themselves forming a continuous circuit. In the centre is laid a third rail—a vertical flat rail. The locomotive carries two rollers by which it is placed in connection with the centre rail. It must be determined by experiment whether rollers or brushes will be preferable for this purpose. In the machinery hall is placed a dynamo-electric machine, and a similar one is employed for the locomotive. The former is driven by a steam engine, and one of its terminals is connected with the centre rail, the other being placed in connection with the outer rails. This produces a difference of electrical condition between the centre and the outer rails. The dynamo-electric machine of the locomotive now becomes an electro-magnetic motor, its coils being traversed by an electric current passing from the inner to the outer rails, the wheels of the locomotive forming the contact with the outer rails. Hence, on whatever part of the track the locomotive may be, it is traversed by the current proceeding from the dynamo machine in the machinery hall, and continues its course until this current is interrupted. * * * A member inquiring if the central rail was well insulated, Dr. Siemens replied:—It is insulated as well as possible, in so far as it is never in metallic connection with the outer rail. The middle rail can be entirely dispensed with, if the road is so constructed that the two rails, as well as the right and left wheels of the train are never in metallic connection.

In view of this publication, the Examiner holds that on July 9, 1879, Dr. Siemens had completed the contested invention, and fully disclosed it to others, besides having reduced it to a practical working form. A number of railways have since been constructed in different parts of Europe upon the plans of Dr. Siemens. His application for a patent in the United States was made on May 12, 1880.

From this review of the evidence in the case, it is clear that Field, if not absolutely the first to conceive of the invention, was certainly the first to do so in a manner entitling him to receive a patent under the statute, for although debarred by an error of the Patent Office, already alluded to, from receiving any benefit, in this proceeding, from the testimony of Milliken and others, showing that he made the invention prior to May 10, 1879, yet even this late date was eight days in advance of the date on which his competitor, Edison, reached the same point.

Although Field was thus the first to conceive the invention, the evidence shows that it was first reduced to practice by Edison, at Menlo Park, on May 13, 1880. Under these circumstances, the rule first laid down by that eminent jurist, Justice Story, that as between independent inventors, "he who invents first shall have the prior right, if he is using reasonable diligence in adapting and perfecting the same, although the second inventor has, in fact, first perfected the same and reduced the same to practice in a positive form,"[2] has been followed in all subsequent decisions down to the present day. The sole remaining question to be decided was whether reasonable diligence was shown by Field in "adapting and perfecting" his invention. A considerable volume of evidence was taken on this point, from which it appears that his resources were very limited, not only while he remained in California, but for some time after his removal to New York, and that his application for a patent was prepared by a friend who not only did the work but advanced the necessary fees for filing the application, in order that the inventor's rights might be protected until such time as he was able to reimburse him. It will be noted further, that this application was filed before the expiration of the year during which the inventor was under the protection of his caveat, which, as we have already seen, was filed on May 21, 1879. Every effort appears to have been made, both by Field himself and by the party who acted as his solicitor, to procure the necessary means to construct an operative electric locomotive and track, but these efforts were not successful until the summer of 1881, when the inventor succeeded in procuring sufficient capital to justify him in making an actual experiment.

The Examiner, in view of the facts of which we have given an outline, adjudges Field to be the prior inventor of the contested invention, and hence entitled to the foundation patent. The opinion of the Examiner fills over 50 closely written pages, and has evidently been prepared with a degree of care commensurate with the importance of the issues involved. We think that few will be disposed to question either the ability with which the points at issue between the contestants have been discussed by him, or the substantial justice of the conclusions which he has reached.

1. Seymour v. Osborn. 11 Wall, 511.

2. Reed v. Cutter. 1 Story, 590.

ABSTRACTS AND EXTRACTS.

SIR WILLIAM THOMSON IN AMERICA.

The following extracts are from an interview with this distinguished scientist, as published in *The New York Herald*. Speaking of the new Mackay-Bennett cable, he said:

"The Atlantic cable which was laid in 1866 cannot be compared with it. All the improvements that scientists have made within the past 18 years in regard to the disposition of cable wires, the placing of copper and the insulation of gutta percha can be found in the new cable and in none of the old ones. Then how successfully the work has progressed from the start! Why, the first Atlantic cable was begun before 1858 and failed four times before it was completed in 1866. So hazardous was the undertaking that the Agamemnon, on board of which I was, was thought to be lost, and it was not until ten days had passed that we were able to communicate with the land. No such difficulty has occurred in this instance, and I am informed by Professor Fleming Jenkin, who sends me every few days the latest news about the cable, that the tests at Waterville have worked most satisfactorily, and that everything points toward a speedy completion of the construction. Hence I say without any qualification that it is a splendid example of American enterprise, and, as I have superintended its construction I ought to be a pretty fair judge."

"What rank do you think America holds in science, Sir William?"

"I think she is second to none among the nations of the earth. America, England, Germany and France—in these four countries science has made faster strides within the past half century than ever before. Italy, too, has of late contributed largely to scientific study. But for honest research and bold scientific inventions America has not yet been beaten. Indeed, it seems to me that the genius of the American people impels them in this direction, and that, whatever may be their achievements in art and literature, it is in science that they will ever score their greatest victories. America's great mathematicians are known all over the world. Indeed, in this branch of science America has made as many advances of late as France, whose chief strength lies in physics and mathematics."

"Has it ever struck you, Sir William, that it would be advisable to have distinct professorships of electricity and magnetism established in the leading schools and universities?"

"That is a good idea, sir, and it might well be carried out as far as possible. Some universities have such a professorship, but not all. To lecture fittingly on electricity and magnetism a man should be thoroughly grounded in most of the other sciences, and that is the reason, I presume, why a single professor is sometimes required to give instruction on all the modern sciences. The world, however, is rapidly recognizing the fact that most of the great modern inventions are due to electricity, and that it is going to be 'the science of the future,' and it is certain that every year its study will be more insisted on by all nations."

"How long do you intend to remain here, Sir William?"

"Until November. I go to Montreal at the close of this month to preside over the mathematical section of the British Association. My main duties will be to introduce Lord Rayleigh, who has been appointed president of the association, and to deliver an address entitled 'Step Toward a Kinetic Theory of Matter.' The choice of Lord Rayleigh as president is very significant, as he is by far the ablest mathematician in England. By a 'kinetic theory of matter' I mean a theory which maintains that all the properties of matter are merely attributes of motion. After leaving Montreal I go to Johns Hopkins University to deliver a course of lectures on higher physical mathematics. After that I keep a few other engagements and return home in November to resume work at the University of Glasgow."

"What scientific work are you engaged in at present?"

"I am inventing some measuring instruments which ought to be of some practical use. I am also engaged in reprinting my lectures. The most curious, though not, perhaps, the most important of my inventions is the siphon recorder, which has worked something of a revolution in submarine telegraphy."

ELECTRICITY AS A MOTIVE POWER.

Joseph V. Meigs, in a communication to the New York *Sun*, makes the following criticism upon the use of dynamos for railway purposes:

"There is a difficulty which has not been met and must be met to make the application of this wonderful transmissible power useful where steam now is. To make it plain to those experimenters and investors who are developing and have the means of developing their ideas, I will state my view. The locomotive—the steam engine—has exactly the same power developed on the crank from the cylinder at one revolution a minute that it has at 2,800 revolutions, were that possible. The dynamo requires 2,800 revolutions a minute to develop its power. At 1 revolution a minute the dynamo has no power. Then to move trains by a dynamo, this 2,800 revolutions must be reduced to 1 revolution.

"It cannot be done with economy by any well-known

means, such as gearing or belting. If a slow-running dynamo, which had the power applied as they apply it in a rotary manner, *i. e.*, without cranks, could be made, that would be a boon indeed to mankind, and you would not hear of successful trials without an immediate adoption.

"The cost of transfers of power from a great speed to a low speed will prohibit the general use of electricity as a motor, where cost is a consideration, until a slow running electric power is discovered.

"The horse is an expensive power, because he is not proof against disease, and he must eat whether used or not; besides he is unhealthy. It may be, therefore, that the drawbacks I have mentioned may not be so expensive as to deter men from using electricity where so small a force as a 2 h. p. is needed."

RESTORATIVE EFFECT OF LIGHTNING.

A CORRESPONDENT of the *New York Times*, writing from Port Jervis, N. Y., August 6th, after detailing the peculiar freaks of the lightning in Pike County, Pa., gives the following narrative, which, however, has not been scientifically verified, so far as we have learned.

"Abraham Cuddeback until a few weeks ago was a highly successful and much respected merchant of Damascus, Penn. Engaged in the general merchandise business, he won the respect of all his neighbors and was doing a nice business. About three months ago, while attending church in his native place, he was stricken with paralysis and had to be carried to his home. Ever since that time he has been helpless, and many physicians from New York and Philadelphia have been called in and have striven to give him aid, but all to no avail. His wife has been untiring in her devotions to her husband, and everything that loving care or surgical aid could devise has been lavished upon the sufferer and he has received no material benefit. About three weeks ago, utterly broken down in health and despondent, the family removed to Matamoras, Penn., directly opposite this village. A physician from this place has been in constant attendance upon Mr. Cuddeback since his removal to Matamoras. During the prevalence of a heavy thunder storm that visited this section of the country yesterday, a huge ball of lightning struck a house very close to the residence of Mr. Cuddeback, and entering the house through an open window, hurled Mr. Cuddeback to the floor from a chair on which he was sitting. He was alone at the time, and after lying on the floor unconscious for some time, his wife came in and helped him to a chair. Restoratives were applied and Mr. Cuddeback was soon himself again, and the happy discovery was made that he whom a few minutes before was almost bereft of all feeling in his limbs, had entirely recovered the use of those members and was in apparent good health. Another peculiar phase of the case is that Mr. Cuddeback had no appetite a few weeks previous to this time, and after his strength and senses were restored he was taken suddenly hungry, and now has his accustomed appetite. The case is attracting considerable attention among the medical fraternity, and the many friends of the family in this vicinity are showering their congratulations on the happy pair for the recovery of Mr. Cuddeback's faculties and strength. The case is to be fully investigated by the physicians who have had charge of this most remarkable case."

LITERATURE.

REVIEWS.

Workshop Receipts: for manufacturers, mechanics, and scientific amateurs (third series). By C. G. W. LOCK. London and New York: E. & F. N. Spon.

It is impossible to pursue the study of electricity and magnetism, especially where the more practical steps of experimentation are indulged in, without entering into the borderland of chemistry, metallurgy, and mechanics. While originality in resource is in every way commendable, valuable time is often wasted in consequence of ignorance of various essential processes which are well known in the arts. Under the modest title of *Workshop Receipts*, a little volume has been prepared, which it is not too much to say no amateur scientist or electrician can afford to be without. A constant companion, thoroughly versed in all that pertains to the complete electrical laboratory, is at hand to answer every question that may arise, so far as is possible through the medium of a text book. The composition and properties of the numerous alloys, the nature of various metals, and the processes of extracting them from the ores: the welding, melting, casting, brazing, lacquering and ornamenting of sheets, rods and tubes of various materials; the manipulation of cements, enamels and glazes, are all fully explained in detail.

It is the electrical department, however, comprising 130 closely printed pages, and illustrated by numerous practical diagrams, that we feel most at liberty to recommend to our readers as a guide to those who take a just pride in "doing their own work;" not because this plan is better or even cheaper, but on account of the satisfaction they derive from their success, and the experience they gain in overcoming the various obstacles which arise during the progress of their labors. The alphabetical arrangement of topics is, perhaps, inconvenient, as different plans of alarms for various purposes are first in order, while still further along in the book are given directions for manufacturing the batteries and bells which are, of course, the important elements of such installations, and must be supplied in the first instance. The reader, however, may learn first the convenience of having alarms for high and low water, for time signals, and watch clocks, and thus be tempted to make and use them. Several forms of galvanic batteries are described, and their functions given. The general principle of a thermopile is explained, but the instructions are not sufficiently detailed to govern the actual manufacture of such an apparatus. Specific directions are given for making electric bells and connecting them in circuits for different purposes. Induction coils, condensers, and resistance coils are also very fully treated of. Among the subjects which are of special interest at the present time, such as dynamos, motors, telephones and storage batteries, all are thoroughly elucidated. It will be a matter of surprise, however, to those who like a little of everything, to find that electric lighting has not deserved a share of attention in this otherwise complete work. The fact that it has been incidentally referred to in relation to dynamos, also that the preparation of carbons for lighting purposes is described, seem to indicate that the omission may have been accidental. It is true that enough could be written or compiled upon this one subject to fill the entire volume to the exclusion of other matter, yet, on the contrary, the leading features of arc and incandescent lamps could be lucidly set forth in a dozen pages in a very satisfactory manner. Microphones, photophones, and the phonograph are separately treated and form interesting features for the investigation of the curious. What the unabridged dictionary is to the printing office, this volume is to the workshop. A table of contents and copious index render the information readily accessible to the busy worker.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

The Electrician (London), August 2 & 9.—The Elements of Electric Light Engineering.—*E. C. Rimington.* The Transformation of Electrical Energy.

Engineering (London), July 25.—Secondary Batteries, No. II. (illustr.)—*Thomas Wilkins.* Electric Lighting at the International Health Exhibition, No. III.

English Mechanic (London), July 11.—Anders' Telephone Transmitters. Causes of disturbance in telephonic communications. July 21.—Experiments with the Hand Dynamo, No. II.—*S. R. Bottone.*

RECENT PUBLICATIONS.

Amidon, Dr. R. W. Electro-Therapeutics. New York: *G. P. Putnam's Sons.* 100 p.

Heap, Major D. P. Corps of Engineers U. S. A. Electrical appliances of the present day; being a report on the Paris Electrical Exhibition of 1881. New York: *D. Van Nostrand,* 1884. 288 p. 8°.

Lock, C. G. W. Workshop Receipts for manufacturers, mechanics and scientific amateurs. (Third series.) New York: *E. & F. N. Spon,* 1884. 480 p., illustr., 8°.

Laws of the United States and the several States and Canada, relating to telegraphs. Compiled for the Baltimore and Ohio Telegraph Co. New York: *J. Kempster.* 302 p. 8°. Sheep.

Preble, W. P., Jr. Patent Case Index. Contains lists of all the cases involving patents for inventions as reported in the United States Supreme and Circuit reports, etc., to 1884, with a synopsis of law points. Second edition. Boston: *Little, Brown & Co.* 707 p. 12°. Sheep.

Thompson, Prof. Silvanus P. Recent Progress in Dynamo Electric Machines. New York: *D. Van Nostrand* 114 p. 18°.

Winton, J. G. and W. J. Millar, C. E. Modern Steam Practice and Engineering and Electricity. New York: *James Leffel & Co.* 4 vols. 900 illustrations.

Watkins, John. Comparison of the numbers and sizes of the new legal standard wire gauge with previously known numbers and sizes of the Birmingham wire gauge and the value in 1,000th of an inch or mil. One large sheet. New York: *E. & F. N. Spon.*

CORRESPONDENCE.

NEW YORK AND VICINITY.

Underground Privileges Vetoed.—Office Location of the Mackay-Bennett Cable Co.—Telegraph Companies, Exchanges and Bucket-shops.—Overhead Wires as Lightning Protectors.—A Building Struck in the City.—The Clamor for Electric Street Lighting.—The United Telegraph Companies.—The Cut-Rate Policy.

ALTHOUGH the underground law is likely to remain a dead letter for over a year to come, it is causing no little trouble to the various corporations for the reason that they have heretofore profited by the ignorance of property holders as to the exact legal rights of telegraph companies. Now, however, a change has come about, and landlords are prone to act upon the supposition that telegraph lines *must* go underground. The Commercial Cable Co., in order to be consistent with the views of one of its principal supporters, *The New York Herald*, applied for permission to place its wires underground through the city. In thus avoiding a deal with subterranean promoters who have already obtained certain privileges of this character, the company encountered an obstacle to its petition in the shape of a veto from the Mayor, who said:

I am desirous that telegraph companies should be afforded all consistent facilities for putting their wires underground * * * but it will not do to grant privileges so entirely unrestricted in their scope as that which this resolution grants. * * * Such a privilege without restrictions would be an unknown quantity; it would be limited only by the convenience and whims of the company itself.

He concluded by saying, that

While obliged to veto this resolution, he would gladly approve one for the proper laying of this company's wires underground when so drawn as properly to protect the interests of the city.

The first floor of 21 Wall street, corner of Broad, has been vacated by its previous occupants, preparatory to being fitted up for the Mackay-Bennett Cable Co., as it is more generally known. Although this is one of the oldest telegraph locations in the city, it is still among the best, for notwithstanding the many changes in business centres, the financial interests of the city continue to gravitate toward Wall street, and here the telegraph companies have always extended their best facilities and gained their choicest patronage. In its missionary efforts to preserve the morals of the community from the pernicious effects of stock gambling, the Stock Exchange usually invokes the assistance of the Gold and Stock Telegraph Co., so that when the New York Petroleum Exchange expressed its intention of dealing in stocks as well as oil, the New York Stock Exchange at once began its warlike tactics. The quotation instrument was removed by the telegraph company from the floor of the Petroleum Exchange, after which quotations were obtained by the members from the printer in the Seaboard Bank close by. The bank officers were then notified that if the instrument was made use of in this improper manner it would be removed. The president of the Petroleum Exchange intimated that if the Gold and Stock Telegraph Co. furnished quotations at all, the entire public, including the new stock board, would have the right to them. It is claimed by the Stock Exchange that the Petroleum Exchange in undertaking to deal in 10 share lots is thus degraded to the level of a "bucket-shop." Relative to this question the defense of the Western Union company in a suit for $2,200 damages brought against it by C. T. Yerkes is of interest. This was the result of an error in the transmission of a message for the sale of grain. The telegraph company says that Yerkes & Co. are not dealers in grain and produce, as claimed, but are merely the proprietors of a bucket-shop for gambling in market fluctuations; that the message was not insured by repeating back; and finally, that it was sent for the purpose of effecting an illegal wager, and that the entire transaction was for illegal purposes. Such an outburst of righteous indignation can scarcely be equaled outside of a political platform.

It has been claimed that the network of overhead wires which covers this city has effectually guarded the buildings from the destructive effects of lightning, by providing such numerous paths for it to pursue, that the bolts were diffused and rendered comparatively harmless. This appears to be not only a sensible theory, but strongly supported by experience, yet there was at least a single exception on the 4th of August. A tall flag-staff on the top of a school building at No. 108 Broome street was struck by lightning, which bent the weather vane to one side, followed the pole to the braces which supported it at the roof, thence through the building in various directions, without however effecting any serious damage. It is said that the same building was struck a year ago. In fact the records of the present season seem to indicate a tendency for lightning to strike twice in the same place, which would seem to prove that certain localities are for some reason favorable to such discharges.

At a meeting of the Aldermen on July 28th, several resolutions were adopted requesting the Commission for Lighting the Streets to substitute the electric light for gas in a large number of the streets of this city, including most of those leading to the ferries. Among the number were Houston street, from river to river: Greenwich avenue, from Sixth to Eighth avenue: Centre street, from Chambers to Broome: Avenues B and D, from Houston street to Fourteenth, and also Paradise Park. After a number of the resolutions had passed, Alderman O'Neil moved that the votes by which they were passed be reconsidered. "The substitution of the electric light for gas will entail great loss on the gas companies," said the Alderman, "and, besides, we have voted that all the wires in the city shall be put underground. We don't want to give any company a chance to string more. The matter should be referred to a committee for careful investigation." Alderman Grant favored the electric light in preference to gas. "The Superintendent of Police has said," remarked the Alderman, "that every electric light is worth an extra policeman." The motion to reconsider was lost, and Alderman O'Neil soon evolved a resolution providing that all the streets of the city be lighted by the electric light. Alderman Grant amended it so as to make the resolution read "all the principal streets so far as practicable." After some squabbling the resolution was laid on the table.

The operating rooms of the Postal and Bankers' and Merchants' Telegraph companies have been united at the main office of the latter, No. 187 Broadway, accessible also from No. 5 Dey street. This is immediately opposite the Western Union building, and for some time to come there will be plenty of room. The details of the pooling arrangement do not appear to have been wholly perfected, and there have been complaints of irregularity in the payment of the employés of at least one of the contracting parties, which, however, it is not thought will continue. Should it become chronic, a strong argument will be presented against the policy of a horizontal reduction in rates by competing companies. The new rates have been advertised in some of the city papers, and they are also made known through the medium of bulletin boards which are displayed at many branch offices. A postscript appended to one of these reads: "Packing boxes for sale cheap in the cellar." This is at least an intimation that telegrams are packed for shipment by express, as has been done frequently in "early days."

NEW YORK, Aug. 20, 1884.

PHILADELPHIA.

The Electrical Exhibition.—Subjects for Discussion at the Electrical Conference.—Interesting Tests of the Electric Light at the Franklin Institute.—Its Use in Microscopy.—The Contest Between the Bell and Clay Telephone Companies.

As the readers of the ELECTRICIAN AND ELECTRICAL ENGINEER are, no doubt, highly interested in the International Electrical Exhibition which is to open in this city on September 2d, we cannot do better than to open our letter with that subject under discussion.

The United States Electrical Commission met here on Thursday of the present month. Courtesies of a very pleasant character were exchanged between the commission and William P. Tatham, president of the Franklin Institute, and Col. Charles H. Banes, director-general of the exhibition. The members present were Professors Rowland, Snyder, Gibbs, Barker, Young, Houston, VanDyke and Wahl. The entire day was consumed in preparing a list of the conferees. It was definitely settled that the National Conference of Electricians should be held under the direction of the commission, in the large lecture room of the exhibition on September 8th, at 11 a. m. It was also decided to issue a circular inviting all prominent foreign electricians who are expected to be in Philadelphia, to be present. The invitations to the conference will be confined to scientists of eminence and to experts in the practical management of electrical appliances and apparatus. Special invitations will be extended to prominent foreign visiting electricians. It has been suggested that the following subjects be discussed at the conference: The sources of electrical energy; the theoretical conditions necessary to the most efficient construction of the dynamo-electric machine for the various purposes of practical work; the electrical transmission of energy; the system of arc and incandescent lighting; the theory of the electric arc, storage batteries, electro-metallurgy; lighthouses for the coast; applications of electricity to military and mining engineering; lightning protection; induction in telephone lines, and the problem of long distance telephoning; the question of underground wires; atmospheric electricity; earth currents and terrestrial magnetism; photometry and standards for photometric measurements; the ratio of the electro-magnetic to the electro-static systems of units and the electro-magnetic theory of light; and finally, on account of the pressing necessity for accurate and uniform electrical measurements, it is probable that the question of establishing a national bureau of physical standards will receive proper attention. By the time the next issue of the ELECTRICIAN AND ELECTRICAL ENGINEER appears the electrical exhibition will have opened its doors

to the public. Everything looks favorable for a large attendance, and all those who are interested in electricity and its uses should put in an appearance. "The more the merrier."

The scientists of the Franklin Institute recently made a series of experiments upon which will, in a measure, depend the future usefulness of the electric light for a variety of purposes. These experiments were especially devoted to determining whether the electric light can be made to burn steadily enough to be applied to uses to which its power makes it particularly applicable, but for which its flickering quality renders it of no value. The tests were made by means of a microscope and projecting lantern. The Drummond light has hitherto been used by the Institute in illuminating objects deposited in the microscope. It has the merit of being remarkably steady, and is invaluable as a marine illuminator, but is not nearly so powerful as the electric light. The first experiment was made with a Brush electric focusing lamp. The microscope was placed immediately in front of the lamp, with its lenses ranged so as to throw the light in a disc upon a suspended screen. In this manner the throat of a fly and the leg of a spider were shown with great distinctness, the light being so steady as to allow a careful and most minute examination of the insect anatomy. The experiments were considered a success as demonstrating that the arc light is capable of being made wonderfully steady.

The fight between the Bell and the Clay Commercial Telephone companies is getting warmer every day. There has been a series of law suits all over the country, in which the Bell people fought smaller companies over the question of patent rights, and which they almost invariably won by swallowing up their rivals. Many people thought that the Clay fight was to end in the same way. The counsel for the latter company, however, are determined to contest the question to the bitter end. A suit has been instituted in the United States Circuit Court by the Bell people, in which the latter claim that the Clay system is an infringement of their patents of March, 1876, and January, 1877. As the Clay people have retained eminent counsel, we may anticipate a hot fight.

PHILADELPHIA, Aug. 18, 1884.

CHICAGO.

Bogus Telephone Inspectors.—The Danger of Canvassing for Telephone Attachments.—An Electric Diagnosis.—Numerous Electric Lighting Plants.—Naked Wires Through Trees.—Rigid Regulations for Wire Running.

A revival of an old form of swindling has recently developed here. Something like two years since the Chicago Telephone Co., to protect its patrons, clad all its employés in a uniform of blue, with peculiar white metal buttons, in consequence of sneak thieves, who, claiming to be inspectors, obtained access to subscribers' houses, and were thus enabled to indulge their pilfering propensities. The disease has broken out in a new form. A subscriber on the south side was called upon the other day, at an hour when he is usually absent, by a party who claimed that for a small sum he would place an attachment upon the telephone by which a record would be made of any calls during the subscriber's absence, and thus no call would be lost. The visit was vain, for he was politely notified that not only was such an instrument not wanted, but the presence of the maker was odious, as well, and the sooner the visit was terminated the better. Had the subscriber been out, it is not at all unlikely the fellow might have made his call more lucrative. This is only one of very many subterfuges by which our better class of dwellings are constantly invaded by tramps and sneaks.

A novel application of electricity is proposed by a Chicago physician, Dr. J. E. Gilman. An abscess or a tumor is sometimes the result of an injury to the bones of the skull, which cannot be precisely located by outward indications. Again, cases are recorded where a threatened abscess on the neck, for some cause changes its location, and develops beneath the bony covering of the brain. Dr. Gilman mentions two instances where the exact locality of the disease was determined, and its contour accurately defined by the extreme sensitiveness of the parts to a very weak electrical current—the inflammation having abnormally excited the nerves of the diseased portion. If the physician is correct in his theory, which he seems to have proven by experiment—and verified in one case by a post-mortem examination—a decided advantage may be arrived at in similar cases, where, once the diseased portion is located, the accumulation of pus might be discharged by the use of a hypodermic needle and an aspirator, inserted in a minute trephined opening. This last operation was lately performed upon a policeman who was recently shot in the head, in this city, and promises to recover through this skilful act of surgery.

The central plant idea of electric lighting is just now having a big boom here. The Sperry company has just placed a 20-light plant between Jackson and Van Buren streets, on State, and are placing another two blocks farther south, on the opposite side of the street. Between these two plants a 40-light plant is about ready, placed by the Excelsior people, and the Vandepoele company is spreading out in four directions from the corner of Halsted and Madison on the west side, with a plant which they have faith to believe will be, as far as one can now judge, the king plant of the city. But two other companies have selected ground for similar operations on a huge scale, and are only waiting developments to move on the enemy's works. There is such close competition here that all movements of the army are made under sealed orders, and it is only after the wire is on the ground, and the advance guard of insulator vandals arrives, that the public, and especially the enemy, discovers the plans of the campaign. The new bridge across Rush street has just flashed out with 6 Thomson-Houston lights, the dynamo being run by an independent engine, which, like the engine for turning the bridge, gets its steam from a boiler inclosed in a neat house over the roadways of the bridge. The two roadways are each sufficiently wide for two vehicles abreast, and no restriction is placed on the speed of these. The bridge is a trotting course, "short, but nice," and drivers avail themselves of the freedom allowed, which it was anticipated would interfere with the lights. I cannot see, so far, that any unsteadiness worth mentioning, has resulted from the jar. The two centre lights are shielded with red glass, which alternately show up and down the stream or from the shores, a "don't" signal, to land and water travelers, and indicate the position of the bridge. The incandescent people, too, are busy as nailers. The United States company is putting Maxim lamps into the post-office, for the benefit of the army of carriers and other employés, who have heretofore been almost compelled to see with their fingers; the Academy of Music plant has just been rearranged and increased by the Edison company, and Haverly's Theatre is being done likewise, by the same company, and the Thomson-Houston agent is putting in an outside plant of 13 arc lights at the same building. In no case that I now call to mind, has a plant been reduced in size. A very few cases there are where the electric light has been abandoned, but an alteration means extension, as a rule. I am well satisfied the days of gas for large illuminations in Chicago, are gone forever, and that the field must be abandoned to the army whose armorial badge, as one of them suggested to me the other day, is, "two carbons reversed standant, inflamed, with a horse-power at the end on't."

The city inspector was recently informed that the telephone manager down in some Missouri town had taken exceptions to some of the Chicago rulings, relative to electric light wires. He *knew* that wires could be run uninsulated through trees, without detriment, because they had been, and were now, in another place which he mentioned. Inquiry brought out the fact that while the wires referred to were and are so running, the armature of the dynamo had been burned out and returned to the agent for repairs no less than ten times. Electricity is one of that class of tramps, that when not compelled to do some useful work, is liable to make mischief, and poor insulation is always an incentive to it to indulge in what Watts said, Satan always "finds for idle hands to do." To those who consider the electric light ordinance of this city oppressive and unnecessary, I would suggest a careful perusal of the regulations of the Franklin Institute, governing similar installations in the coming exposition. Having fully digested these, the milder Chicago diet may possibly be more palatable, and less liable to provoke an electrical dyspepsia.

CHICAGO, Aug. 16, 1884.

WASHINGTON.

Electric Street Lighting Fairly Begun.—Fair Prices and Good Service.—Prospects of a Division of the Territory.—Discharge of Employees by the United Telegraph Companies.—A War of Rates.—New Quarters for the United Companies and the United Press.—Failure of Subterranean Tarred Office Wire.—Compositors Concede the Superiority of the Incandescent Light.—Suspension of Hostilities Against Overhead Wires.—The New Police Telephone System.

ON Friday night the Brush-Swan Electric Light Co. commenced to light Pennsylvania avenue, from the Capitol to the Treasury Department, under a contract with the district commissioner, for a period of 45 days or the remaining half of the present quarter. They are to keep the avenue lighted all night, and to light even if the moon shines, which the gas company did not do, and are to receive the amount the gas company would have been paid for the gas lamps rendered unnecessary by the electric lights. The gas company receives $22 per annum for each street lamp, and there are 105 lamps on the avenue between the points designated, which makes the compensation of the electric company $288.75 for the term, or $6.42 per night for the electric light, which is supplied by 4 arc lights (4,000 c.p. each) with 24-inch conical reflectors—two at the termini and two midway, throwing their light in opposite directions. In addition to this, and outside of the contract, the company keeps burning 7 reflector lamps, projecting their lights along the various avenues radiating from the Capitol, and a circle of 14 lights without reflectors around the top of the tholus of the Capitol, for experimental purposes. The effect around the building and grounds, and for some distance away, is very fine. The announcement that a contract had been made with the Brush-Swan company aroused the ire of the United States Electric Light Co., who assert that they have twice submitted proposals for street lighting to the district authorities, without so much as a reply being received. They claim that under the law the commissioners have no right to contract with anyone for the purpose without advertising for proposals and inviting competition. To this the commissioners reply that Congress fixed the price not to exceed that paid for gas, and that if the U. S. people want to come in they can take any other part of the city and receive pay at the rate of $22 per annum for each gas lamp they can render unnecessary. The war only broke out on Friday, but it promises to be a hot one, and the parent companies may be brought into it. It will doubtless be an interesting fight, at least to outsiders.

On the 15th inst. Mr. W. H. Clark, the manager of the B. & O. telegraph office in this city, who has been made manager of the consolidated companies, notified all, save three, of the employees of the Bankers' and Merchants', and Postal Telegraph companies that their services would not be required after the close of the present month. This notice is probably not intended so much as a wholesale discharge as to make a clean slate from which to make his new appointments without regard to former relative positions. It has enabled the Western Union, which never fails to see its opportunity, to step in and take its pick of of the men so notified. In my last I ventured the prediction that the last consolidation made a rival too strong for the Western Union to attempt its "burning out" process by reducing its rates on lines parallel with its opponent's, and keeping up or raising them where the opposition had no wires. In this opinion it appears I was in error, as I learn that, either from supposed policy, or the force of long habit, that policy is to be resorted to in an indirect way, and that for this purpose the Mutual Union company is to be nominally revived, with offices in close proximity to the B. & O., with wires to be supplied by the Western Union, and with Western Union operators, and at these offices the rates where above 15 cents will be cut from 25 to 50 per cent., while the Western Union maintains regular rates at all but the so-called Mutual Union offices The Western Union company here has been stirred up to another enterprise inaugurated by its rivals some time since, but never before resorted to by the old corporation. It will at once commence to furnish any business house that desires it a wire and call bell, so that a messenger from the office can be summoned whenever the party has a telegram to send.

Reference was made in my last to the proposed remodeling of the Baltimore & Ohio ticket and telegraph office for the main office of the consolidation. The plans have been completed and contemplate substantially a new building. The new structure will be three stories with mansard roof, with a clock tower on the corner fronting the two streets. The entire third floor will be occupied as an operating room. The second floor will be used as offices for the railroad and telegraph officials, and the ground floor for a ticket office and receiving office. It is to be elegantly fitted up and to have large plate glass windows, etc. The work is expected to be completed by the first of November and will be an improvement to a thriving section of the city.

The United Press, which, with its system of leased wires, is quite a telegraph office in itself, has been forced by the change to find another location, and has secured the quarters on 14th street, for so many years occupied as headquarters by the *New York Tribune*, where with a switch-board and instruments quite a business-like appearance is presented.

In May last I gave a brief description of some experimental underground wires, laid by the Chesapeake and Potomac Telephone Co. Three 100 and three 50 wire cables, of the Phillips and the Western Electric company's make, were laid in coal tar and enclosed in a 6 inch box, each kept from the other by the tar. Some 50 wires—mainly office wire of different sizes and qualities—were then drawn through perforated boards placed sufficiently close to one another to keep the wires which were drawn tight from touching, the idea being to surround each with an insulating coating of the tar. The single wire experiment was a total failure, not a single wire of the lot proving serviceable. On the other hand, there is not a wire in either cable that is not perfect.

A singular accident happened to one of the telephone wires the other night. One of the air lines dropped upon an imperfectly taped splice in the Brush-Swan wire running to the Capitol during the day, and when the dynamo of the latter was started the current ran off on the telephone wire, burning the coils of the fire bells on the circuit and at the annunciator, but passing the lightning arrester at the cable box and through the cable without injury to the wire.

Quite an addition has been made to the Edison plant at the Government Printing Office. Heretofore the composing room of the *Congressional Record* only was supplied with the incandescent lamp, but new machinery has been put in and the lamps supplied to the remaining compositors. To avoid complaint the gas burners are left and the option is given to use either, but in no case both. The same course was pursued in the *Record* room when the lights were put there. Some of the hands stuck to the gas for a while, but the last one long since turned off his gas. The additional lamps were lit up for regular work for the first time on Saturday last

The war against overhead wires in Washington seems to have abated, if not ended. The commissioners concede that the recent decision of Judge Snell in the Police Court cuts them off from any control of wires strung from the house tops, and the Western Union and other companies fall back on their vested rights, having been granted permission to "erect and maintain" their lines. The Telephone company is the principal victim, it being organized under the local act relating to corporations.

The Gamewell police station box, with fire alarm and telephone boxes at convenient street corners, has been on trial for several months in one precinct, and is highly commended by the police and the commissioners. The latter would use the authority given by Congress to accept that already put up and contract for its extension, but for the price demanded, which they think extortionate. Some action is likely to be taken soon.

WASHINGTON, Aug. 18, 1884.

BOSTON.

Financial Prosperity of the American Electric and Illuminating Co.—Reported Retirement of the Celebrated Lowell Syndicate.—Telephone Book-keeping.—Decline of the Erie Telephone Stock.—Baseball by the Rays of the Electric Light.—Telegraph Wires Interfere with Firemen's Work.—Another Police Call and Telephone System.—The Exhibitions this Fall.

IT is encouraging, while so many electrical companies are failing to pay dividends and some even going out of business, to note the statements made by the American Electric and Illuminating Co. The directors state that the net earnings for the last six months amount to 7 per cent. on the preferred and 3 per cent. on the common stock, but in view of the rapid expansion of the company's business, they determined to carry 1 per cent. of the surplus earnings to the creation of a reserve fund, which is to remain undivided and entire until it reaches 50 per cent. of the company's cash capital, which at the present rate of growth of the business will take several years. This fund is, of course, the property of the stockholders and subject to division at any time when it may be deemed desirable. The dividends declared are to be paid on September 1. The statement of the dividend and amount carried to reserve fund in detail is as follows:

Four per cent. on		$250,000	preferred		$10,000
Two	"	250,000	"		5,000
Two	"	750,000	"		15,000
One	"	1,000,000	"	and common stock.	10,000
Total					$40,000

From this statement it will be seen that the 1 per cent. carried to reserve fund is 25 per cent. of the total amount declared.

There is a report, with probable foundation, that the original telephone manipulators of New England, known popularly as the "Lowell Syndicate," are to withdraw from official life, and the places that knew them are to know them no more. The history of their operations, from very humble beginnings and origins, if it could be told with all the embellishments, would make mighty interesting reading. If there had not been a fecundity in the telephone equal to that of the fluked creatures of the sea, the "Syndicate" would have been swamped time and again. But water has been plenty in New England and the suckers very numerous. Men who could not scoop in millions under such circumstances deserve to be sent to the arctic regions and fed on ice cream.

The "wicked partner," the American Bell Telephone Co., owning the lion's share of the New England Co., seems to have adopted a system of book-keeping which makes a material difference in the balances, as there is now no money for dividends. As the construction account is being attended to, large amounts of money are being put into construction, which, by the way, was deficient, offices and lines are being reconstructed, with an idea of permanent business and not for stock speculation—better service is given and fewer failures made. Reserve funds are being created and handy "pockets" made for future use. As a most natural consequence a large increase of subscribers has taken place, and yet there are more to follow. People are beginning to understand the change that has taken place in the management and look with more favor upon the stock as an investment. Prices are nearly one-third higher than 2 months ago. Meanwhile the Erie Telephone Co.'s stock declines and dividends fail, the managers awakening to the fact that booms are off and that business must be attended to.

The electric light has been put to a very practical and pleasurable use in our city recently. The field where the "national

game" is disported has been lighted on several occasions, that the base-ballists might have their fill of the favorite game.

The overhead wire question has been brought to discussion again by a recent fire on Beach street, where two firemen were burned to death. The telegraph wires on poles in front of the building interfered very seriously with the operations of the fire department. I presume the next legislature will have its hands full of the underground subject, and the various syndicates who each own the true and only system will be on hand to advocate stringent measures.

J. C. Wilson, late Western Union electrician and a prominent electrical inventor, will have a novel invention on exhibition at Philadelphia. It is in the nature of a police call-box. A call-box is to be placed on each policeman's beat, and connected with the police station. As the officer reaches the box he inserts a key and if the central station does not want him he hears a single click; if he is wanted the number of his box is sounded. Magneto transmitting and receiving telephones are in the box for his use. The make-up is simpler and smaller than the Chicago variety.

We have in our town two large exhibition buildings, where the varied industries and arts of this and foreign countries are shown to visitors. This fall both will have a trial of rivalry in the exhibition business; the various electric lights are to be put in, and an electric railway will be in operation.

Boston, August 18, 1884.

PROVIDENCE.

Temporary Suspension of Postal Telegraph Construction.—Facilities of the Opposition Companies Between New York and Boston.—Location of Office Not Yet Settled.—Affairs of the Multiplex Co.—A Successful 40 Mile Test.—Telephone Business Good.—Subsidence of the Electric Light War.—The Sixth Annual Clam Bake.

THE lines of the New England Telegraph Co., or, as they are otherwise called, the Postal Telegraph and Cable Co., are at this writing resting under a legal cloud, the outcome of a dispute between the contractor in this section and one of the pole contractors. How soon the case will be settled is a matter of conjecture, but as the wires are reported to be strung from Rockport to Boston, it is to be hoped that there will be no serious embarrassment, and that the line will be speedily completed. Two copper wires are already strung through Massachusetts from the Rhode Island line, the forerunners of 8 more that are to follow.

The United Telegraph Lines, as the new combination is to be called, will command 40 wires between New York and Boston. The Bankers' and Merchants' have 22; the Baltimore and Ohio, 8, and the Postal will have 10. This will give the pool splendid wire facilities over different routes, and enable it to make a strong pull against the Western Union.

The question has not probably been settled as to which office will be occupied in this city, and hence the employés are in an unsettled state of mind. It is supposed, however, that as the Baltimore and Ohio have not yet run in their wires but temporarily, and as the Bankers' and Merchants' Co. have a large number in working order, that the established location will be maintained. The line of the Standard Multiplex Company, between Boston and Providence, opened for business between those two points August 25th. R. W. Kemp is manager at Providence. The rate is 25 cents for 20 words. I hear that the stockholders have put in $60,000, which has been expended in getting the experimental line ready, and that now the directors intend to capitalize the concern at $3,000,000, and start the ball in motion. The experiments made thus far prove that on a short line of 40 miles it is more serviceable than the quadruplex. If it can be made to work on long circuits, a fortune certainly awaits Messrs. Delany and Calahan, who have labored assiduously on the system.

The telephone business is good, and the new directory shows a goodly increase in the number of subscribers. The electric light war has subsided.

The annual clam-bake tendered to his numerous electrical friends by Eugene F. Phillips, was this year given on Narragansett bay, and included a brief but enjoyable sail over those romantic waters. With the assistance of the usual variety of athletic sports, the necessary appetites were stimulated to make way with the bountiful lunch, and the mysterious and succulent contents of the "bake," which was opened at 3 p. m. Over a hundred guests were present from all parts of the country, being hospitably welcomed with a brief address by the genial host. The bill of fare was of a tasteful and appropriate design, printed on white silk, bearing the following inscription: "The Sixth Annual Bake. Complimentary to Telephone, Telegraph, and Electric Light Men. Tendered by American Electrical Works, E. F. Phillips, President. Providence, R. I., 1884." Those who have never attended can scarcely realize the solid enjoyment which is developed at these annual re-unions, which we hope to see repeated yearly, so long as the supply of clams continues in Rhode Island.

Providence, Aug. 30, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed Editor of The Electrician and Electrical Engineer, *115 Nassau Street, New York city.*

ROTARY SWORD ENGINE FOR DRIVING DYNAMOS.

[17]—I wish to call attention to a steam engine that has been almost neglected for more than 2,000 years. It was invented by Hero, of Alexandria, in Egypt. The following is a description of the "eolipile":

Two tubes of equal length are fastened to a hollow axle. The tubes are at right angles to the axle and in a straight line with each other, one being on one side of the axle, and the other on the opposite side. These two tubes are closed at the outer ends, but each has a hole in its side, near its outer end. The internal diameter of these tubes is much greater than that of the holes. Steam is admitted into the hollow axle and escapes through the holes after traversing the tubular arms. The unbalanced pressure of steam opposite each hole causes a rotary tendency.

Now, why has not this simplest of all steam engines been more extensively used? An English engineer informed me that he had one called the "sword engine," because the tubular arms were made of steel, and had sharp edges, that they might readily cleave the air and the exhaust steam. With steam of a high pressure this engine would rotate 3,000 times in a minute. Each sword was about 1½ feet in length, and the hole near the end of each was about ½ inch in diameter. This engine drove a saw-mill. I suppose that a casing, nowhere in contact with the swords, was used to prevent the exhaust steam from clouding the mill. Probably the exhaust pipe led off from the bottom of the casing in order to easily carry away any water of condensation. It seems to me that this engine is just what is needed for driving dynamos. Here are some of my reasons:

1. The armature of the dynamo may be attached directly to the axle of the engine, thus dispensing with belting or gearing. If built solidly together on the same base it would be the simplest of steam dynamos.
2. There are no cranks, pistons, rings, links, springs, valves, etc., as in other engines.
3. The first cost will be less than half that of other engines of the same power.
4. The motion will be uniform at all points of the revolution.
5. No metallic friction exists except that of the journals.
6. No steam is wasted in "clearance" as in all other steam engines.
7. As the motion is always in the same direction less loss of power will occur than in other engines in which heavy pistons, rods, etc., have their motion reversed many hundreds of times in a minute.
8. An exceedingly high speed may be attained without injury to the engine.
9. Priming will give no trouble.
10. Since no dead points exist in this engine it will always start without assistance.

The only apparent disadvantage is that it is not economical except at very high steam pressures. In constructing these engines the passages should be made of the proper size to suit the size of the boiler and the pressure required. It will also be found that the engine will give its greatest power, at a given steam pressure, when it is loaded until the number of revolutions per minute is about one-half the number that would be performed in the same time when running light. Where high speed is required this engine will probably supersede piston engines for the same reasons that the turbine superseded the overshot, undershot and breast waterwheels. The reasons for using the turbine in preference, are less cost; higher speed; less space occupied; better results at high pressure or head, etc.

The turbine grew out of Barker's mill. The sword engine is a slight improvement on Hero's eolipile. The principle is the same in each, only Barker's mill uses water while Hero's eolipile uses steam. A little attention will enable any intelligent person to understand the principle. It is explained in many books on physics. Philosophers of the highest ability state that Barker's mill is the most economical water motor. Are we not right when we state that the eolipile is the most economical steam motor?

James Asher.

Kleinburg, Ontario, August 1, 1884.

INSTRUMENT PROTECTORS.

[18]—Referring to the letter of C. H. Haskins, published in The Electrician and Electrical Engineer of August, and accompanied by a clear diagram, I would respectfully ask Mr. Haskins (albeit with some trepidation, he being one of the old masters), whether he has verified his statement which he makes in regard to electro-magnetic instrument protectors, "that the trouble with them all is, that before the core has time to be charged, and in its turn move the armature, enough current has passed to do the damage?"

I ask for information—as I have tried the experiment and find that such is not the case. I recently had occasion to examine and report upon a protector which is adapted to open the circuit when an abnormally strong current passes. I examined the patent; duly referred to the device shown in Shaffner, and which, by the way, was invented by Mr. J. D. Reid, and gravely sat down and wrote a report in which I made the same statement now made by Mr. Haskins. Before tendering my report to the person to whom it was addressed, I sat thinking it over, and it occurred to me that I had not tried whether or no the result would be as I had averred, and that to quote a colloquialism, it would be rather a bad "give away" if it should turn out oppositely. Therefore, I tried it in direct circuit with a powerful Brush machine. Putting different lengths and coils of No. 36 silk covered wire in circuit, *with* the protector I found that the wires were safe, the magnet acting and opening the circuit every time before the fine wire was warmed, while without the protector they were volatilized in no time at all. Thus it was demonstrated that the magnetic effect was quicker than the heating effect. I do not, however, therefore approve of electro-magnetic protectors. I do not see why I should use a costly device when many which are cheaper and simpler will work equally well, and I regard it as a questionable advantage to ground the line, thereby leaving the strong current still flowing in it to do damage elsewhere. It is also an open question whether the electric light companies would approve of a dead ground thus being thrown on to their circuits with the chance of burning up their machines. On these considerations is it not best to employ a device which opens the main line completely, thus at once removing the danger?

Boston, August 4, 1884. Thos. D. Lockwood.

THE CLOTHES-PIN INSULATOR.

[19]—In the August number of the Electrician and Electrical Engineer, your Chicago correspondent referring to my insulator, raises the question as to the sulphur in the rubber damaging the wire. Pure rubber is not used, but packing which is, or may be steeped in asbestos and silicate of potash, which enables the rubber to resist both heat and moisture. Without this treatment, however, I have had lines up all last winter and now all the summer on which my insulator is used, and I defy anyone to see a particle of damage done to the wire. An important feature in addition to those mentioned, is the absolute stillness of the line and the clearness of the voice. I have a line from Windsor to Chatham, 50 miles, which can't be beaten either in Canada or the States. I have lines in the town of Windsor which can't be beaten in any Exchange in the Union, and I will submit it to the decision of a committee at my expense. I have lines 5, 10 and 20 miles in length, and one continuous line of 150 miles, over which conversations may be carried on with ease between the exchanges, but it is hard to talk with subscribers at the terminals at that distance. Another point is the cheapness of the insulator, and again, the time saved in construction.

Windsor, Ont., Aug. 8, 1884. J. W. Tringham.

[The samples of this insulator, kindly forwarded by the inventor, show it to be a marvel of simplicity. The wire which is said to have been secured to it for 9 months, evinces no signs of deterioration. Whether its properties are such as to warrant its more general introduction, is a question of experience. Our creed is, that excellence of insulation and stability, should not be sacrificed for the sake of minor economies.—Editor.]

DRY BATTERIES.

[20]—In a recent number of The Electrician and Electrical Engineer, under the caption that heads this item, was a statement to the effect that "M. W. Becquerel and Onimus have been experimenting on dry batteries," and a description of the ground over which they had gone in their experimental researches. Over two years ago I went over practically the same line of experiment for the purpose of securing a dry battery, but found it an utter failure. In May, 1883, however, I commenced a line of experiment which culminated in success, and in July of the same year I filed an application for letters patent covering the dry battery that I had invented, and, after an appeal to the Examiner-in-Chief, the letters patent, under date of Aug. 12, 1884, were issued to me. In this dry battery as an exciting material I use a delequescent and non-delequescent but exciting salt or chemical in combination. The delequescent salt draws sufficient moisture from the atmosphere to hold the non-delequescent salt in a state of slow solution. The elements of the battery may be zinc-carbon, zinc-copper, or any other of the ordinarily used elements, including the chloride of silver or the Leclanché element. The E. M. F. of the battery is about equal to that of the Leclanché, and it can be used for all the purposes for which the Leclanché is used. The particular design of the battery, however, is for signal purposes on moving vehicles, such as railroads, street cars, cabs, etc. One of these batteries, consisting of zinc and carbon, with an exciting paste composed of chloride of ammonia and acetate of potash, will give out a perfectly steady reliable current of electricity for from 3 to 5 months without interference. The durability and intensity of the battery are governed to some extent by the proportions of the compound of delequescent and non-delequescent salts used, and of course the most suitable proportion for all practical purposes can be fully determined by experiment. My letters patent also cover a prismatic-shaped battery jar.

T. Cleland, M. D.

354 West 22d Street.

HOW TO MAKE BATTERY CARBONS.

[21]—For the benefit of those of your readers who may wish to make their own battery carbons I herewith append a leaf from my experience in that direction, which will enable any one of ordinary ingenuity to produce a suitable article for that purpose.

The size of the carbon is the first thing to determine; but I strenuously advise the experimenter at the outset not to test his patience by attempting the production of "sheet carbon," *i. e.*, that which is usually made in large slabs and afterwards cut into pieces of the shape desired. First satisfy yourself as to the size you wish to make it, and when made let it remain so. Take, for instance, a carbon for use in an ordinary 5x7 Fuller or Bunsen battery. Make it, say, 2x8x⅛ inches. Procure two pieces of sheet iron or brass, preferably brass, but the former will answer, each 3x10 inches, not less than ¼ inch thick and perfectly flat. Then make, or have made, from a rod of metal ½ inch square and about 22 inches long, a rectangular frame of three sides, whose internal dimensions will be 2x10x½ inches or thereabouts. These three pieces constitute the mold, and in order to complete it, it only remains to place the U-shaped frame between the two plates, fastening the whole firmly together by means of screw clamps, and you will have an oblong box, open at one end. See that the parts fit as closely as possible.

Next pulverize in an iron mortar a quantity of gas retort carbon or common coke, taking care to have a little more than is sufficient to fill the mold. The finer the coke powder the better. Place it in a glass or earthenware dish and pour upon it a small quantity of syrup or dissolved sugar. Mix and knead the mass thoroughly with the fingers, adding by degrees a little of the syrup until it becomes sufficiently moist to bind well when pressed together. Set the mold on end, drop in enough of the mixture to fill it about one-third, and tamp it down lightly with a quarter-inch rod. Continue the operation until the mold is full, then get a piece of wood or metal nearly large enough to fit the mold for use as a rammer. Place one end in the opening and strike it smartly with a mallet. The mass will be driven down about two inches and tightly compressed. With a little water mix up some plaster of paris to the consistency of dough, and press it into the opening, having previously removed the rammer. Force it down, and continue adding the plaster till the end is thoroughly closed.

The contents of the mold are now ready for the "carbonizing" process. Make a good coal fire, place the mold upon it and expose to a red heat for an hour or more. Allow it to remain until the fire has gone out. When cold enough to admit of being handled by the fingers, remove it, and if the experiment has been properly conducted you will find the carbon complete.

It is true that a carbon made in this way is not so dense as the commercial article, but for ordinary battery purposes it will be found equal to any, and all that can possibly be desired.

No 1 Franklin Street, San Francisco, Cal. Wm. A. J. Kohen.

QUESTIONS AND ANSWERS.

[34.] **Position of Sounder Magnets.**—E. E. P., Albion, Mich., asks:—"Why are sounder magnets always placed in a vertical position? I should suppose that in some cases they would work better if placed horizontally." Ans.—The greater part of the volume of sound which apparently emanates from the sounder really come from the table top, which acts as a sounding-board or resonator, and is thrown into vibration by the blows of the sounder lever. With the magnet in a vertical position the movement of the armature lever is necessarily directly towards the table top, and the force of its blows are communicated directly to the latter through the sounds post, without producing interfering vibrations. Hence a louder and clearer sound may be produced by a vertical than by a horizontal magnet.

[35.] **Measurement of Tangents.**—H. C. C., Lowell, Mass., inquires how the length of the tangent of the angle of deflection of a galvanometer needle is measured. Ans.—The usual and most convenient method is to take the tangent from a table of natural tangents, which is given in nearly all works on electrical measurement, for each degree of the quadrant, and usually to half or quarter degrees. These values are not measured, but are calculated by trigonometrical formula. A method of constructing the tangents graphically is given in Culley's *Hand-Book of Practical Telegraphy*.

[36.] **E. M. F. of Large and Small Cells.**—C. T. I., Kendallsville, Ind., writes:—"On page 140, July number, Mr. F. L. Pope says the E. M. F. of the miniature cell is precisely the same as that of the Daniell cell. Why could not the miniature cell be used as well as the large one for practical purposes?" Ans.—Principally for the reason that the quantity of material is so small that the battery is quickly exhausted. For purposes requiring but a brief use of the current, as for insulation tests, such small cells are often used with advantage. They also offer much more internal resistance than a large cell, and for this reason the resulting current is more feeble, although, as stated, the E. M. F. is the same.

[37.] **Porous Cells.—Induction Coils.**—E. H. T., Hagerstown, Ind., asks:—"1. Of what material are porous cups made and where can it be had? 2. Does a porous cup increase or decrease the E. M. F. of a battery? 3. In the Bell telephone transmitter there is an induction coil with a bundle of iron wires. Is the primary wire of this coil connected with the battery accompanying each instrument and the secondary wire with the line? 4. Can you explain why the placing of a tube of copper or brass over an induction coil will increase and decrease its power when it is moved, as well as if placed in the coil surrounding the core? 5. Will Mr. Pope's series of articles contain one on electrical induction?" Ans.—1. Porous cups are made of potters' clay, such as is found in New Jersey, Ohio and elsewhere. The cups are baked without glazing. The material can be procured at any pottery. 2. It does not affect the E M. F., but increases the internal resistance of the battery. 3. Yes. The microphone contact points are also included in the primary circuit. 4. A piece of metal has an inductive effect upon a current traversing a wire in its neighborhood, whatever may be its direction from the wire. The effect when the metal is on the outside of the coil is not so strong as when placed in the inside, because in the latter case the action is concentrated within a smaller space. 5. We shall shortly publish such an article, either as a part of Mr. Pope's series or separately, containing the results of recent original investigations.

[38.] **Construction of Induction Coils.**—J. W., St. Louis, Mo., asks:—"1. What weight of wire, and what gauge will be required in a secondary coil, to insure a spark of 3 inches length, supposing the primary coil to be about 8 inches in length and fed by two bi-chromate batteries? 2. Which will give the best results, winding the secondary coil in *fewer* layers around a *long* primary, or winding it in *many* layers around a *short* primary coil. 3. Which will give the better results, a large amount of fine wire on the primary, or a smaller amount of thicker wire." Ans.—1. To give a 3-inch spark, the secondary coil should contain about 3 lbs. of No. 38 B. W. G. wire, and the primary, 2 layers of No. 16, wound on a core 12 inches long and 1 inch in diameter. The results depend largely upon the skill and care used in constructing the coil. Consult Sprague's *Electricity*, new ed., p. 550, and Dyer's *Induction Coil, How Made and How Used*, for much valuable information for the amateur. 2. A short and thick coil. 3. A long and thin wire.

[39.] **Hughes' Induction Balance.**—M. A. C., Somerville, Mass., writes:—"I wish to make a Hughes' Induction Balance. Can you furnish a description of the apparatus? Ans.—We regret that we have not space to comply with your request. A full description, with drawings to scale, may be found in Gordon's *Electricity and Magnetism*, vol. i, p. 282. See also Hughes' original paper, *Phil. Mag.*, July, 1879, ii. p. 50.

ELECTRICAL NEWS AND NOTES.

TRAIN DESPATCHERS' CONVENTION.

About 150 train despatchers met at Louisville, Ky., Aug. 20th. Delegates were present from almost every State in the Union. A temporary organization was effected by the election of W. N. Marshall, of Louisville, as Chairman, and W. W. Wheatly, of Chicago, as Secretary. Committees on a constitution and by-laws of the organization and on resolutions were appointed.

DEATH OF CAPTAIN PELL.

Captain William W. Pell, who commanded the packet ship Sully, on board of which Prof. Morse conceived the idea of his electric recording telegraph in 1832, died at his home in Brooklyn, July 25. He went to sea at an early age, but retired from active service in 1842, and died at the age of 84. He had maintained a deep interest in the progress of telegraphy, owing, no doubt, to his associations with its earliest history.

THE SUIT AGAINST THE COMMERCIAL TELEGRAM CO.

In the suit of Henry C. Gardiner as a stockholder of the Commercial Telegram Company against its directors and organizers, Judge Bartlett, holding Supreme Court, Chambers, has overruled, with costs, a demurrer to the complaint. The demurrer was interposed by J. G. Case, on the ground that the Attorney-General alone had the right to sue, and that certain technical errors had been committed by the plaintiff.

ARMY TELEGRAPH VETERANS.

The Society of the United States Military Telegraph Corps met at St. Louis, August 21, in annual reunion. Most of the time was taken up with discussion of the best methods for having their members recognized by the Government as part of the army and as legal claimants for pensions. A letter was read from Gen. Grant to J. C. Morgan, acknowledging the good service done by telegraphers during the war. The old officers, including W. R. Plum for President, were re-elected. The next meeting is to be held in New York city.

ACKNOWLEDGEMENTS.

Our thanks are due to the Western Electric Association, The New York and New Jersey Telephone Company, and the American Underground Electric Wire Company for invitations to their several excursions; also to the American Electrical Works, of Providence, for the annual clam-bake on August 27th. We regret that we have not been able to participate in these festivities thus far during the season, and that future engagements may prevent our attendance at those which are to come. These kind remembrances are, however, heartily appreciated.

ELECTRIC LIGHT LITIGATION.

The Brush Electric Company have issued a circular in reference to the recent adverse decision of Judge Shipman, in the suit for infringement brought by it against the selling agents of the Weston electric lamp, the defense of which was assumed by the United States Electric Lighting Company, in which it is stated that the case will at once be appealed to the United States Supreme Court. The circular also states that "other suits are still pending against the agents of the U. S. company or users of its apparatus that are of much more importance than the one recently decided," and that suits are also pending in the U. S. Circuit Courts against users of the Fuller, Excelsior, Schuyler, Van Depoele electric lighting systems, and the Boulton and Pittsburg carbon companies. Suits are also stated to be in preparation against the Thomson-Houston and other systems, it being claimed that the former infringes important patents of the Brush company on dynamo machines.

CONVENTION OF OLD-TIME TELEGRAPHERS.

The Old-Time Telegraphers' Association convened at St. Louis Aug. 20th. George M. Dugan, President, and S. B. Fairchild, Secretary and Treasurer, were both present. Over 50 delegates were present, the large cities represented being New York, Baltimore, Chicago, New Orleans, Memphis, Louisville, Omaha, Denver, and Kansas City. The President made a brief address, and some new members were elected. Edward Rosewater, Vice-President of the association, delivered an interesting address. Letters of regret from many prominent telegraphers were read. Resolutions of regret were adopted regarding the death since the last meeting of O. H. Booth, of Mansfield, Ohio, the first President of the association, and of George W. Trabue and L. M. Painter. A committee consisting of Messrs. Plum, Bunnell and Taylor was appointed to solicit papers to supply matter for the history of the early days of telegraphy, and to secure specimens of old fashioned telegraphic apparatus. In the afternoon the party had an excursion on the river.

THE MANUFACTURE OF ELECTRIC ARMS.

A corporation to be known as the American Electric Arms and Ammunition Co., has been formed by George B. Satterlee, of New York; William H. Barbour, of New York, and James S. Merriam, of New York, who, with Ethel C. Hine, of Brooklyn, Charles H. Tompkins, of New York; Thomas L. Watson, of Bridgeport, Conn., and John W. Hedenberg are to be its Trustees for the first year of its existence. Its capital stock is $1,000,000, divided into 40,000 shares of $25 each, and its objects are "to acquire patents useful in the construction of arms and ammunition, to sell the same, to work, and to license to work thereunder, and to manufacture and sell arms and ammunition, especially with the application of electricity thereto."

TOURNAMENT OF MORSE TELEGRAPHERS.

In order to determine the relative speed in transmitting by the Morse system between different experts, a contest took place at the Western Union building, New York city, Aug. 17th The work was done on a local circuit, using the steel lever key of J. H. Bunnell & Co, the prizes being offered by that firm, for "clearness of character and speed combined." The matter to be transmitted consisted of 500 words, 15 periods and 4 commas, making a total of 2,368 characters. The trial begun at 11 o'clock, a. m., and was finished at 1 p. m., in the presence of over 100 spectators, the judges being J. H. Dwight, night-force manager, W. B. Waycott, cable manager, and E. F. Howell, chief operator; the arrangements being in charge of F. Catlin, chief operator, all of the Western Union main office. The prizes were awarded as follows: First, W. L. Waugh, of the Commercial Telegram Co., "superior" work; time, 11m. 27s. Second, W. M Gibson, of the Bankers' and Merchants' company, "good" work; time, 11m, 3s. Third, F. J. Kihm, of the United Press, "fair" work; time, 10m. 32s. The fastest time was made by J. W. Roloson, of the Bankers' and Merchants' company, in 10m. 10s., but his work was not considered sufficiently perfect to entitle him to a prize. Gold and silver medals, of appropriate designs, were presented to the successful contestants.

THE INDIVIDUAL'S RIGHTS SUPERIOR TO THOSE OF THE PUBLIC.

After the Colwell Lead Company had begun to make an excavation for a vault in front of its premises at Sixth avenue and 39th street, the Metropolitan Telegraph and Telephone Company found that some of its poles were likely to drop into the hole. A preliminary injunction restraining the Colwell company from continuing to excavate was obtained in the Superior Court. Judge Ingraham heard a motion to continue the injunction during the suit This motion he denied August 12, holding that the maintenance of telegraph and telephone poles and wires in the streets is not a legitimate street use. The fee of the land in streets opened, as 39th street was, under the provisions of the general act of 1813, is vested in the city in trust, to be appropriated to the purposes of public thoroughfares.

"The power of the Legislature over the street is not unlimited," he says. "It is to govern and regulate such use or interest in the land as vested in the corporation under the provisions of the law for the taking of the property. The city took the property in trust to appropriate it as a public street, and so far as it held it for a public street it was subject to the control of the Legislature. That the power of the Legislature over the streets is limited, and that the Legislature had no authority to authorize a structure on a street that is inconsistent with such street use, was held in the Story case. * * *

"The property is paid for by the abutting owners. Neither the city nor the State pays the amount awarded for the taking of the property, but the owners of the land on the street pay for whatever is taken. The statute provides that such payment shall be apportioned among such abutting owners as shall be benefited by the appropriation of the property as a public street, and that such owners have an interest in the streets is recognized in the Story case, and in that of Mahady against the Bushwick Railroad Company. I think, therefore, that the power of the Legislature to regulate the streets is confined to the uses for which the land was taken.

"The plaintiff owns and operates a telephone line in 39th street, and uses poles to conduct the wires used in such business, and I am clearly of the opinion that such a use of the street is not a street use, and does not come within the terms of the trust within which the city holds the fee of the streets, and that, so far as the rights of abutting owners are involved, the Legislature had no power to authorize plaintiff to use the streets for such a purpose. Plaintiff cites the case of the People against the Metropolitan Telegraph and Telephone Company, but in that case the people were objecting to the use of the streets by plaintiff, and plaintiff had the consent of the people for such use. As was said in the Story case, in speaking of the authority given by the Legislature: 'So far as the public is concerned it may stand; not so far as to the individual.'"

ELECTIONS AND APPOINTMENTS.

Major L. B. Wright, for 3 years General Superintendent of the Brush Electric Light Company, and for the past year Engineer of the Jarvis Engineering Company, of Boston, tendered his resignation to the latter company, July 26th, to accept the position of General Superintendent of the American Electric and Illuminating Company, vice C. D. Smith, who has assumed the position of General Manager. Since the American company was organized, Mr. Goff has occupied the position of President and General Manager, but the rapid growth of the business has necessitated a division of the responsibilities.

THE TELEGRAPH.

Domestic.

The Baltimore & Ohio Telegraph Co. has leased the line along the old Midland Railroad, now known as the New York, Ontario & Western Railway.

A Western Union officer was fined $250, at Chicago, August 16, for violating an ordinance prohibiting the erection of telegraph poles and the stringing of wires in the streets. An appeal was taken and the case will be made a test one.

A fire originating from the switch-board broke out at 9 20 p.m. August 20, in the Western Union Telegraph office at Cleveland, O. By 10 o'clock it had gained such headway that the operators were driven from the office and retreated to the Union Station where communication was restored.

Foreign.

The construction of a telegraph line from Bangkok to Zimmay, and thence afterwards to Burmah, has been sanctioned, and will be pushed on and completed in the next dry season.

Card telegrams are much in use in Paris. There are two kinds of them—one like the ordinary postal card in form and color, and the other blue, and capable of being so closed as to conceal the writing. They are each large enough to contain a message of fully sixty words. When a card is dropped into the card telegram box of the nearest telegraph office, the official in charge picks it up, and has it transmitted through one of the pneumatic tubes which extend all over the city, thus insuring its delivery at the place to which it is addressed in less than half an hour from the time it was posted.

A message of 69 words was forwarded by the Governor of Victoria, announcing the opening of the Melbourne Exhibition on that day. The message was despatched from Melbourne at 1 p.m., and reached London at 3.43 a.m. on the same day, or 9 hours 17 minutes before the hour of its despatch. Allowing, however, for the difference of time between the 2 cities, it occupied only 23 minutes in transit. The route of the message was over the lines of the Victorian and South Australian Colonies, the cables of the Eastern Extension Australasia and China Telegraph Company, the lines of the Indian Government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French Government, and the rapidity of its transmission shows the harmony with which the various administrations work together. The total distance traversed was 13,398 miles.

THE TELEPHONE.

The June report of the New England Telephone Company shows a net gain of 229 subscribers in June, and a present number of 18,437 subscribers. The extra territorial messages transmitted during the month were 28,282, a gain of 1,767 over the previous month; 510 cities and towns are now connected by telephone in this company. The net gain in subscribers since January 1, is 1,438.

The Sunset Telephone Company of California, has laid, and has now in working order, one of the Bishop Gutta Percha Cables 4½ miles long (with seven conductors), across the bay at San Francisco to Oakland. The telephone service through this cable to Sacramento, 100 miles distant, has been exceedingly good.

RAILWAY SERVICE.

Foreign.

A French paper says that the railway companies are about to try an electric gate opener. The method to be tried is briefly as follows: A catch connected with an electro-magnet keeps the gates closed. An approaching train closes the circuit at a certain distance from the gates, the catch is released, and the gates open. When the last carriage has passed, the circuit is broken again and the gates close. A bell is also rung as the train approaches.

About 94 per cent. of the double mileage of the railways in England and Wales, is now worked on the absolute block system. In Scotland the percentage is 90, and in Ireland, 22.

ELECTRIC LIGHT AND POWER.

Domestic.

The Tucson Electric Light Co., Tucson, Arizona, has started its new station. The plant consists of a 40 and 16-light Brush machine, driven by a 60 h. p. engine.

Binghamton, N. Y., has decided to have a Brush installation of 20 arc lights.

The electric light will be tried in the Evening High School of New York next winter, as being steadier and better than gas.

Preparations are being made to light several factories at Waterbury, Conn., by the Thomson-Houston system.

President Zaldivar, of the Independent Central American Republic, of Salvador, visited the works of the Edison Electric Lighting Company, in this city, July 2d, and ordered a plant for lighting his home in the city of San Salvador.

The electric light is a great boon to fruit growers near the cities in California. At Los Angeles, it is reported, several bushels of moths and millers are killed every night, while at Sacramento it is believed that the black beetle has been nearly exterminated.

In consequence of a serious accident to its machinery, the electric light company at Sedalia, Mo., was recently obliged to suspend operations for about three weeks, and as it is not receiving much encouragement there are some doubts about resumption.

A fire occurred on the evening of Aug. 26th in the photograph gallery of J. M. Brengel, No. 55 East 13th st., New York, which is said to have originated from the electric light wires which enter his rooms. Mr. Brengel uses the Brush light for developing his plates, the wires being led in through the wood work. A hissing noise was heard at this point, followed by an outburst of flame, the heat breaking bottles of alcohol, ether and other combustibles, that soon caused a fire which was subdued by the steamers in about half an hour. The total loss to the building and contents, by fire and water was about $5,000.

The contract for lighting Detroit, Mich., with 72 towers, for $95,000, has been duly executed and the Brush company has given a bond in the sum of $100,000 to perform its part of the agreement. It is understood, however, that the Excelsior Electric Light Company will apply for an injunction to restrain the city from carrying out the contract on the ground that it was not awarded to the lowest bidder in response to specific proposals for lighting the entire city. The Excelsior company claims that if it had been allowed to bid it would have offered to light the city for not more than $80,000.

Foreign.

A full-sized telpher locomotive and train is running at Hitchin, to afford practical illustration of Mr. F. Jenkin's invention, the object of which is to convey minerals, etc., by the aid of electricity along a cheap suspended line. The experiment is thoroughly satisfactory, and is exciting great interest.

The "Tasmania," which is the latest addition to the fleet of the Peninsular and Oriental Company, went for her trial trip a few days since, when an average speed of 15½ knots was obtained. She has been fitted with incandescent lamps by Messrs. Siemens Bros.

The Board of Trade have decided to proceed at once to revoke no fewer than 25 of the provisional orders which were granted by them last year, and subsequently confirmed by Parliament, for the electric lighting of London and its suburbs. So far as London is concerned, the result of the numerous electric lighting orders which have been granted during the past two years is that only 8 now remain in force.

In its report for the 6 months ending June 30th, the Anglo-American Brush corporation says that the half-year's working shows a net profit on trading after including exceptional law charges, and after making provision for all losses and depreciation of property. It is added that at present not only are all charges, ordinary and exceptional, met by revenue, but the financial position of the corporation is such as to enable the board to undertake important contracts which they have in view, involving further expenditure of capital, without asking the shareholders to provide additional supplies.

A tram car motor, invented by M. H. Smith, of Halifax, was recently tested at Manchester, Eng. It ran along a track made on a field near the telegraph works. The electricity was supplied from a Siemens' generator in the works. Mr. Smith calculates that with his system, cars can be driven for 2d. per mile per car, including all contingent expenses, and it seems that the cost on the same basis of horse conducted traffic is about 10d. per mile per car.

The New British Iron Company, limited, one of the largest South Staffordshire iron-making concerns, have just started a second installation of Weston arc lighting throughout their works at Corngreaves, near Cradley. The electrical plant is supplied by the Maxim-Weston Electric Company. This second installation has been applied after several months' trial of a former one, which has proved most successful, both as regards efficiency and economy, as compared with gas. A part of the second installation is being used to light the new steel works which the company are just now commencing.

MISCELLANEOUS.

Domestic.

Important experiments were attempted at the torpedo station at Newport, July 31, but were not very successful. The Lay-Haight torpedo did not work well, and the same result was experienced with the electrical torpedo boat. While the latter was being removed from one point to another the whole of the keyboard and steering apparatus was pulled overboard and lost, and a heavy expense will be incurred in replacing them.

Foreign.

The Italian government proposes to found a central magnetic observatory at Rome, to be placed under the direction of the Meteorological office. The government asks for a vote of 176,000 francs, in addition to an annual sum of 5,505 francs for general expenses and 11,500 francs for *personnel*.

During the past 12 months, the London system of electric fire alarm circuits has been considerably extended, and it now constitutes one of the most important features in the manipulations of the Metropolitan Fire Brigade. There are 23 of the above circuits in operation, with 150 points of alarm.

SUBMARINE CABLES.

A company has been organized to lay a cable from Brazil to New Orleans, via St. Thomas, to cost $3,000,000, which will work in connection with the Bennett-Mackay cable.

George G. Ward, General Superintendent of the Commercial Cable Company, has been in London for some time in consultation with the other officials of the company. He is about to return to New York to establish the main office of the company and to prepare for the reception of public business. He expects to be able to receive and send all despatches that may be offered for transmission by the 1st of October, and possibly earlier.

Dr. John Muirhead, the electrical engineer and inventor, is engaged in applying his system of duplexing to the first of the Commercial company's cables. The office and receiving station of the company at Waterville, Ireland, is completed, and has been opened with a semi-public reception.

Arrangements have been completed for connecting the quarantine station of Grosse Isle with Quebec, by submarine cable and land lines. This route will be a boon to pilot service, and also to the numerous inhabitants of Orleans Island, and will provide reliable connection with Grosse Isle. It has also been decided to establish telephonic communication between the hospital and convalescent ends of Grosse Isle.

There are rumors of another Atlantic cable being laid between England and Canada. The cable would start from Thurso, in Scotland, touching at the Faroe Islands, Iceland, the West Coast of Greenland, and from there, running in a southerly direction, as far as the Bay of St. Lawrence, it will land in Gaspe Harbor. The total length of these cables would be some 3,150 n. miles; whilst the longest section would not exceed 900 miles. It is believed that, on this account, the working capacity of the proposed cable will be about double that of any of the present cables.

MANUFACTURING AND TRADE NOTES.

The Phillips Electric Cable Manufacturing Company of Philadelphia, has made an assignment to P. C. De Sanque. The assignment was dated Aug. 28, and included the machinery in the manufactory, on Willow street, above Twelfth, and four patents—one of April 10, 1883, for electric cables; a second, of the same date, for a machine for manufacturing cables: another, of Feb. 12, 1884, for a method of and apparatus for laying branch underground electrical conduits, and a fourth, dated March 25, 1884, a coupling for electric wires. The liabilities of the concern could not be ascertained, but it is understood that the assignee is the heaviest creditor.

FINANCIAL.

NEW YORK, August 30th, 1884.

There has been some improvement during the past month in the market for electrical securities. Western Union stock is gradually returning to the quotation of six months ago. More confidence is being shown in legitimate electric light shares; and it is believed that the coming exhibition at Philadelphia will create a tendency toward investment in various electrical enterprises with which the public heretofore has not been familiar. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	150 00	150 00	Molecular	3 00	9 00
Am. Speaking	90 00	120 00	New England	25 00	29 25
Currier-Tele. Bell	3 00	—	New York & N. J.	50 00	60 00
Columbia & Pan.	24 50	25 00	N. Y. & Penn.	40 00	65 00
Continental	10 00	—	Peoples	5 00	10 00
Dolbear	5 00	10 00	do. N. E.	1 25	2 00
Erie	18 00	19 25	Southern Bell	—	125 00
Globe	5 00	7 00	Southern N. E.	—	175 00
Hudson Riv.	40 00	75 00	Tropical	1 50	2 00
Inter-Cont.	50	1 50	W. I. Tel. & Telph.	1 00	1 25
Mexican Central	1 75	2 00			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Cable	50 00	58 00	Manhattan Telegraph	10 00	85 00
American Rapid	20 00	50 00	Mexican	125 00	147 00
Bankers' & Merchants' 1st m. bonds	24 00	25 00	Postal	4 50	5 25
do stock	17 00	20 00	do. bonds	41 00	42 50
Com'l Tel. Co., common	—	75 00	Western Union	68 50	68 62½
Harlem Dist. Tel. Co.	—	2 50			

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
Brush	50 00	80 00	Edison European	1 00	15 00
Brush Ill.	30 00	45 00	Swan	15 00	40 00
Cons. Electric Light	—	24 00	Sawyer-Mann Ill. Co.	10 00	45 00
Daft	20 00	40 00	U. S.	60 00	85 00
Edison	70 00	85 00	do. Ill. Co.	—	90 00
Edison Ill.	30 00	75 00	United Globe	70 00	75 00
Edison Isolated	40 00	80 00			

The Erie Telephone and Telegraph Company declared a quarterly dividend of one-half of 1 per cent. on July 29, a reduction from 1½ per cent. for the previous quarter.

The following sales of electrical securities at auction have been made since our last issue:

39 shares Southern and Atlantic Telegraph Company (5 per cent. interest guaranteed by Western Union Telegraph Company), $25 each, at 57.

10 shares Edison Electric Light Company of Europe, limited, lot at $29.

5 shares Solenoid Telephone Company, lot at $3.

At a meeting of the members of the Electric, Manufacturing and Miscellaneous Stock Exchange, August 20th, it was decided that the exchange should continue in business.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 50 Wall Street, New York city.*

LEGAL NOTES.

Western District of Pennsylvania—*Stutz* v. *Armstrong & Son.* Acheson, J. Where it appears from the original papers in a case that a certain feature was within the contemplation of the inventor as a valuable element in a patentable combination, and it is proved that a claim embracing such feature was erased from the original application through a misunderstanding of the invention by the solicitors; *held* that the Commissioner of Patents committed no error in granting a reissue containing a claim embracing such feature. The fact that a reissue application was filed within two years after the grant of an original patent, while it may not be conclusive against the charge of unreasonable delay, is entitled to some consideration in view of that provision of the patent laws by which nothing less than two full years' public use of an invention is a bar to an application for a patent. The fact that the correction of a mistake by reissue was before any adverse rights had accrued is a consideration of paramount importance, and it ought to count something in his favor that, being of foreign birth, education, and an alien tongue, he encountered difficulties in acquiring a knowledge of our language and laws. It is by no means essential that the several devices or elements thereof should co-act upon each other. It is sufficient if all the devices co-operate with respect to the work to be done and in furtherance thereof, although each device may perform its own particular function only.

Northern District of New York—*Crandall et. al.* v. *The Parker Carriage Goods Co.* Coxe, J., held that a device which could not be used as a substitute for the patentee's invention without the exercise of invention is not an anticipation of it. Also that when it can be seen that the patentee seeks by apt words of description to secure what he has honestly invented and nothing more, the Court should hesitate to regard with favor the accusation now so freely made against reissued patents.

Southern District of New York—*Wooster* v. *Handy.* This suit was brought on two reissued patents. Blatchford, J., held that interlocutory decrees remain under the control of the Court and subject to its revision until the master's report comes in and is finally acted upon by the Court; and therefore, upon final hearing, the Court is at liberty to interpret the law in the light of decisions announced since the rendition of the interlocutory decree. The rule laid down by the Supreme Court is, that where it is sought merely to enlarge a claim there must be clear mistake and inadvertence and a speedy application for its correction, with no unreasonable delay; that in such a case a patentee cannot wait until other inventors have produced new forms of improvement and then apply for such an enlargement of his claim as to make it embrace these new forms, and that when it is apparent from a comparison of the two patents that the reissue is made to enlarge the scope of the patent, the Court may decide whether the delay was reasonable and the reissue therefore void. Where an invention covered by the claim of the original patent was clearly and accurately described in the specification of that patent and there was no defect or insufficiency so far as the description was concerned, and the patent was not invalid or inoperative to cover anything arising out of such description which was set forth as an invention; *held* there is no evidence that there was, in fact, any inadvertence, accident or mistake, and hence a reissue with enlarged claims was not authorized. *Thayer* v. *Hart, jr., et. al.* Coxe, J., held that where the complainant's patent was granted before the date at which the defendant's application was filed, it is incumbent upon the latter to prove beyond a reasonable doubt that theirs was the prior invention, and this being done, the burden is transferred to the complainant to satisfy the Court, by proofs as convincing as that required of the defendants, that his invention preceded theirs. The evidence of prior invention is usually entirely within the control of the party asserting it, and so wide is the opportunity for deception or mistake that the authorities are almost unanimous in holding that it must be established by proof clear, positive and unequivocal—nothing must be left to speculation or conjecture. It being found that no one of the principal circumstances *relied on* by the complainant is free from perplexity, either its own date being uncertain or there being difficulty in connecting it with the invention, the doubt is created which the authorities hold must be absent from the mind of the Court, and it follows that the bill must be dismissed. *Consolidated Electric Light Co.* v. *Brush-Swan Electric Light Co.* Wheeler, J., held that when an amended bill was brought upon five different patents, even though the patents cover inventions which are capable of being used conjointly, and which are made and sold as parts of the same electric lighting system, yet if the inventions may be used separately and operate independently with respect to each other, and any of them may be infringed without infringing the others, the bill must be adjudged to be open to the objection of multifariousness.

Southern District of Ohio—*Kuhl* v. *Mueller, et. al.* Sage, J., delivered the opinion to the effect that it has never been held that an equivalent known at the date of the invention could be used without infringing the patent; such a holding, if generally adopted, would amount practically to the destruction of the law of equivalents. If an inventor is the first to produce a result, he is entitled to all means known at the date of his patent by which the same result can be produced.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From July 22 to August 12, 1884 (inclusive).

Alarms and Signals:—*Feed Water Alarm*, G. W. Getchell, July 22, 302,345. *Fire Alarm System*, E. F. Phillips and J. F. Land, Aug. 5, 302,935. *Fire Extinguisher and Alarm*, C. E. Buell, 302,980. *Fire Alarm Box*, E. B. Birge, 303,109. *Watchman's Time Recorder and Register*, W. W. LeGrande, Aug. 12, 303,208.

Conductors, Insulators, Supports and Systems:—*Cable*, E. M. Bentley, July 22, 302,377. *Underground Way*, same, 302,378. *System of Communicating with Moving Trains*, G. E. Fullerton, 302,475. *Underground Conduit*, J. E. Morris, D. H. Dorsett and B. Williams, Aug. 5, 303,035; G. H. Benjamin, 302,883. *Insulator*, C. W. Prince, Aug. 12, 303,309; D. R. C. Bailey, 303,483. *Cap for Telegraph Poles*, G. L. Broomhall, 303,261. *Apparatus for Distributing and Regulating Currents*, J. J. Skinner, 303,402.

Dynamo Machines and Motors:—*Dynamos*, C. F. Brush, July 22, 302,319; R. H. Mather, 302,418; J. J. Wood, 302,460. *Mode of Winding Field Magnets for*, R. H. Mather, 302,417. *Armature for*, W. K. Freeman, July 29, 302,554, 302,555. *Field-of-Force Magnet for*, same, 302,556. *Armature Winding for*, same, 302,557. *Means of Applying Motors to Cars*, W. F. Sherman, 302,596. *Apparatus for Winding Armatures*, W. B. Espent, 302,627. *Motors*, E. T. Starr, 302,723. *Regulator for Dynamo*, E. Thomson, Aug. 5, 302,963.

Galvanic Batteries:—A. de Khotinsky, July 29, 302,633; G. G. Skrivanow, Aug. 5, 303,237; T. Cleland, Aug. 12, 303,560.

Ignition:—*Gas Lighter*, T. & J. Taylor, July 22, 302,447.

Lamps and Appurtenances:—*Process of Making Incandescents*, A. Croto, July 29, 302,837. *Arc Lamps*, W. K. Freeman, 302,553; E. Thomson, Aug. 5, 302,960, 302,962; J. F. Kelly, 303,030; J. J. Wood, 303,245. *Focusing Arc Lamp*, E. Thomson, 302,961. *Incandescent Lamp*, C. M. Ball, Aug. 5, 303,202; C. F. Beck, Aug. 12, 303,358. *Incandescent Lighting*, same, 303,357. *Cut-out for Lamps*, T. N. Shaw, 303,402.

Measurement:—*Dynamometer*, C. F. Brackett, Aug. 5, 302,976.

Miscellaneous:—*Photographers' Retouching Device*, J. F. Geesbergen and Alfred Geruzet, July 29, 302,836. *Apparatus for Heating*, J. S. Sellon, 302,673. *Coupling for Wires*, H. L. Bailey, Aug. 5, 302,972. *Method of Displaying Signs*, L. H. Day, Aug. 12, 303,496. *Automatic Hydrometer Apparatus*, G. A. Bobrick, July 29, 302,580. *Magnetic Window Shade*, H. D. Winton, 302,618. *Contact for Doors*, A. Lungen, Aug. 12, 303,579.

Protectors:—*Safety Appliance*, K. W. Hedges, July 22, 302,485. *Lightning Rod*, G. S. Prescott, Aug. 12, 303,591. *Coupling for Tubular Lightning Rod*, S. Bradley, 303,488. *Safety Device for Circuits*, E. Weston, Aug. 5, 302,968.

Railway Appliances:—*Signal*, A. D. Blodgett and H. D. Winton, July 29, 302,831; W. W. LeGrande, Aug. 12, 303,526. *Train Signal*, L. W. Lindley, July 22, 302,505. *Signal Apparatus*, C. A. Scott, Aug. 12, 303,595; F. L. Pope, 303,589, 303,590. *Magneto Signal*, W. W. Gary, 303,597. *Insulating Block for Rails*, W. W. Le Grande and R. Meek, 303,525. *Connection for Rails*, L. D. Hamilton and R. Meek, 303,599; R. Meek, 303,537, 303,538. *Double Acting Relay*, L. D. Hamilton, 303,570.

Storage Batteries:—A. De Khotinsky, July 29, 302,623; T. S. Sarney, 302,783.

Telephone Systems and Apparatus:—*Automatic Adjustable Double Telephone Receiver*, D. G. Barnard, Aug. 12, 303,553. *Exchange System*, H. E. Waite and S. H. Bartlett, July 22, 302,364; W. H. Knight, 302,344. *Switch*, H. K. Goodwin, 302,330; E. B. Hamlin, Aug. 12, reissue, 10,508. *Transmitter for Telephone Time System*, G. W. Ruehle, Aug. 5, 303,052.

Telegraphs:—*Quadruplex*, F. W. Jones, July 22, 302,410. *Synchronous*, P. La Cour, 302,502. *Transmitter*, C. G. Spengler, 302,360. *Escapement for Printing*, D. B. Scott, Aug. 12, 303,327.

BUSINESS ADDRESSES.

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Thau, H., Telegraph and Electrical Instruments and Supplies, Models and Experimental Work, 130 Fulton Street, N. Y.

Thompson, E. P., M. E., Expert and Patent At- torney. Member Am. So. M. E. and Am. Inst. Elect. E. 13 Park Row, N.Y.

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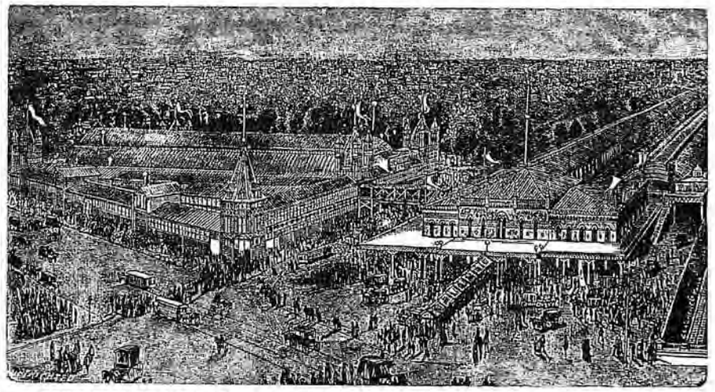

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1884. 1884.

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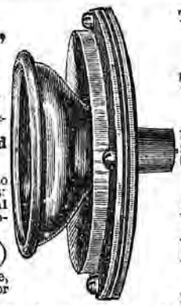

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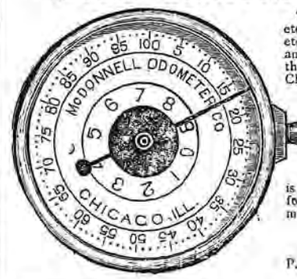

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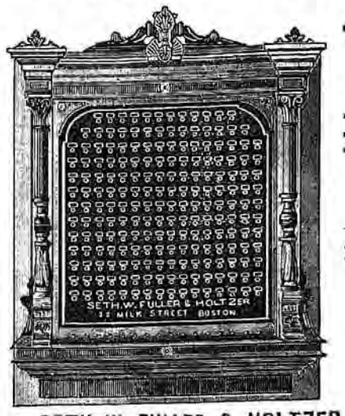

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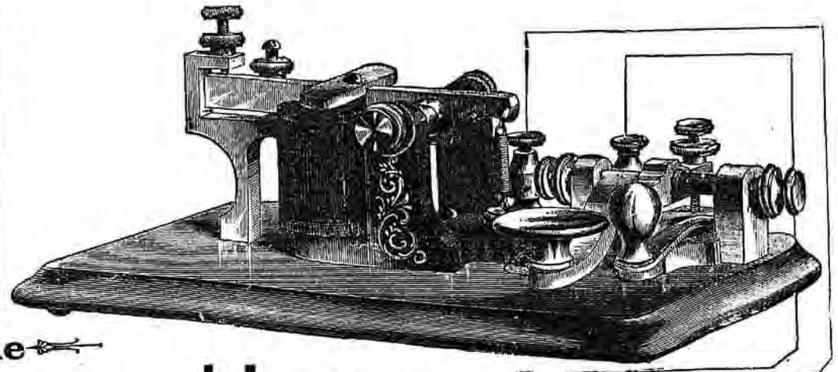

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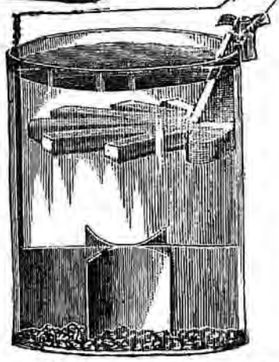

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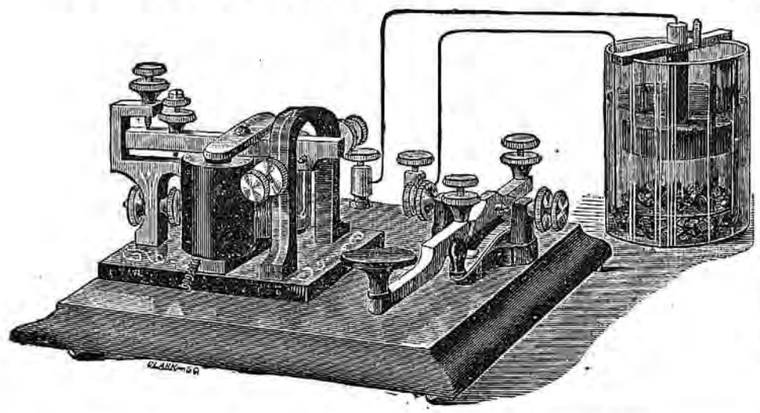

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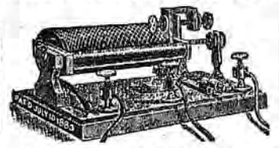

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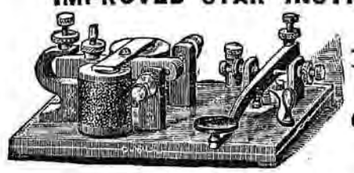

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PUBLISHED MONTHLY BY

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Great Britain and other Foreign Countries within the Postal Union	"	1.50
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NEW YORK, OCTOBER, 1884.

THE NATIONAL ELECTRICAL CONFERENCE.

THE six days' work of the Electrical Conference has terminated very satisfactorily, considering the many disadvantages under which it has labored. Of these, one of the most serious was the intense heat which prevailed, a drawback which will doubtless be avoided in the case of any future appointments. It is to be regretted that on this occasion, in which the respective advocates of theory, and of practice in the electrical field, have been brought together for the first time under circumstances affording an opportunity for open discussion, there should have been any apparent disposition to depreciate the value and importance of the researches of those who have acquired their knowledge from intimate association with the dynamo, the telephone, the telegraph, and the cable. If such a feeling existed, this of all others, was the occasion on which to bury it. It is difficult to realize that in the scientific investigation of electricity where practical experience has wrought so many triumphs, it should be asserted that no person has a right to express an opinion on any of its theoretical problems "without a knowledge of its mathematics." Such a dictum would have suppressed the teachings of a Faraday whose example alone is sufficient to prove the unsoundness of the argument. There is work for all, and none of us are so wise, but that we may gather crumbs of knowledge from many to whom the higher mathematics are a sealed book. The indispensable value of purely scientific investigation is fully recognized by all, but it has not fallen to the lot of every one of those who are blessed with minds to conceive and hands to execute, to be supplied with elaborate apparatus and ample resources with which to demonstrate that a certain theory must be correct, when the facts prove the contrary. No; this is a free country, and we live in the nineteenth century, and at this particular period, even the importance of the "honest workingman" is generally recognized. One of the happiest results of the conference was the apparent disappearance of this feeling, as the arena of discussion gradually developed the fact that the experience of practical men was after all as interesting and instructive as any part of the proceedings. This was due no doubt in a great measure, to the presence of a considerable foreign element, which has been trained in a school where theory and practice have been brought into closer relationship. The work which has been thus auspiciously inaugurated should now be taken up by individuals and associations, in order that it may be perpetuated before the enthusiasm wanes.

THE TELEPHONE CONVENTION.

THE recent convention of telephone exchange representatives at Philadelphia, was of more than ordinary interest to all owners and operators of electric lines, owing to the practical experience many of these gentlemen have had with subterranean work. The presence of M. Berthon, representing the telephone system of Paris, also afforded an unusual opportunity for obtaining reliable information regarding the underground lines of that city, to which reference is so often made. The annoying sounds arising from induction and earth currents, are there neutralized by the use of metallic circuits. It appears from the statements made at the convention by delegates from Chicago, Washington and Pittsburg, that comparatively little difficulty will be experienced with underground work if a little common sense is used, and the authorities consult with the representatives of the different companies in the proper spirit. In Washington for instance, while wires must be buried in the principal streets and avenues, the telephone company is allowed to plant distribution poles of the necessary height in alleys, from which wires are led overhead to the various instruments of the subscribers in the immediate vicinity. There is evidently a disposition on the part of the telephone people to meet this problem, and when once a satisfactory subterranean system is established no one will desire to return to the old methods of construction. The appointment of a committee to co-operate with other wire consumers in the adoption of a universal wire gauge, is in the direction of a reform that will meet with hearty approval. The matter has been gradually getting worse, and although not exactly within the province of a telephone organization, there is no other body so situated as to be able to bring about this desirable change, and it is to be hoped that the movement will be successful. The use of hard-drawn copper wire for lines is growing in favor, and appears to be a very much needed improvement in "extra-territorial" construction. The question of rates for long distance telephony which was discussed informally, brought out some instructive facts from those who have devoted considerable thought to the subject. The best results appear to have been attained in California, and it seemed to be the general impression that the service must be made more satisfactory before it could

be depended upon as a source of direct profit. It is very evident that these conventions have been of great advantage in the general advancement of telephony, from the interchange of practical experience rather than from any direct legislative action which they may have taken. Electric light interests would be greatly harmonized if their representatives in different cities could meet occasionally in a similar manner.

TECHNICAL EDUCATION.

THERE is no more important question in the whole range of social topics than that of education, and public attention has been directed to it in both Europe and America, for the purpose of devising, if possible, some system which would more effectually teach what the pupil may be expected to practice when he reaches maturity. The fact that a student in obtaining a classical education devotes to that work the very years when he should be gaining a practical knowledge of the handicraft by which his living must be earned, has, in a measure, obliterated the old idea that every boy with brains *ought* to go through college. The value of such a training is by no means to be underrated, but it should not be exacted without proper consideration of the future, and every parent should be able to discern whether a boy of 14 has a decided leaning toward the so-called learned professions, science or mechanics. Whatever walk in life he may finally travel, he may not prove eminently successful, even if meritorious. Success, from a worldly point of view, is a matter of chance as well as of merit; but moderate success, which brings contentment and happiness to thousands of humble homes, is but the application of honest industry and judicious economy to that line of duty which has finally been selected as the means of livelihood. This is the fundamental idea of a technical education. To what extent it should be carried out is still a matter of dispute. There can be, however, no good reason advanced why a bricklayer may not graduate from his special school, as well as a physician from a medical college. Practically the artisan would be the more perfect production of the two, for the reason that the elements that he deals with do not present such a variety of phases which require far more practical experience. In discussing the merits of technical schools, both their opponents and advocates are prone to lose sight of the value of experience. The amateur artisan, as well as the college graduate, in cutting loose from their alma mater enter the professional arena, and instead of humbly seeking further light as to the mysteries of the craft, endeavor to parade their superior attainments, get snubbed for their pains, and at once build up a feeling of enmity which years of association may not entirely eradicate. The student should be constantly impressed with the idea that he is not *learning* a trade or profession, but merely learning how to begin, and then, when he enters the vast field of labor it will be in the more dignified garb of a skilful apprentice, rather than that of a bungling journeyman. He will thus escape much of the drudgery which usually falls to the lot of the youngest employees, for the reason that his time will be too valuable to be devoted to such service. Here it may be remarked that much of the animosity that exists against the introduction of new labor in the trades is caused by the placing of incompetent hands, at low wages, in positions which they are not qualified to fill. Employers are also responsible for the existence of considerable ill feeling, by not properly appreciating the value of long experience in certain branches of the service. A larger proportion of the spirit of humanity infused into these years of toil would, beyond question, materially increase the profits of nearly every branch of business.

LAST OF ALL KEELY CAME ALSO.

OUR columns bear witness to the fact that we have but little sympathy for the innumerable host of humbugs and pretenders who have from time to time trespassed upon the electrical field. In confining our attention to these, however, we have by no means overlooked the existence of similar intruders in other quarters. The occasional appearance of a promised test of the Keely motor at some future time, has not been altogether lost sight of. It was at the home of the Keely enterprise; the hospitable old Quaker City, that a humble follower of Benjamin Franklin saw a placard displayed "Drinks given away here to-morrow," and it was not until he reflected upon the possibility of this alluring sign being continuously displayed in the same place every succeeding day that he was fully impressed with the idea that to-morrow is a day that never comes. But there must be a limit to all things, especially to the patience of a capitalist who is upholding the visionary schemes of a "crank," consequently we had no occasion to be surprised when the statement appeared that Keely had discovered that the vibrations of his "etheric" force could be utilized for telegraphing. Whether the principle is electrical, mechanical, or ethereal our readers must determine for themselves. It has the appearance, however, of having been dragged into the discussion more particularly for the purpose of distracting attention from the ostensible object of Keely's experiments, which has been the adaption to practical use of the mysterious force that he claims to have discovered. Although a long and weary period of sixty days must elapse before the patient stockholders of this ethereal enterprise will gaze in wonderment upon the oscillations of a 250 h.p. engine, driven by a "vapor" of one-quarter the weight of hydrogen gas, a representative of newspaper science has been permitted an audience with the Oxford street wizard, and the great secret has been unveiled. "That steel bar" said Mr. Keely, "was the beginning of my motor; by means of it I stumbled on my discoveries. For seven year I have kept flowing through that core a stream of etheric vapor. . . . . Were I to pass through it for 20 years longer this etheric vapor, it would crumble into nothingness; be transformed into impalpable dust." Strange to say electricity is not to share in the triumphs of this wonderful force. "I am positive" said the inventor "that they are entirely different substances. The ether passes through glass, but does not affect it. Electricity will not pass through glass. I expect to be able to apply the ether vibrators to telegraphy. I have experimented on 8,000 feet of wire, and in one-eighth of a second I have transmitted to the other end of the wire a force sufficient to make holes in pasteboard. I confidently assert that I can intensify the vibrations so as to disturb the molecules in a wire 25,000 feet in length, and that in a second of time. The vibrations travel with extreme velocity. The operation of the wire in telegraphy is simply this: It is passed into a resonator, one end of which is attached to a vibrator. In this way the vibrations are induced and promulgated. My large motor is completed and only needs to be adjusted. I will give a public test inside of two months. I have filed caveats of all my motors and inventions and will have them patented."

Our readers cannot fail to be impressed with the lucid manner in which the operation of the "ether vibrators" upon a wire is explained by Mr. Keely, and we sincerely hope that they will refrain from adding to the burden of the editor's labors by writing to him for additional information in respect to a matter which, if they will carefully study the above quoted explanation, they will be able to understand, just as well as Mr. Keely himself does.

THE BOSTON ELECTRICAL EXHIBITION.

THE preliminary arrangements for the Boston exhibition are progressing. The officers have been appointed, an advisory board formed, and electrical people generally notified that it is to be opened on the 24th of November next. It will be held in the building of the Massachusetts Charitable Association, and continue about five weeks. Goods will be received between the 5th and 19th of November. It follows very closely upon the Philadelphia exhibition, and must necessarily, in many respects, be a duplicate of that, if the display is complete. If these exhibitions can be made commercially successful, it is scarcely possible that there will be too many of them, for the reason that it is probably the most effective manner in which the public can be made familiar with the various electrical appliances. The business is already jeopardized in certain directions by reason of popular ignorance of the subject, and if there are those who still believe that immense profits are realized in every branch of it, they may learn by examination of various exhibits that considerable sums of money must be invested before any returns are secured. How far the general public will patronize a technical exhibition of this kind, depends upon its attractiveness, the character of the people in the vicinity of its location, and the price of admission.

THE LATEST DECISION ON THE UNDERGROUND BILL.

IT has been decided by Judge Van Brunt, of the New York Supreme Court, that telegraph companies have had no valid rights for the erection of poles in the streets, excepting where compensation had been made to the owners of property in front of which they were erected. As to the question whether the "Daly act" can be enforced, he is governed by what he considers the spirit of the law, which is, that it is to "take effect immediately." He also holds that the national government has no right to override the local authority by granting privileges to telegraph companies for the construction of lines along post-roads. Fortunately for the citizens who may hereafter desire to avail themselves of such conveniences as the telephone and messenger service, this decision appears to have no bearing upon the construction of housetop lines. In such cases, where roof privileges are regularly leased or permission for occupancy granted by the owners, no legal restriction can be imposed by the authorities—at least as the question now stands. Existing lines may remain, but subscribers desiring electrical facilities of any kind need not be surprised if they are politely informed that their wishes cannot be complied with unless they care to assume the extra expense incurred by placing the wires underground. The various electrical companies who are affected by this decision should lose no time in combining their efforts for the practical solution of this problem which they will be compelled to face at an early day.

UNEASY TELEPHONE STOCKHOLDERS.

QUITE a number of the stockholders of the Erie Telegraph and Telephone Co., residing in Manchester, N. H., and Lowell, Mass., have addressed a communication to the management in which they request that some change in the policy of the company be made to prevent further depreciation in the value of their investment. Over 6,000 shares, one eighth of the capital stock are represented in this appeal, and they claim to have studied the annual reports in vain, to ascertain the true cause of the depreciation in the value of their holdings. If the report as submitted is correct the diminished dividends are easily enough accounted for, and under the circumstances it may be said that the stockholders were fortunate in receiving any. So far however from indulging in despondency, they should consider that their present standing is but the legitimate result of an effort to increase the earning capacity of the plant without the acquisition of additional actual capital. An expenditure of $339,619 in the construction of 2,897 miles of line with additional operating machinery represents nearly twice the amount of the dividend declared. If not actually compelled by contract to continue the extension of extra territorial lines it would seem that this branch of the business might wisely be suspended, and proper provision made for it by means of a reserve fund. The territory covered by the system of the company although at present sparsely settled is rapidly developing, and with conservative management, and less expectation of large dividends while the business is comparatively speaking in its infancy, there is little reason to doubt that the property will recuperate if honestly handled, in spite of its inflated capital.

THE BELL-DRAWBAUGH PATENT SUIT.

THE arguments in this case were begun on September 22d, before Judge Wallace of the United States Circuit Court. Public attention has been generally directed to the suit, and the result will be awaited with no little anxiety by thousands of people who have become financially interested in the telephone business. Whatever may be the decision of Judge Wallace, the case will be carried to the Supreme Court of the United States, and several years may elapse before it is finally terminated.

ARTICLES.

THE ELEMENTARY PRINCIPLES OF ELECTRICAL MEASUREMENT.

BY F. L. POPE.

(Continued from page 161.)

THE legal *ohm*, therefore, is represented by the resistance of a column of pure mercury having a sectional area of 1 square millimetre (.00155006 square inches), and a length of 1.06 metres (3.47775 feet), at the temperature of 0° centigrade or 32° Fahrenheit.

The *Ampère* is the unit of current, and is equal to the quantity of electricity which will pass during 1 second through a circuit having a resistance of 1 ohm when the electromotive force is 1 volt. This quantity of electricity was formerly spoken of as 1 farad per second. It more recently came to be called by British and American electricians a *weber*, and sometimes an *œrsted*, but the designation of ampère, having been established by the Paris Congress, may now be considered authoritative.

The actual value of the ampère has been carefully determined by the electrolytic method; that is, by ascertaining the weight of a given metal which it is capable of depositing from solution in a given time, the quantity of metal thus deposited being known to be proportional to the whole quantity of electricity which passes during such time. The results obtained by different investigators are now in close accordance, the conclusion being as follows:

The ampère is represented by that quantity of current which is capable of depositing 4.025 grammes (62.10 grains) of silver per hour[1] or 0.001118 grammes per second.

The quantity of current traversing a conductor may be measured in ampères by various methods, some of the more important of which will hereafter be described.

The *Coulomb* is the unit of dynamic quantity, and its value corresponds with that of the ampère; for example, it would require a quantity of electricity equal to 10 coulombs to supply a current of 10 ampères for 1 second, while the same quantity would supply a current of 5 ampères for twice the length of time or 2 seconds. The quantity of electricity contained in a storage battery or in a condenser is measured in coulombs. The value of the coulomb is of course determined from that of the ampère.

The *Farad* is the unit of capacity. It is employed for measuring the capacity of telegraphic lines, cables, condensers and the like. Its value is equal to 1 coulomb divided by 1 volt. A unit condenser, therefore, is one which will contain 1 coulomb of electricity under a potential of 1 volt. The farad itself being too large a unit for convenient use, the microfarad, which is the one-millionth part of a farad, is universally employed as the practical unit. The microfarad is equal in capacity to about 5.6 kilometres (3.5 miles) of ordinary submarine cable.

MECHANICAL UNITS.

In nearly all the practical applications of electricity we have occasion to deal with the conversion of electrical into mechanical energy, as in the movement of mechanism by electro-magnetism, or the conversion of mechanical into electrical energy, as in the operation of dynamo or magneto electric machines. The conversion of electricity into heat, as in the case of electric lighting, and the firing of fuses, is another application which often calls for consideration. Hence, certain additional units are required, which, strictly speaking, do not belong to the electrical system, although they bear a definite and measurable relation to that system.

1. At the recent meeting of the British Association in Montreal, Lord Rayleigh said that this result was reached independently by Professor Kohlrausch and himself, and could hardly be in error more than a thousandth part.

The *Joule* or *Joulad* is the unit of energy, as manifested in the production of heat or of mechanical work. As pointed out by J. T. Sprague, it represents the true resistance; it is analagous to mechanical friction and like it, varies as the square of the current. It represents the work done or heat generated by 1 ampère of current traversing 1 ohm of resistance, or by 1 coulomb running down through a difference of potential of 1 volt. According to Joule's determination it is equivalent to the heat required to raise the temperature of 0.238 grammes of water 1° centigrade.

The *Watt* is the unit of power, and its relation to the joulad is very similar to that of the coulomb to the ampère. It is the power conveyed by 1 ampère of current through a conductor whose ends differ in potential 1 volt, or the rate at which work is done by 1 ampère traversing 1 ohm. It is equal to 1 joule per second or $\frac{1}{746}$ of a h. p. nearly.

The British Board of Trade commercial unit is 1000 volt-ampère-hours, or 1000 watt-hours; 10 ampères at 100 volts per hour are equal to one Board of Trade unit or watt-hour.

UNITS OF LIGHT.

In determining the efficiency of electric lamps, it is necessary to employ a light unit for determining the amount of illumination produced. No such standard has as yet been authoritatively settled upon, but the matter is receiving careful consideration. Several different standards have heretofore been employed in photometric work.

The *British Unit* is the light produced by a spermaceti candle ⅞ inch in diameter, and burning at the rate of 120 grains per hour. It is said to be liable to vary as much as 25 per cent.

The *French Unit*, usually termed the bec-carcel, is the light produced by a carcel lamp, burning 42 grammes per hour of pure colza oil, with a flame 40 millimetres high, under certain conditions laid down by Dumas and Regnault. This unit is assumed to equal 9.5 British standard candles.

The *German Unit* is the light produced by a paraffin candle having a diameter of 20 millimetres and a flame 5 centimetres in height.

It has been proposed by Dr. Draper, and also by L. Schwendler, to employ as a unit a strip of platinum of definite dimensions maintained at a white heat by an electric current of given strength. Violle and others have proposed to take as a unit the light emitted by a square centimetre of platinum surface at the point of fusion.

The values of the quantities required to be measured in electrical work vary so widely that the units which have been described are in some cases too great and in other cases too small for convenient use. In order to avoid this inconvenience, it has become customary to make use of decimal multiples and sub-multiples of the different units, which are expressed by certain prefixes, as follows:

MULTIPLES.

Mega. or meg.,	denotes.....	1,000,000 units.
Myria.,	"	10,000 "
Kilo.,	"	1,000 "
Hecto.,	"	100 "
Deca.,	"	10 "

SUB-MULTIPLES.

Deci.,	denotes.....	$\frac{1}{10}$ of a unit
Centi.,	"	$\frac{1}{100}$ " "
Milli.,	"	$\frac{1}{1000}$ " "
Micro or micr.,	"	$\frac{1}{1000000}$ " "

Thus, for example, 1 megohm = 1,000,000 ohms, and is a unit used in measuring the resistance of insulators; 1 milli-ampère = $\frac{1}{1000}$ of an ampère, and is well adapted for measuring the strength of telegraphic currents; 1 microfarad = $\frac{1}{1000000}$ of a farad, and is a convenient unit for measuring the electro-static capacity of submarine cables.

We may now re-state Ohm's law in a more concrete form, having become familiar with the units practically employed in dealing with the electrical manifestations to which the law is applicable:

1. The strength of an electric current in ampères may be found by dividing the number of volts of electromotive force, or difference of potential, by the number of ohms of resistance. That is to say:

$$\text{Ampères} = \frac{\text{volts}}{\text{ohms}} \text{ or } C = \frac{E}{R}$$

2. The resistance which is being overcome by an electric current may be found by dividing the number of volts of electromotive force, or difference of potential, by the number of ampères of current. That is to say:

$$\text{Ohms} = \frac{\text{volts}}{\text{ampères}} \text{ or } R = \frac{E}{C}$$

3. The electromotive force, or difference of potential, by which a given current is produced, may be found by multiplying the number of ohms of resistance into the number of ampères of current. That is to say:

$$\text{Volts} = \text{ohms} \times \text{ampères, or } E = R\,C.$$

4. The quantity of electricity conveyed by a given current may be found by multiplying the number of ampères of current by the number of seconds of time during which it flows. That is to say:

$$\text{Coulombs} = \text{ampères} \times \text{seconds, or } Q = C\,T.$$

(*To be continued.*)

THE BRITISH ASSOCIATION.

MONTREAL MEETING.

THE inaugural address of Right Hon. Lord Rayleigh was largely devoted to electrical matters, and the following extract is of interest to all who desire to keep abreast of the advance of science:

One of the most striking advances of recent years is in the production and application of electricity upon a large scale—a subject to which I have already had occasion to allude in connection with the work of Sir W. Siemens. The dynamo machine is indeed founded upon discoveries of Faraday now more than half a century old; but it has required the protracted labors of many inventors to bring it to its present high degree of efficiency. Looking back at the matter, it seems strange that progress should have been so slow. I do not refer to details of design, the elaboration of which must always, I suppose, require the experience of actual work to indicate what parts are structurally weaker than they should be, or are exposed to undue wear and tear. But with regard to the main features of the problem it would almost seem as if the difficulty lay in want of faith. Long ago it was recognized that electricity derived from chemical action is (on a large scale) too expensive a source of mechanical power, notwithstanding the fact that (as proved by Joule in 1846) the conversion of electrical into mechanical work can be effected with great economy. From this it is an evident consequence that electricity may advantageously be obtained from mechanical power; and one cannot help thinking that if the fact had been borne steadily in mind, the development of the dynamo might have been much more rapid. But discoveries and inventions are apt to appear obvious when regarded from the standpoint of accomplished fact; and I draw attention to the matter only to point the moral that we do well to push the attack persistently when we can be sure beforehand that the obstacles to be overcome are only difficulties of contrivance, and that we are not vainly fighting unawares against a law of Nature.

The present development of electricity on a large scale depends, however, almost as much upon the incandescent lamp as upon the dynamo. The success of these lamps demands a very perfect vacuum—not more than about one-millionth of the normal quantity of air should remain—and it is interesting to recall that, twenty years ago, such vacua were rare even in the laboratory of the physicist. It is pretty safe to say that these wonderful results would never have been accomplished had practical applications alone been in view. The way was prepared by an army of scientific men whose main object was the advancement of knowledge, and who could scarcely have imagined that the processes which they elaborated would soon be in use on a commercial scale and intrusted to the hands of ordinary workmen.

When I speak in hopeful language of practical electricity, I do not forget the disappointment within the last year or two of many over-sanguine expectations. The enthusiasm of the inventor and promoter are necessary to progress, and it seems to me almost a law of nature that it should overpass the bounds marked out by reason and experience. What is most to be regretted is the advantage taken by speculators of the often uninstructed interest felt by the public in novel schemes by which its imagination is fired. But looking forward to the future of electric lighting, we have good ground for encouragement. Already the lighting of large passenger ships is an assured success, and one which will be highly appreciated by those travelers who have experienced the tedium of long winter evenings unrelieved by adequate illumination. Here, no doubt, the conditions are in many respects especially favorable. As regards space, life on board ship is highly concentrated; while unity of management and the presence on the spot of skilled engineers obviate some of the difficulties that are met with under other circumstances. At present we have no experience of a house-to-house system of illumination on a great scale and in competition with cheap gas; but preparations are already far advanced for trial on an adequate scale in London. In large institutions, such as theatres and factories, we all know that electricity is in successful and daily extending operation.

When the necessary power can be obtained from the fall of water, instead of from the combustion of coal, the conditions of the problem are far more favorable. Possibly the severity of your winters may prove an obstacle, but it is impossible to regard your splendid river without the thought arising that the day may come when the vast powers now running to waste shall be bent into your service. Such a project demands of course the most careful consideration, but it is one worthy of an intelligent and enterprising community.

The requirements of practice react in the most healthy manner upon scientific electricity. Just as in former days the science received a stimulus from the application to telegraphy, under which everything relating to measurement on a small scale acquired an importance and development for which we might otherwise have had long to wait, so now the requirements of electric lighting are giving rise to a new development of the art of measurement upon a large scale, which cannot fail to prove of scientific as well as practical importance. Mere change of scale may not at first appear a very important matter, but it is surprising how much modification it entails in the instruments, and in the processes of measurement. For instance, the resistance coils on which the electrician relies in dealing with currents whose maximum is a fraction of an ampère fail altogether when it becomes a question of hundreds, not to say thousands, of ampères.

The powerful currents, which are now at command, constitute almost a new weapon in the hands of the physicist. Effects which in old days were rare and difficult of observation may now be produced at will on the most conspicuous scale. Consider for a moment Faraday's great discovery of the "Magnetization of Light," which Tyndall likens to the Weisshorn among mountains, as high, beautiful, and alone. This judgment (in which I fully concur) relates to the scientific aspect of the discovery, for to the eye or sense nothing could have been more insignificant. It is even possible that it might have eluded altogether the penetration of Faraday had he not been provided with a special quality of very heavy glass. At the present day these effects may be produced upon a scale that would have delighted their discoverer, a rotation of the plane of polarization through 180° being perfectly feasible. With the aid of modern appliances, Kundt and Röntgen in Germany, and H. Becquerel in France, have detected the rotation in gases and vapors, where, on account of its extreme smallness, it had previously escaped notice.

Again, the question of the magnetic saturation of iron has now an importance entirely beyond what it possessed at the time of Joule's early observations. Then it required special arrangements purposely contrived to bring it into prominence. Now in every dynamo machine, the iron of the field magnets approaches a state of saturation, and the very elements of an explanation of the action require us to take the fact into account. It is indeed probable that a better knowledge of this subject might lead to improvements in the design of these machines.

Notwithstanding the important work of Rowland and Stolotow, the whole theory of the behavior of soft iron under varying magnetic conditions is still somewhat obscure. Much may be hoped from the induction balance of Hughes, by which the marvelous powers of the telephone are applied to the discrimination of the properties of metals, as regards magnetism and electric conductivity.

The introduction of powerful alternate-current machines by Siemens, Gordon, Ferranti, and others, is likely also to have a salutary effect in educating those so-called practical electricians whose ideas do not easily rise above ohms and volts. It has long been known that when the changes are sufficiently rapid, the phenomena are governed much more by induction, or electric inertia, than by mere resistance. On this principle much may be explained that would otherwise seem paradoxical. To take a comparatively simple case, conceive an electro-magnet wound with two contiguous wires, upon which acts a given rapidly periodic elec-

tromotive force. If one wire only be used, a certain amount of heat is developed in the circuit. Suppose now that the second wire is brought into operation in parallel—a proceeding equivalent to doubling the section of the original wire. An electrician accustomed only to constant currents would be sure to think that the heating effect would be doubled by the change, as much heat being developed in each wire separately as was at first in the single wire. But such a conclusion would be entirely erroneous. The total current, being governed practically by the self-induction of the circuit, would not be augmented by the accession of the second wire, and the total heating effect, so far from being doubled, would, in virtue of the superior conductivity, be halved.

During the last few years much interest has been felt in the reduction to an absolute standard of measurements of electromotive force, current, resistance, etc., and to this end many laborious investigations have been undertaken. The subject is one that has engaged a good deal of my own attention, and I should naturally have felt inclined to dilate upon it but that I feel it to be too abstruse and special to be dealt with in detail upon an occasion like the present. As regards resistance, I will merely remind you that the recent determinations have shown a so greatly improved agreement that the Conference of Electricians assembled at Paris in May, have felt themselves justified in defining the ohm for practical use as the resistance of a column of mercury of 0° C., one square millimetre in section and 106cm. in length—a definition differing by a little more than 1 per cent from that arrived at 20 years ago by a committee of this association.

A standard of resistance once determined upon can be embodied in a "resistance coil," and copied without much trouble and with great accuracy. But in order to complete the electrical system a second standard of some kind is necessary, and this is not so easily embodied in a permanent form. It might conveniently consist of a standard galvanic cell, capable of being prepared in a definite manner whose electromotive force is once for all determined. Unfortunately most of the batteries in ordinary use are for one reason or another unsuitable for this purpose, but the cell introduced by Mr. Latimer Clark, in which the metals are zinc in contact with saturated zinc sulphate and pure mercury in contact with mercurous sulphate, appears to give satisfactory results. According to my measurements the electro-motive force of this cell is 1.435 theoretical volts.

We may also conveniently express the second absolute electrical measurement necessary to the completion of the system by taking advantage of Faraday's law that the quantity of metal decomposed in an electrolytic cell is proportional to the whole quantity of electricity that passes. The best metal for the purpose is silver deposited from a solution of the nitrate or of the chlorate. The results recently obtained by Professor Kohlrausch and by myself are in very good agreement, and the conclusion that one ampère flowing for one hour decomposes 4.025 grains[1] of silver can hardly be in error by more than a thousandth part. This number being known, the silver voltameter gives a ready and very accurate method of measuring currents of intensity varying from one-tenth of an ampère to four or five ampères.

The beautiful and mysterious phenomena attending the discharge of electricity in nearly vacuous spaces have been investigated and in some degree explained by De La Rue, Crookes, Schuster, Moulton, and the lamented Spottiswoode, as well as by various able foreign experimenters. In a recent research Crookes has sought the origin of a bright citron-colored band in the phosphorescent spectrum of certain earths, and after encountering difficulties and anomalies of a most bewildering kind has succeeded in proving that it is due to yttrium, an element much more widely distributed than had been supposed. A conclusion like this is stated in a few words, but those only who have undergone similar experience are likely to appreciate the skill and perseverance of which it is the final reward.

A remarkable observation by Hall, of Baltimore, from which it appeared that the flow of electricity in a conducting sheet was disturbed by magnetic force has been the subject of much discussion. Mr. Shelford Bidwell has brought forward experiments tending to prove that the effect is of a secondary character due in the first instance to the mechanical force operating upon the conductor of an electric current when situated in a powerful magnetic field. Mr. Bidwell's view agrees in the main with Mr. Hall's division of the metals into two groups according to the direction of the effect.

Without doubt the most important achievement of the older generation of scientific men has been the establishment and application of the great laws of thermo-dynamics, or as it is often called the mechanical theory of heat. The first law, which asserts that heat and mechanical work can be transformed one into the other at a certain fixed rate, is now well understood by every student of physics, and the number expressing the mechanical equivalent of heat resulting from the experiments of Joule has been confirmed by the researches of others, and especially of Rowland. But the second law, which practically is even more important than the first, is only now beginning to receive the full appreciation due to it. One reason of this may be found in a not unnatural confusion of ideas. Words do not always lend themselves readily to the demands that are made upon them by a growing science, and I think that the almost unavoidable use of the word equivalent in the statement of the first law is partly responsible for the little attention that is given to the second. For the second law so far contradicts the usual statement of the first, as to assert that equivalents of heat and work are not of equal value. While work can always be converted into heat, heat can only be converted into work under certain limitations. For every practical purpose the work is worth the most, and when we speak of equivalents we use the word in the same sort of special sense as that in which chemists speak of equivalents of gold and iron. The second law teaches us that the real value of heat as a source of mechanical power depends upon the temperature of the body in which it resides; the hotter the body in relation to its surroundings, the more available the heat.

In order to see the relations which obtain between the first and the second law of thermo-dynamics, it is only necessary for us to glance at the theory of the steam engine. Not many years ago calculations were plentiful demonstrating the inefficiency of the steam engine on the basis of a comparison of the work actually got out of the engine with the mechanical equivalent of the heat supplied to the boiler. Such calculations took into account only the first law of thermo-dynamics, which deals with the equivalents of heat and work, and have very little bearing upon the practical question of efficiency, which requires us to have regard also to the second law. According to that law the fraction of the total energy which can be converted into work depends upon the relative temperatures of the boiler and condenser; and it is therefore manifest that as the temperature of the boiler cannot be raised indefinitely, it is impossible to utilize all the energy which according to the first law of thermo-dynamics is resident in the coal.

On a sounder view of the matter, the efficiency of the steam engine is found to be so high that there is no great margin remaining for improvement. The higher initial temperature possible in the gas engine opens out much wider possibilities, and many good judges look forward to a time when the steam engine will have to give way to its younger rival.

1. This is undoubtedly an error. What Lord Rayleigh probably said, or at least intended to say, was that 4.025 *grammes* of silver was deposited in 1 ampère hour. [Editor.]

THE NATIONAL ELECTRICAL CONFERENCE.

In accordance with the announcement, the inaugural meeting of the National Conference of Electricians convened in the lecture hall of the Philadelphia Electrical Exhibition, at 3 P. M., on September 8th. The following officers and members were present at the opening exercises: Prof. Henry A. Rowland, President; Sir William Thomson, M. B. Snyder, Simon Newcomb, W. H. Wahl, E. J. Houston, L. Duncan, Silvanus P. Thompson, J. W. Moore, A. L. Kimball, Elihu Thomson, A. W. Reinold, E. W. Rice, Jr., J. H. Cotterill, W. H. Preece, Conrad W. Cooke, H. S. Carhart, Thos. D. Lockwood, O. E. Michaelis, Theo. F. Jewell, W. T. Sampson, M. W. Harrington, E. W. Blake, Jr., Wm. A. Anthony, A. E. Outerbridge, E. H. Hall, S. H. Short, B. A. Fiske, C. Carpmael, A. E. Dolbear, J. Hamblet, N. S. Keith, C. L. Clarke, Spencer Borden, J. B. DeMotte, F. J. Sprague, W. P. Trowbridge, Chas. B. Dudley, T. C. Mendenhall, Chas. K. Wead, D. Draper, Thos. French, Jr., W. L. Hooper, Wm. A. Rogers, E. A. Scott, F. E. Nipher, C. F. Himes, Oliver J. Lodge, Geo. Forbes, Wm. Harkness, W. H. Spangler, A. Graham Bell, N. D. C. Hodges, Brown Ayres, E. L. Nichols, S. P. Langley, J. G. MacGregor, W. F. Barrett, G. E. Dasselli, C. H. Koyle, J. B. Murdock, S. M. Plush, G. A. Hamilton, H. T. Eddy.

The conference was called to order by Prof. Simon Newcomb, who said:

The U. S. Electrical Commission has charged me with the honorable duty of calling this conference to order and making a brief statement of its objects. It was hardly necessary to qualify this statement by the word "brief," from the very necessity of the case. It was only a short time ago—this forenoon—that I was informed of this duty, I have, therefore, had no time to prepare any remarks whatever, and will merely do what is required of me—state how it is that we come to be called together.

The enormous advance made in electricity within the past few years has resulted, as you know, in several electrical exhibitions in other countries. The object of these exhibitions is to bring together the various improvements which are made by inventors in the applications of electricity. The possibility of these improvements, I may say, parenthetically, offers a very remarkable example of the practical value of pure mathematics. It is only in consequence of the reduction of electrical phenomena to mathematical laws, and their expression in such technicalities as ohms, volts and ampères, that it has been possible to make the great improvements with which you are so familiar in the practical applications of electricity.

The foreign exhibitions to which I have referred have generally had invited to them conferees, both from their own and from other countries, with the object of exchanging views. When this exhibition was proposed by the Franklin Institute it seemed eminently proper that the same course should be taken, that advantage should be taken of this opportunity to bring together, both from our own and from foreign countries, such experts in the science of electricity as could enlighten us on the subject of its practical application. You are brought here together as practical electricians interested in the improvements made on this subject, and each of you desirous to learn from others. That you might so learn, however, it was necessary to have a programme of operations; and that programme has been made out in some sort under the auspices of the United States. The Franklin Institute, desiring that the electricians of the country might take advantage as far as possible, and avail themselves of the opportunity thus afforded, made an application to Congress, at its last session, for assistance in the present conference; and although in the law passed, no special reference is made to the Franklin Institute Exhibition, yet we are here on the grounds of the Institute, and in some sort as their guests, and they have courteously offered to us all the facilities at their command.

We are therefore here, I say, as practical electricians, desirous to learn from each other, and exchange views on the list of subjects which has been made out by the United States Commission, with the best light it could get from the practical men with whom it consulted. We hope to have your views on all these points, and to have your support in any public measures you may deem advantageous to present to the government, with the view of getting support for them in the future.

With this statement of the objects of the present commission, gentlemen, I have the honor to introduce to you the President of the Commission, who has also been nominated President of the Conference, Professor Henry A. Rowland, of Johns Hopkins University, Baltimore. (Applause.)

Prof. Rowland gave a very complete review of the advance of science from the earliest ages. The following extracts are of special interest:

In the electro-magnetic method of electrical measurement we make use of the magnetic action of the current, either on a neighboring magnet or another current or portion of the same current. The laws of the action of a current on a magnet were discovered by Biot and Savart, and of two currents on each other by Ampère, and the results applied to practical measurement to-day give us galvanometers of all kinds, and the electro-dynamometer of Weber. By the galvanometer we can measure the quantity of electricity passing at any moment, but by the electro-dynamometer we measure the integral square of the current, a quantity on which the heating of the circuit and the energy expended depends.

Thus the electro dynamometer measures the energy from an alternating current dynamo-electric machine as easily as from one giving a continuous current, but to know this energy we must know something else besides the integral square of the current, and this is either the resistance of the circuit or the electromotive force. But the measurement of electromotive force depends on a resistance. The question then comes up as to what unit of resistance is the proper one. Here we have to refer to the mathematical theory of the subject, and the great law of the conservation of energy tells us that what is known as the absolute unit of electrical resistance is the proper one for us in this case. Hence the great practical use of determining this unit. The experiments of Kirchoff, Weber, Kohlrausch and the British Association found a value from one to three per cent. too large.

Many years ago I myself experimented on the subject and obtained a result about 4 per cent. too high. Recently Lord Rayleigh has taken up the matter and made a series of experiments of unparalleled accuracy in this line. The International Commission, determined on by the Electrical Congress in Paris, in 1881, met in April of this year at Paris, and has now given us a legal ohm defined as being the resistance of a column of mercury 106 cm. long and 1 mm. in section at 0° C. The length best satisfying the experiments is about 106.25, but it was considered best to use the round number. The experiments which I have been making under an appropriation from the government are now barely completed, but they will probably agree very well with the latter figure. Hence, we can say that we now know this unit of resistance to one part in one thousand, at least. And so we are in a position to measure the energy of a current to the same degree of accuracy, as far as this quantity is concerned.

But to measure the current by the tangent galvanometer one requires to know the intensity of the earth's magnetism, a quantity difficult to determine and constantly varying with time and place. The electro-dynamometer, when made with care, is excellent, but a good one is immensely expensive. Our methods, then, of current measurement are bad, unless carried out in a completely equipped physical laboratory. With a practical standard of electromotive force, such as a Clark's standard cell or a thermo-electric battery, this difficulty partially vanishes. Better, perhaps, we might make simple electro-dynamometers with constants determined by comparisons with a more costly instrument.

But where shall these standards be kept? Evidently the government, which decides on our standards of weights and measures, should take in charge the electrical standards, and possibly also the thermometric standards. The formation of such a bureau of physical standards will be brought to the attention of this conference.

Having given certain standards then, the measurement of currents and current energy becomes easy. The amount of heat generated in a wire of known resistance by a known current is also easily found from the absolute system of electrical measurement.

Besides the two so-called absolute systems of measurement of electricity and electric currents, we have also one based on the chemical action of the current whose laws were discovered by Faraday. Knowing the electro-chemical equivalent of some substance we are able to measure the time integral of the current or the total quantity of the current which has passed.

The absolute measurement of magnetism is equally simple with that of electricity, and it is a common observation to find the earth's magnetic force. But Faraday has put in our hands a very simple method of measuring a magnetic field, and to-day all are familiar with his beautiful laws with respect to magnetic lines and force. We know the laws of electro-magnetism and just how many lines of force (better induction) can pass through a piece of iron of given cross section, and what is their relative resistance when passing through air or iron. In fact, we have all that is necessary for a complete theory of the dynamo-electric machine, and consequently we find that the latter agrees perfectly with theory, and no fact has been observed with reference to it which could not have been foreseen from theory by a person of proper intelligence.

This part of electrical science, the measurement of electrical and magnetic quantities, is thus in a very forward state, based as it is on the mathematical theory of the subject. But, in reality, this forms but a very small portion of our science. Shall we be contented with a simple measurement of what we know nothing? I think nobody would care to stop at this point, although he might be forced to do so. The mind of man is of a nobler cast, and seeks knowledge for itself alone. We are not so base as to be honest because "Honesty is the best policy," neither are we so ignoble as to seek knowledge because "Knowledge is power," two sayings which are certainly true but low and sordid in their tone.

We have, then, the beautiful fabric of mathematical electricity given to the world by Poisson, Green, Helmholtz, Thomson, Maxwell, and others whose names are immortal. No hypothesis as to the nature of electricity rests at its base. Starting from the most simple laws of electricity and magnetism, it rises from a stable foundation and rears its form high in air, never to be overturned, whatever the fate of the so-called electric fluid or the ultimate theory of magnetism. On the simple fact that there is no electric force inside a closed conductor, it is proved that the electric attraction and repulsion varies inversely as the square of the distance. This fact is sufficient to give us the whole theory of electrostatic distribution on conductors.

From the simple fact that we can break a magnet up into parts which are similar to each other, and that these parts attract and repel each other in a certain manner, we derive many important facts with regard to magnetism.

From the magnetic action of the current we find, by an application of the great law of conservation of energy, all the laws of induced currents, either from magnets or other currents. By an almost superhuman effort of the intellect we detach our electric currents from matter, and suppose them to take place in the ether of space, and we have the grand electro-magnetic theory of light given to us by Maxwell.

But the subject is too vast to be treated in a moment. Suffice it to say that no person at the present day has the right to express an opinion on any theoretical question connected with electricity without a knowledge of its mathematics.

This study has led us to alter our ideas on many questions. What is the mechanism of electric or magnetic attraction? Faraday has given us his idea of lines of force and has made them play an important part in the theory of magnetic induction. When treated mathematically, Maxwell has shown that all electric and magnetic attractions can be explained by a tension along the lines of force and pressure at right angles to them, an idea due to Faraday.

The mathematical theory of these lines show that all electrostatic forces between either conductors or non-conductors can be explained in this manner. As the laws of magnetic attraction

are the same in every way as electrostatic attraction, if we should do away with electric conduction, it follows that magnetic attraction is to be explained in exactly the same manner. In obtaining this result Maxwell calculated the forces acting on the medium at every point, and compares these with imaginary stresses in a medium at the given point. Hence, the energy stored up can be represented either as due to the mutual attraction of the electricity at a distance or to the stresses in the medium at every point, and thus, as Thomson has shown, by a volume integral of the square of the force at every point. Hence, we are at liberty to deny the existence of all action at a distance, and attribute it to the intervening medium, which, to be logical, we must assume to be continuous and not molecular in constitution.

Thomson has pointed out that magnetism must be of the nature of rotation, such as possibly vortex motion in a fluid, and Maxwell has done something toward making a mechanical model of such a medium. Thomson's wonderful address at Montreal has also given us much to think of in the same direction.

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We are yet unable to picture to ourselves what takes place in a medium subject to electrostatic action. We are face to face with the great problem of nature, and the questions, what is matter? what is electricity? evoke no answer from the wisest among us. Our mathematics has guided us safely up to a certain point and will guide us still further; science will advance and we shall know more. But, for the present, this is the limit which we have yet attained in this direction. However, the idea of a medium is still serviceable in other portions of our science.

We have seen that the medium explains the electrical and magnetic attraction of bodies at rest. The question then comes up as to what happens in the medium when these bodies move. Are the imaginary stresses in the medium transmitted from place to place instantaneously or do they require time? Mathematics in the hands of the immortal Maxwell has answered this question, and we now know that any magnetic or electric disturbance is propagated through space with a velocity equal to the ratio of the electro-magnetic to the electrostatic unit of electricity. This great physical constant has now been found by experiment to be equal to the velocity of light, and thus has arisen that great modern theory, Maxwell's electro-magnetic theory of light. Indeed, at the present day, so perfectly does this theory agree with experiment that we can almost regard it as a certainty. The velocity of light and the ratio of the units agree far within the limits of experimental error. The fact that bodies having a true (not electrolytic) electric conduction are always more or less opaque, the refraction and dispersion of light, double refraction and diffraction, all are explained on this theory with an ease and simplicity wanting in all other theories; and lastly, an electro-magnetic phenomenon has been discovered, which, when applied to this theory of light, explains the rotation of the plane of polarization produced by a magnet. There is no fact in nature seriously in disagreement with this theory, and it serves to connect two of our most important branches of physics, light and electricity,

But some physicists say that it is not a true theory because it is not mechanical, the object of these physicists being to reduce every phenomenon of nature to matter and motion. Whether this is necessary or not I leave to the philosophers. But it is to be noted that the old mechanical theory that light is a vibration in a medium having the properties of an elastic solid is not entirely at variance with the new theory. The medium we call ether. The electro-magnetic theory says that the waves of light are the waves of electric displacement, while the old theory says they are waves of ether. Make electricity and the ether equal to each other and the two theories become one. We have arrived at that hazy and unsatisfactory theory of Edlund that ether and electricity are one, except that by this theory electricity is presented to us as an elastic solid!

But the ground trembles beneath us, and we shall soon be plunged in the mire of vague speculation if we do not draw back.

Among the other questions which depend for their solution on the presence of a medium, may be mentioned the mutual action of two electrified bodies moving in space. It has been found that electricity carried through space on a charged body has exactly the same magnetic effect on a stationary magnetic needle as if it had been conducted.

But when electrified bodies move uniformly forward in space we can conceive of no mutual effect from such motion unless it is relative to a medium. For we cannot even conceive of absolute motion.

Assuming the medium to exist we then know that a positively and a negatively charged body flying through space with the velocity of light would have their electric attraction just balanced by their magnetic repulsion, and so would exert no force on each other.

But it is a most wonderful fact that we have never been able to discover anything on the earth by which our motion through a medium can be directly proved. Carried as we suppose by the earth with immense velocity through regions of space filled with ether, we have never yet been able to prove any direct influence from this ethereal wind.

The assumption of a medium allows us to solve in some cases that problem so long under discussion by electricians—namely, the true velocity of an electric current. We now know that the term velocity hardly applies to this case, and that the current arrives at different points so gradually that we know not when to say it has arrived. But there is certainly a minimum time when even an infinitesimal current can reach a distant point. Suppose two wires stretched in space with their ends near together at one end and a Leyden jar can be discharged from one to the other at the near end. The *minimum* possible time of obtaining a spark at the distant end will evidently be the time required by light to pass from the Leyden jar to the distant point, not around the wire, but in a straight line. In this case the greatest maximum velocity is thus twice that of light reckoned around the wire, and may be any amount greater when we bend the wire. For all ordinary distances this velocity may be considered infinite, and the retardation to depend only on the electrostatic capacity and magnetic self-induction of the wire. Treated in this way, we have Thomson's mathematical theory of the propagation of an electric wave along a telegraph wire or cable, a theory of great practical use in telegraphy and telephony. But until the action in the external medium is also taken into account, it can only be considered an approximation. For we can never move a magnet, discharge a Leyden jar or complete the circuit of a battery, without causing a wave of electro-magnetic disturbance in the ether, and every signal which is sent along a telegraph line is accompanied by a wave in the ether, which travels outward into space with the velocity of light. Truly, the idea of a medium is to-day the keystone of electrical theory, but we can hardly suppose that it has even yet attained a fraction of the importance to which it is destined to rise.

Let me now call your attention to one of the most wonderful facts connected with electrical science. When we are dealing with the electrostatic action of electricity, we find that it is the so-called electric fluid which attracts the opposite. Not only do we observe the attraction of bodies oppositely charged, but the electricity itself on the two bodies is displaced by its mutual action. But when we come to investigate the mutual attraction or repulsion of electric currents on each other, we find an entirely different law. In this case the conductors carrying the currents attract or repel each other, but the currents within those conductors have no influence of attraction or repulsion to displace themselves within the body of the conductor. In other words, the current is not displaced by the action of a neighboring magnet, but flows on calmly as if it were not present.

This to me is one of the most wonderful facts in electrical science, and lies at the foundation of our science. It cannot be ignored in any further progress we may make in electrical theory, but points out a radical difference between electrostatic and electro-magnetic action.

I have said there is no action of a magnet in displacing an electric current, and have thus stated the broad general fact, and which is perfectly true in some metals. But in others there is a small action which changes in direction with the material. The elements of the electric current within the material are rotated around the lines of magnetic force, sometimes in one direction and sometimes in the other, according to the material. But the action is, in all cases, very weak. When applied to the electro-magnetic theory of light, this action leads to the magnetic rotation of the plane of polarization of light. As to the explanation of both these actions, Thomson has remarked in the case of light, from dynamical considerations, the rotation can only come from a true rotation of something in the magnetic field, and leads us to think of all magnetic action as of the nature of vortex motion in a fluid. But here our theory ends for the present. We have obtained a clue, but it is not yet worked up.

I have now taken a rapid glance at some of the modern advances of electrical science, and we have not yet had to give up the old idea that electricity is liquid. To the profound thinker this idea is very vague, and there are some facts at variance with it, but it is still useful. We often hear persons say that this old idea is gone, and that electricity is "force," whatever they may mean by that. But let us see. The work or energy of an electric current between any two points is the quantity of electricity passed multiplied by the potential; this work goes to heating the wire. Let a current of water be passing in a pipe and the quantity of water multiplied by the difference of pressure between two points gives us the work which has been done in the intervening space, and which has produced heat. The analogy is complete. No electricity has been destroyed in the one case, or water in the other, but the work has come from the fall of potential in the one case, and the fall of pressure in the other; the resultant is the same in both—heat. Again, we can obtain work from the mutual attraction and repulsion of electrified bodies, and the work in this case always comes from the change of potential between the bodies while the electric charges remain undisturbed in quantity. Electricity, then, is not energy, but is more of the nature of matter.

So far for electricity in the state of rest or steady flow. But when it changes from rest to motion, all known liquids have a property known as inertia; furthermore, they have weight. But the electric fluid has neither inertia nor weight as far as we have yet experimented, and in this respect differs from all known matter. Furthermore, we have never yet been able to separate electricity from ordinary matter. When we pass electricity through a vacuum, the resistance becomes less and less, and one may have hopes of finally having an electric current through a vacuum. But, as the exhaustion proceeds, we observe that the resistance begins to increase until it reaches such a point that no discharge can take place. Electricity cannot exist then without matter, a fact fatal to the idea of a fluid, however useful that may be. We have but one conclusion from this, and that is that *electricity is a property of matter*. Do with it what we may it can never be separated from matter, and when we have an electrical separation the lines of force must always begin and end in matter.

The theory of matter then includes electricity and magnetism, and hence light; it includes gravitation, heat and chemical action; it forms the great problem of the universe. When we know what matter is, then the theories of light and heat will also be perfect, then and only then shall we know what is electricity and what is magnetism.

It is the problem of the universe which *looms* up before us and before which we stand in awe. The intellect of the greatest among us appears but feeble, and we all, like Newton, appear but as children on the seashore. But how few of us find the shells which Newton did and how few of us try. The problem is vast and the means for its solution must be of corresponding magnitude. Our progress so far has been but small. When we push our inquiry in any direction we soon reach a limit; the region of the unknown is infinitely greater than the known, and there is no fear of there not being work for the whole world for centuries to come. As to the practical applications which await us, the telegraph, the telephone and electric lighting are but child's play to what the world will see in the future.

But what is necessary to attain these results? We have seen how the feeble spirit, which was waked up by friction in the amber and went forth to draw in light bodies, has grown until it now dazzles the world by its brilliancy, and carries our thoughts from one extremity of the world to the other. It is the genius of Aladdin's lamp which, when thoroughly roused, goes forth into the world to do us service, and returns bearing us wealth and honor and riches. But it can never be the servant of an ignorant or lazy world. Like the genius of Aladdin's lamp it appeared to the world when the amber was rubbed, but the world knew not the language in which to give it orders, and was too lazy to learn it. The spirit of the amber appeared before them to receive its orders, but was only gazed at in silly wonder, and retired in disgust. They had but to order it and it would have gone to the uttermost part of the earth with almost the velocity of light to do their bidding. But in their ignorance they knew not its language. For two thousand years they did not study it, and when they then began to do so, it took them 250 years to learn the language sufficiently to make a messenger of it. And even now we are but children studying its A B C. It is knowledge, more knowledge that we want.

I have briefly recounted the advances which we have now made in one science, and, however beautiful it may appear, we have soon reached the limit of the known, and have stood in wonder before the vast unknown. For very much of our science we see no practical applications, but we value it no less on that account. We study it because we have been gifted with minds whose exercise delights us, and because it seems to us one of the highest and noblest of employments. And we know by the history of the past that the progress of the world depends on our pursuit, and that practical applications, such as the world has never even conceived of, await us. It is necessary that some should go before to clear the way for the world's advance.

The session was closed by a brief address from Sir William Thomson, in which after paying hearty tribute to the words of Prof. Rowland, and the work of ancient philosophers, he said:

This Electrical Conference, of which this is the first meeting, is to be viewed as a piece of liberal progress of the nineteenth century of the great nations of Europe and America, according to which science and its practical applications go hand in hand and mutually act and interact beneficially. If there had been an electrical conference, an international bureau of weights and measures, an international society of astronomy in Newton's time, all that Newton did for his countrymen in the way of improving the coinage and improving the mechanics and engineering of the mint would have been done, and a great deal that he left undone, and a great deal that his powers and genius allowed him to do, might have been done, and we might have had the fruits of that to this time.

An Electrical Conference, such as we are now entering upon, with the objects that have been put before us by Professors Newcomb and Rowland, is of the most superlative use, not merely for the practical purposes for which it is designed, but for the recognition of applications to practical purposes, which all men, who cultivate science, must feel to be most potent in guiding their own work, even in the most transcendental regions of thought. The special objects of this International Conference are partly carrying out, and partly expanding those which have been put forward by a committee of the British Association as long ago, I think, as 1862, and then again by the Conference of Electricians in Paris, which was held in the years 1881-'82-'83.

The introduction of an international system of electrical measurement, as it has been spoken of by Prof. Rowland, is one of the most important subjects that will come under discussion of this conference.

Another very, very important object is the laying out of international standards. That is a matter of the most superlative importance for the scientific worker, as well as for the engineer. It is as necessary that we should be able to measure electricity as it is that we should be able to weigh out quantities of tea and sugar, fish, meat, etc. We have, for example, a spring balance for weighing fish, a gigantic balance for weighing a loaded truck of seven or ten tons. Those are the basis of weighing and measuring masses by gravitation, which are well carried out in ordinary life. Quite corresponding aids, only through a wider range, are wanted for electricity. The smallest weights that the chemist needs amount to one-tenth to one-hundredth of a milligram; the gram is a thousand times as large, and a ton is one hundred million times as large. In ordinary weighing we want to weigh from a very small quantity, say one hundredth of a milligram, to one hundred times as much. We want to do the same thing in electricity. The vast and intricate developments of electrical science on the one hand show us the thousandth or hundred thousandth of an ampère, as in the splendid experiments which have been made on solar radiation by Langley in his bolometer.

Rowland's investigations on the magnitude of the ohm help to give us the foundation to bridge over the absolute measurement of currents—such as those of Langley's—which require the determination of the hundred thousandth, or the millionth of an ampère, to the current of an incandescent lamp, such as an Edison lamp of six-tenths of an ampère, and the current of five thousand ampères. When we have a central station, such as that which is so admirably worked out by Edison, and which will come to be worked out more and more, in New York and all cities of the world by which one large station shall give light to every place within a quarter of a mile of it; the wants of practical measurement for electricity will correspond quite in magnitude to the wants of ordinary weighing.

We want not only instruments that shall be as convenient as the fishwife's spring balance for weighing fish, or the quick automatic balance for weighing a railway truck; but we want quick, accurate instruments, prepared from absolute standards. As has been stated by Prof. Rowland, the comparison of practical instruments with absolute standards is one requiring the superrefinement of scientific methods, and the hardest work of the scientific investigator in his laboratory.

Lord Rayleigh has done this to a remarkable degree. He has produced an absolute electro-dynamometer free from the objections that Prof. Rowland has spoken of with regard to the difficulty of measuring the continually varying wave of terrestial and magnetic force.

This instrument is now in the Cavendish Laboratory in Cambridge, Eng. The comparison of this with other instruments requires the difficult transportation of instruments, or the very difficult method of electro-chemical measurement which has been described to us.

The great object of an international conference must be the laying out of convenient standards—a convenient, absolute milloampère-meter, and a convenient, absolute hecto-ampère-meter which will measure a few hundred ampères in a convenient way. The establishment of such instruments in all the cities of the United States and Europe is one of the first objects of the Electrical Conference. We must not hope too much from this one conference. If it opens the way to carry out such an object, those who have worked as some have done for the public good in the way of promoting the institution of this conference will have their reward.

I fear I have taxed your patience too long, but I cannot sit down without again reflecting on the men whose lives have been patterns to the world. There is none more remarkable perhaps than the man of this country, Joseph Henry, who ended his days here. He and Faraday were patterns of scientific investigators. In some degree they went parallel and made similar scientific discoveries. Henry, indeed, preceded Faraday in the great discovery of electro-magnetic induction between unmoved conductors. Henry gave the warmest welcome to all practical applications of his discoveries. He sought to make none himself, not because he superciliously despised the applications of science to the public good, but because his own convictions constrained him to go on in pure science; because he felt, as Prof. Rowland has said so well in respect of Faraday, that it would have taken him from his work to have devoted himself at all to the practical ap-

plications of his discoveries. But what a beautiful trait of character it is to see what a kindly welcome he gave to those who did make the practical applications. He saw what might be done, but deliberately left it to others.

I know no other parallel to Henry's action in this respect except that of Faraday himself. The beautiful and simple manner in which Faraday describes the dynamo, which is making such a mechanical and engineering revolution in the world, is remarkable: "Put a little more wire together, make the thing a little larger, and there is a vast power there, competent to do great things." I wish I could remember his words. He says in the very simplest manner that he must leave this to others. "I have to go on; I have something before me that I must do. This will be done. This will come perhaps, but not by me." I have only been able to clumsily repeat the idea in ten times the number of words, as I remember it, from reading his paper a long time ago. He thought little of the practical application; but it was not one of those gifts given with an offhand generosity, because the giver did not value it. Faraday valued the practical application. He was, like Newton, in the public service as an engineer. He was scientific adviser to the English Board of Lighthouses, as Henry was scientific adviser to the U. S. Board of Lighthouses.

The friendly welcome that Faraday gave to the dynamo is quite refreshing to think of. When he was first shown a great dynamo with power enough to produce the electric light he said: "I gave it to you as an infant and you bring forward the child as a giant." No one took a greater pleasure in the application of his science than Faraday. He was content to stand by and see the great results that were obtained, while he remained at work in the Royal Institution to the very end of his working days, trying to see deeper and deeper into the properties of matter, and trying to penetrate further along that line of investigation you have heard described so admirably by Prof. Rowland, the relation between electro-magnetism and gravitation.

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SECOND DAY, SEPT. 9.

Prof. Abbe, of the Signal Service Corps, responded to the first part of the programme, "Work of the United States Signal Service in Relation to Atmospheric Electricity and Earth Currents," and read communications suggesting a line of inquiry upon this subject which should be discussed by the conference. The adoption of the International Electrical Standard provoked a brief but interesting discussion, in which Sir William Thomson, Prof. Bell, the inventor of the telephone, and W. H. Preece, of the English Government Department of Telegraphy, took part.

It was finally resolved that steps should be at once taken to have legalized in this country the ohm, the ampère and the volt—the French legal standards, as the standards of measures in this country. A committee, to be appointed, was also instructed to report upon the question of the establishment of a unit of measure of the power of electric lights. A general resolution was passed that a preliminary report should be made by these committees at once, and that more thorough reports be made at such time as occasion may require.

The conference then adjourned to meet at Franklin Institute, for which meeting the following programme was arranged: "The Establishment of a National Bureau of Physical Standards," the discussion to be opened by Prof. M. B. Snyder. "The Theory of the Dynamo-Electric Machine."

THIRD DAY, SEPT. 10.

Prof. Snyder read a paper favoring the proposed bureau. Prof. W. A. Rogers, of Harvard, approved of the establishment of a national bureau, but Mr. J. E. Hilgard, Superintendent of the Coast Survey, opposed it on the ground that the department with which he was connected had already commenced the work of forming standards of measurement.

Lieutenant James Allen, of the United States Signal Service, read a paper describing what had been done by the signal service to secure accurate thermometers.

Prof. Simon Newcomb urged that it would be advisable to have some one clothed with authority of the government to fix the standards of electrical measurements.

Sir William Thomson warmly approved of the creation of a National Bureau of Physical Standards. He said that it would be a great benefit to scientists if they could at small expense send their ampère and volt meters to be verified. A few persons should be given the task of establishing the standards, that the others might easily and cheaply make comparisons. He suggested that after the establishment of the central bureau government, inspectors of electrical measurements be created in the principal cities, to whom instruments could be sent for verification. If this were done, he said, English scientists might send their instruments to America to be verified.

The discussion was continued by Prof. Houston, N. S. Keith, Prof. C. K. Wead, Prof. Rogers, Silvanus P. Thompson, of Bristol, England, Prof. Kimball and Prof. Fitzgerald, of Dublin.

A committee, consisting of the president of the conference and Profs. Rogers, Newcomb and Wead, was appointed to draft a resolution expressing the views of the conference.

FOURTH DAY, SEPT. 11.

The Committee on the Advisability of the Formation of a New Unit of Power reported verbally through Mr. W. H. Preece.

The report called attention to the great necessity of some unit of power in accord with the metric system and with electrical engineering. This necessity, the watt, in the opinion of the committee, met perfectly. A watt, defined electrically, was the rate at which work is done when a current of 1 ampère is maintained in a resistance of 1 ohm. It has, therefore, been called the volt-ampère, but this name was awkward, and the name of Watt, himself the first careful measurer of power, was fitly appropriated to it by Prof. Siemens. The unit of power which Watt adopted was the h. p. By a series of experiments he determined the work of one horse to be about equivalent to that of raising 33,000 pounds one foot every minute. This number seeming too small to him, he added 50 per cent., and arbitrarily fixed the h. p. at 33,000 foot-pounds. As the watt is too small a measure to be suitable for large measurement, he proposed that the arbitrary h. p. be raised 34 per cent., so that instead of representing 33,000, it would be about 44,000 foot-pounds. It would then be equivalent to exactly 1,000 watts. He therefore moved that it is the opinion of the conference that the unit of power should hereafter be the watt, and that the value of the h. p. should be raised so that it should equal 1,000 watts. After a little discussion the motion was adopted.

The Committee on the Advisability of the Formation of a Bureau of Physical Standards made a report, which, after considerable debate, was referred back to the committee for amendment.

The Committee on the Standard Unit for Light reported informally through its chairman, Prof. Trowbridge, that in the opinion of the committee the standard unit of light proposed by the Paris conference was impracticable, and that they did not believe its adoption advisable in this country. He called upon one of his colleagues, Mr. Preece, who had prepared some statements.

[The standard unit of light here referred to, is that amount of light of the same character as the light to be examined which is emitted from the surface of one square centimetre of melted platinum at the temperature of solidification.]

Mr. Preece said that he had devoted much time to the study of the measurement of light as a member of a committee of the British Association. Two points are necessary to be considered. First, the formation of a practical standard for all lights; and, second, the accurate definition of the standard of white light. The first of these is practically all that it is necessary to examine. After referring to the personal equation of the individual observer, he went on to consider the systems which are legal in the various countries. In England they have a standard sperm candle of certain quality, and burning 120 grains per hour. In Germany they have a different standard candle. In France they use a lamp known as the carcel, which represents about 9.7 of the British standard candle power. Mr. Preece believed that all of these were defective, because they did not relate to the illuminating power, the important point of the light. He had proposed as a standard the light given off from a perfectly white surface when the light from a British standard candle fell upon it from a distance of 12.7 inches. This would correspond to the amount of light given off when the same surface was illuminated by a carcel lamp at the distance of 1 metre. He thought the practical method of comparing and studying the three points, the standard of light, the standard of illumination, and the means of photometric measurements were best found in the incandescent electric lamp. It was convenient and accurate, and could always be reproduced. He promised further aid to the committee until their report to the commission should be rendered.

Prof. Koyle asked if the surface of incandescent platinum of a certain size would not be better than that of the carbon filament. Mr. Preece replied that in the air the surface of platinum had not been successful, and that sufficient experiments had not been conducted with platinum in vacuo.

Prof. H. A. Rowland then opened the discussion on the theory of the dynamo-electric machine. He stated that neither time nor opportunity offered for more than a general inquiry into some of the theoretical considerations affecting dynamos. One of the first and most important considerations was that of the causes of loss of power. These he divided into five: mechanical friction, Foucault currents, the current used in sustaining the magnet, the heating effects on the revolving coil, and the production of self-induction in the coil.

The first two of these needed no discussion. Their remedies were obvious and had already been applied. Under the third cause the speaker suggested several possible causes of loss of power, such as the use of wrought iron instead of steel in the magnets, the elongated shape of the cross section of the magnets in some of the forms, and especially on the duplication and multiplication of magnets. The form of the poles of the magnets was also a possible cause of loss of energy. He showed how in several forms of the machine leakage of magnetic force would occur. His deductions were that the magnets of a perfect dynamo must be circular in section, of one pair of poles and perhaps of steel; that the poles should be of large size approaching closely to the armature, and that opportunities of leakage should be avoided as much as possible. He believed, with reference to the fourth cause of loss of power, that more was lost than was generally understood. In the Gramme ring he thought that as much as one-half of the electric energy was wasted in what was called "dead" wire. In the Siemens armature the loss, while not so great, was yet probably very considerable. In the same way the distance which separated the poles of the magnet from the armature was "dead." The fifth cause he would leave to be discussed by Prof. Fitzgerald.

The speaker then proceeded to elucidate by formulæ the strength of the magnetic field, the force necessary to expend in magnetization, the weight, and, finally, the efficiency and speed of a theoretically perfect dynamo machine of any given size. His results show that, leaving out of the question various minor mechanical considerations, size had nothing to do with efficacy. The increase of efficiency he showed must be due to the greater proportional speed of the armature, and to other considerations.

Prof. Francis J. Fitzgerald, of Dublin, Ireland, considered the loss in the dynamo machine from the induction of local currents in the coils. He showed how the sudden reversal of the direction of the current occured under the brushes of the machine, and how in faulty construction of these brush contacts short circuiting and loss occured. He agreed with what Prof. Rowland had stated, but criticised the statement that the efficiency did not depend on the increase of size, pointing out that several causes of internal resistance, notably in the loss from separation of the armature from the poles of the magnet, did not increase with the increase in the size of the machine.

Prof. Elihu Thomson criticised the paper of Prof. Rowland in many points. He did not believe that extension of the poles of the magnet would be followed by a gain, since loss by radiation into the air would be inevitable. Neither did he see the objection to having a double magnet with the poles joined and the armature in the centre. He thought that the loss would be far less than where the poles were placed upon and within a few inches of an iron base plate, and with the armature revolving on the internal lateral surface of the poles. As to the use of steel he had made extensive practical experiments, and had found nothing which was so suitable as was soft malleable iron. In the matter of the "dead" wire of the Gramme ring, as represented by Prof. Fitzgerald, he thought that the "loss" was based on a mistaken theory, and that there was no "dead" wire, save possibly at the moment of changing the direction of currents; certainly the statement that fully one-half the wire was dead was incorrect. He also criticised Prof. Fitzgerald's statements as to the internal self-induced currents of the armature.

Prof. Rowland took the floor to reply to Mr. Thomson's remarks. He claimed that he was correct in stating that steel could be as easily magnetized as iron, and that his experiments in previous years had proven the fact. He reiterated his views with regard to the proper form of magnets and poles.

Mr. N. S. Keith, with the aid of a diagram, drew out the theoretical evolution of a dynamo. He did not agree with Prof. Rowland in regard to single magnets, but preferred the form in which the poles were joined and the armature revolved in their mutual axis. He believed that in such machines there was a concentration of the lines of force along the axis of the conjoined magnets. In a single magnet the concentration occured at the end and not on the lateral surface of the pole, where the armature was placed.

Prof. Silvanus P. Thompson, of Bristol, England, gave a comprehensive account of the mathematical laws governing the construction of dynamo machines. His remarks were illustrated by formulæ, which cannot be reproduced here, but some of his conclusions were important. He believed that future progress in dynamo electricity would not be gained by increasing either the speed or the amount of wire on the armatures, but by increasing the force of the field magnets. He did not agree with Prof. Rowland as to the cylindrical magnets being invariably the best form, and pointed out the defects where several cylindrical magnets were joined to a single pole. He was sure that the effects of magnetism were much better where the lines of magnetic force corresponded with the grain of the iron, and hence that the magnets were always best when made of wrought rather than cast iron. He did not agree with the president either in thinking that the double magnet machine was necessarily a bad form. In connection with the form of magnets he stated that he had proven that the entire mass of the iron does not magnetize equally, and that it is possible to have currents of magnetic force inside the core of the magnet itself.

Prof. Rowland attacked this statement, which, he said, was evidently a mistake, and that, if true, it would strike at the foundations of all the acknowledged laws of magnetism.

Mr. Thompson replied that he had performed experiments which proved the fact.

Prof. Forbes made an explanation reconciling the discordant results. The discussion became general on the methods and time required to saturate masses of iron, and the advantages and disadvantages of a slow or quick magnetization of the field magnet.

Prof. Newcomb introduced the report of the committee to consider the advisability of establishing a Bureau of Physical Standards.

The resolutions as agreed upon were as follows:

Whereas, The rapid increase in the applications of electricity requires the adoption and legalization of common standards of electrical measures to form the basis of contracts for the supply of electricity; and

Whereas, The realization of such standards requires that all instruments for electrical measurements shall be tested and verified by one central authority; therefore, be it

Resolved, That this conference deem it of importance that Congress in pursuance of its constitutional authority to fix a standard of weights and measures, should fix a standard of electrical measures, and in order to secure the use of such standards should establish a bureau charged with the duty of examining and verifying instruments for electrical and other physical measurements.

Resolved, That the president of this conference be requested to communicate the above resolution to Congress through the proper official channels.

Resolved, That the United States Electrical Commission conducting this conference shall appoint a suitable committee to represent this conference before Congress, and to move for such legislation as will secure the object of these resolutions.

After discussion by Captain Michaelis, Prof. Newcomb and Mr. Preece, the resolution was finally carried.

FIFTH DAY, SEPT. 12.

The schedule of topics for discussion was, "The Electrical Transmission of Energy," "Storage Batteries," "Underground Conductors," and "The Measurements of Currents of Large Volume."

The subject of the transmission of energy was first treated by Prof. F. E. Nipher, and the discussion was participated in by Profs. Houston and Sprague. Quite an animated debate followed the presentation of the subject of secondary batteries by W. H. Preece, which was participated in by several members. At the afternoon session a preliminary report was presented by the Committee on Atmospheric Electricity, in which it was recommended that the government be urged to appoint a permanent committee of five electricians to co-operate with the chief signal officer of the army in organizing a service to secure observations of atmospheric electricity on a large scale, and that this committee should include among others the electricians of prominent companies, and others of wide experience. On account of the pressure of time an attempt was made to dispense with the reading of Thomas D. Lockwood's paper, covering his well-known practical knowledge of induction, long distance telephony and underground lines, but common sense prevailed, Mr. Lockwood took the floor and the audience was well pleased with his able treatment of those subjects. Mr. Preece added many interesting facts derived from his own experience, so that a considerable fund of information on those subjects has been brought out, which will appear in due time.

SIXTH AND LAST DAY, SEPT. 13.

The conference listened to a carefully prepared paper by Captain O. E. Michaelis, of the Frankford Arsenal, upon the "Electrical Investigation of the Physical Qualities of Structural Methods." Captain Michaelis had found certain weaknesses in copper and alloys of copper, the unknown cause of which he thought could be discovered

by electrical investigation. The paper was discussed by Chas. H. Koyle, of Annapolis, and finally referred to the commission. The measurement of large currents was discussed by N. S. Keith, of New York, and Prof. Rowland, and various faulty methods were pointed out. A very interesting paper was then read by Lieutenant Commander Jewell, of the torpedo station at Block Island, upon naval and military applications of electricity. He devoted himself especially to the lighting of vessels, both of war and commerce, and stated that the great need was economy of space. There should be made, for the supply of naval and other ships, compound-wound dynamos, of 60 volts current. These should be geared directly to the engine, as the necessary economy of space would prevent the use of belting. The direct gearing would necessitate a low rate of speed for the dynamo, not more than 500 revolutions a minute being compatible with the steadiness of the engine. For search lights, one powerful light was far better than half a dozen weak ones. The carbons of such a light, he thought, would always have to be adjusted by hand. The great essential was that the carbons should be at such an angle as to present the incandescent surface of the positive carbon to the reflector, without being obscured by the negative carbon.

The last subject considered by the conference was perhaps the one in which there is the widest popular interest as well as the most general ignorance. "Lightning Protection" was the subject, and those who discussed it took occasion to express their opinion of the "lightning-rod man" in scathing terms. Prof. Rowland first presented Maxwell's ideas on the subject, which he believed to be the latest and best.

The problem of lightning protection was to produce a space into which electricity cannot enter. If a hollow shell of copper were made, for example, a person inside would be perfectly safe, though all the lightning of the heavens were playing about him, because the electricity would pass around the outside, which would be of superior conductivity, instead of leaping across the space within. So, if a house were enclosed in a cage of copper, the lightning would pass around the cage instead of through it. The best method of protecting a house, therefore, would be to erect a central rod on the roof, from which conductors would pass to the four corners and then down to the ground. But the rods must not stop there; they must continue beneath the house, surrounding it below as above, completely enclosing the bottom as well as the roof. If it were desired to make this cage more complete, conductors might be carried from the central rod down the four sides of the house, as well as down the corners. It was an exploded notion that rods must be insulated—indeed, it was practically impossible to insulate them, because lightning which had come a mile or more through the air would not regard an inch of glass. The safety of the house would depend not in insulation, but in the superior conductivity of the rods, which would make it easier for the lightning to pass around the enclosed space, instead of through it. Some of the devices for protecting houses were absurd and dangerous. One of these contrivances, indeed, was so "dangerous a humbug" that, although one scientific man had been sued for criticising it, Prof. Rowland declared that it would be a pleasure to him to incur a similar danger by denouncing it. Prof. Rowland was heartily applauded.

"The ideas of the average lightning-rod man are of an exceedingly curious character," said Prof. Houston, of the Central High School, Philadelphia, "and the public should know how to treat him."

Prof. Houston agreed that the rods should not be insulated, and that when they passed beneath the house they should be thoroughly grounded. Mass, not surface, is the chief requirement of a rod, so that fancy shapes had no value and hollow rods had so much less capacity. There was no doubt that many of the rods now in use are a menace instead of a protection. There was much doubt as to the space protected by a rod, and also as to how high a rod should extend. It had been stated that the returns of underwriters showed that nearly all of the destructive thunderstorms in the United States occurred east of the Mississippi and north of the Ohio. Prof. Houston thought that this seeming fact was against meteorology, and that the real reason might be found in the patterns of rods used in that part of the country. He also denounced as dangerous and absurd a recent device, consisting of a T-shaped rod projecting from the side of the house. The deviser of this contrivance held the astonishing theory that the lightning would strike one of the projecting arms and pass off at the other.

Resolutions were passed of thanks to the Franklin Institute, to the distinguished electricians from abroad who have attended the sessions, and to the officers. W. H. Preece, of London, expressed the thanks of the foreign conferees for the hospitality and courtesy shown them, and after some discussion as to a future session the conference adjourned to meet again at the call of the chair.

THE INTERNATIONAL ELECTRICAL EXHIBITION AT PHILADELPHIA.

OPENED SEPT. 2, CLOSES OCT. 11, 1884.

ALTHOUGH minor additions are being made to various displays, and a few new ones are coming in, the exhibition was practically complete at the expiration of the second week, and those who visited it first, have evidently assured their friends that it is worth seeing, for the recent attendance has certainly been large enough for comfort, numbering about 7,000 per day. It is evidently the sensation of the day at Philadelphia, and its characteristic novelty is attracting thousands who have lost interest in ordinary fairs and exhibitions. Special rates are made for the attendance of pupils in various schools, but it is to be regretted that the children who attend are not controlled by persons in authority. They swarm about the building, accumulate loads of circulars and catalogues, play tag among the exhibitors, by their meddlesome propensities in one instance causing the burning out of a dynamo by dropping a nail into it. The pulling of call boxes and steam whistles is also occasionally indulged in by them. The delay in the appearance of the official catalogue is unfortunate, but this to a great extent was the fault of the exhibitors themselves. The collection of the models of Daniel Drawbaugh's inventions, referred to in our last issue, has been screened from public inspection by a winding sheet. A placard announces that the exhibit will not be displayed until after the argument of the case in New York city. It is surmised that this concealment is a shrewd device of the Drawbaugh management to awaken interest in the cause.

While the billiancy of the electric light displays attracts the attention of the casual observer, the practical electrician will be interested in some of the exhibits of cables, wire, insulators, etc., the perfection of which is a matter of considerable importance. The American Electrical Works, of Providence, E. F. Phillips, President, makes a fine display of the different classes of insulated wire manufactured at that well known establishment. The various styles and colors make the exhibit very attractive, but users of magnet wire will be especially interested in the fact that the finest grades are now drawn under a new process invented by W. H. Sawyer, Supt., by which No. 36 wire may be produced in lengths of five miles, which is of absolutely the same gauge measured at either end or in any part of it. It can also be drawn down from No. 19 to 36 without annealing. Of course the intermediate sizes may be drawn equally well. These results have never been attained before, and the perfection of the process is bringing the wire into general favor with manufacturers of electrical apparatus. Holmes, Booth & Haydens, of New York, exhibit an attractive collection of electrical wires, manufactured at their Waterbury establishment. Telegraph, telephone and electric light people are alike interested in their hard drawn copper, "K. K." insulated, and "underwriter's" wire of the best material. This firm supplies the wire for the official tests of the exhibition made by the board of examiners. The Kerite wire and cables of A. G. Day, of Seymour, Conn., are a prominent feature of the wire display. These products have been so long in the field that their merits are generally and favorably known to all who require a perfect and enduring insulation. Alfred F. Moore, of Philadelphia, shows a full assortment of braided and insulated wire of all descriptions. Mr. Moore has had long experience in this class of work, and his goods are of the best. The Ansonia Brass and Copper Co., of New York, display a sample case of their insulated and bare copper wire from the Ansonia factory. The Callender insulated wires and cables are exhibited by the Electrical Supply Company of New York. Here also may be seen the foreign exhibits of Frederick Smith & Co., and Elliott Brothers, England. The former shows a case of samples of galvanized wire which has been entered at various exhibitions since 1862, and has appeared in America once before at the Centennial. The testing and measuring instruments of Elliott Brothers, make a fine display, some of them being exceedingly rare in this country. The Chicago Insulating Company in addition to different styles of the Fiske & Mott high resistance insulator, show samples of knobs and hooks made from a patented compound of asphaltum and marble dust, which is said to be preferable to porcelain. The official tests of the examiners, will be awaited with interest, and if they confirm the very favorable reports already made, there need be no hesitation in giving these insulators a thorough trial. A collection of white glass insulators is shown by Thomas McGrory, manufacturer and patentee, called the lock wire insulator, from its peculiar form. By means of a crooked groove on one side, into which the wire is forced, it is held by means of the bend so made, on the same principle as by the well-known iron hook. The use of a tie wire is thus dispensed with. The glass has no screw thread for securing it to the pin. The various historical collections will be found of great interest, and of these the models from the United States Patent Office, form the most important part. As these are in the annex, in a room adjoining the lecture hall, they are liable to be overlooked by a person whose time is limited. If this collection was accessible at all times to the numerous electrical inventors of the country many of them would save considerable time which is too often devoted to old ideas. The number of electro-magnetic motors in early times will surprise many. One patented by F. Davenport, in 1837, another by S. Stimpson, in 1838, are among the oldest. The model of Royal E. House's printing telegraph in 1846, is a formidable piece of wooden mechanism, bearing no resemblance to his later effort of 1852, which appears to have been almost exactly followed in every detail by the House printers, which subsequently came into practical use, and which, considering the state of the art at that time, were marvels of mechanical ingenuity. This is followed by the invention of D. E. Hughes, in 1856, a printer which, although used to some extent in this country, has perhaps not been fully appreciated. In the same year, Moses G. Farmer also invented a printer, and the models of all these instruments are worthy of close examination. In the same group are models of the Calahan, Edison, Phelps and Burrell printers. The fire alarm signaling instrument of Farmer and Channing, 1859, is also here. One of the visionary schemes of 1859 was Vosmer's magnetic driving wheel for locomotives, in which a coil of wire surrounded the lower part of the wheel, the wire leading to a small battery box back of the steam chest. This patent has expired and railroad companies may use it without fear of infringement. The various telephone models form an interesting collection all of which are of such recent date that they are familiar to those who have watched the development of this vigorous electrical branch. A frictional electric machine invented by G. W. Mowbray, consists of a powder keg, from one head of which protrudes a crank. There is a curious collection of lightning rod models. An oil tank is protected by a cobweb of wires overhead, connected to the grounds by uprights surrounding the tank.

Across the passageway will be found the Bibliographical collection, also the electrical apparatus used by Dr. Franklin. The first Morse register for actual use is here, in apparently good working order. The electrotype copies of ancient coins in the British Museum, also a still larger collection loaned by the American Numismatic and Archæological Society, of New York, may be examined with pleasure and profit. There are over 3,000 specimens in all, dating back to B. C. 700. Under the railway sheds, the very complete working systems of the Union Switch and Signal Company, of Pittsburg, attract considerable attention. The interlocking switches, automatic and electro-pneumatic signals are kept in constant use during exhibition hours, for the information of visitors. The railway annex, outside of the Lecture Hall, and restaurant is lighted principally by what is hereafter to be called and known as the "Stanley and Thompson lamp," in accordance with an agreement between the inventors, William Stanley, Jr., and Edward P. Thompson, executed at the time of the sale of the patent to George Westinghouse, Jr., of Pittsburg. In the circulars issued and widely distributed by the Union Switch and Signal Company, manufacturers of the Stanley and Thompson lamp, it is described under a title which has been improperly applied, which may lead to confusion in identity. The inventions in this lamp comprise principally that of the method of manufacturing the carbon filament from a new chemical preparation, and the process of carbonizing several hundred horseshoe-shaped carbon filaments simultaneously in the space of five or six cubic inches, while the advantages claimed refer to the high specific resistance and uniformity of structure of the carbon filaments, and simplicity and cheapness of manufacture. The Bidwell electric railway, of Philadelphia, is putting down a section of track about 100 feet long on which a motor car for passengers is to be run. Among the *anti*-electric exhibits are the Siemens regenerative gas burners, which illuminate the restaurant, and several clocks in the gallery which are said to run a year without winding, and "no electricity." The use of electricity as a motor has enabled the sewing machine and parlor organ agents to enter the field. The incubator, by reason of its electric regulator of temperature, comes into the fold, and chickens are brought into existence by it rather faster than they can be sold at the rather inflated price of 25 cents each. An electric indicator in the main building is supposed to record the number of bricks manufactured by a machine under the railway shed. The Roosevelt organ is operated by an electric keyboard about 50 feet distant, and the manipulation of it seems to have a peculiar fascination to those who are not familiar with electricity. The Cleveland electric motors are used for various purposes about the building where a small amount of power is required.

Twice every evening the building is darkened, in order to make a more effective display of the central fountain, which is one of the principal æsthetic features of the exhibition. It is illuminated by differently colored lights around its borders, while the rays of the headlights in the galleries are focused upon it, the effect being varied by the use of slides of colored glass. It is certainly a most beautiful sight, and is thoroughly appreciated by the ladies who linger near the refreshing coolness, when other parts of the building are oppressively warm, which however is now no longer the case.

Any description of such an exhibition is necessarily incomplete and unsatisfactory. Personal attendance can

alone do it justice, and one day and evening may be profitably spent by the visitor, without its becoming a tedious experience. Of course those who desire to examine into the comparative merits of various exhibits, can and should devote more time to their study than those who attend simply for the pleasure they derive from the experience.

EATON'S INSTRUMENTS OF MEASUREMENT.

Users of dynamic currents for lighting, electroplating, or power, should be interested in Prof. A. K. Eaton's various instruments for measurement, which are manufactured under his personal supervision by A. D. Fisk, 27 Fulton street, New York. They are intended to supply the demand for a simple, rapid and reliable method for ascertaining the strength and electromotive force of currents, and owing to their peculiar construction they are not only very accurate, but retain their magnetism for a long time.

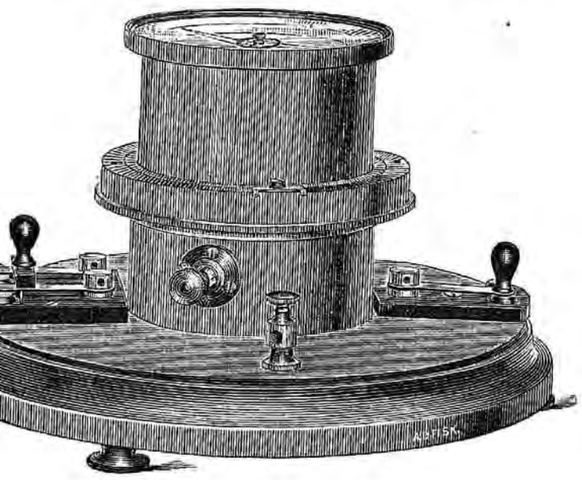


Figure 1.

Figure 1 represents a combined volt-meter and am-meter adjustable to different rates of reading, and, if necessary, immediately convertible into a tangent galvanometer; in fact, a universal instrument. The distinguishing feature of this instrument consists in the action of an annular magnet upon an annular needle. The annular magnet, which in the cut is represented as supported by a movable sleeve, neutralizes the action of terrestrial magnetism, and acting upon the annular needle represented at the top of the instrument, holds the poles of the needle always in line with the poles of the field ring. If a current be passed by means of the binding posts, through a coil beneath the needle, it will be deflected more or less from the zero point. By then rotating the ring, the needle is brought back to zero and the amount of movement of the ring as read from the vernier attached to it, gives directly the electromotive force or current strength in degrees or fractions of a degree. The graduated circle is seen within the annular steel magnet in the engraving. It is the use of the magnetized ring which forms the basis of Prof. Eaton's patent that was granted January 22, 1884, one of the important features of which appears to be its property of retaining its magnetism for a greater length of time than is the case with any other known form. This at least has been the result of the inventor's experience with his original instrument. An artificial field is also obtained in which there is a symmetrical distribution of magnetic forces, and which takes the place of the terrestrial magnetic field of the ordinary galvanometer, and by using for the needle, an annular magnet, the action of the coil or coils is so equalized that for equal increment of electromotive force corresponding increments of deflection are obtained. The switch upon the base at the left is used to change the direction of the current. Switched to the left, it gives electromotive force in volts; to the right, it gives current strength in ampères. If the distance of the ring from the needle be diminished, the amount of deflection will be correspondingly diminished. The ring is therefore made movable vertically, so that a deflection of 2°, for instance, may represent every volt, or by fixing the ring at a higher point, the deflection can be changed so that 1°, or any fraction of a degree will represent a volt. A graduation of the body of the instrument, on a vertical line, enables the operator to fix the reading at any desired rate, thus varying its range to meet the requirements of the current. The detailed construction of this instrument is shown in figure 2.

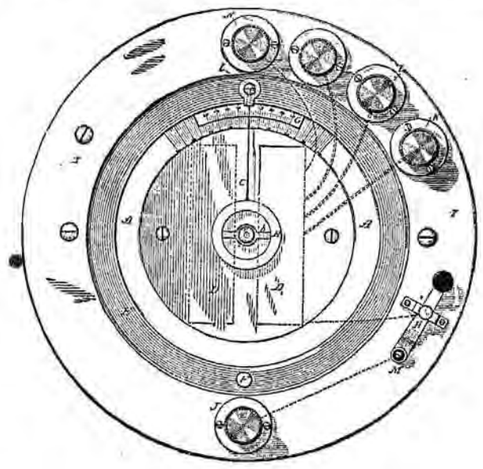


Figure 2.

E is a ring of steel which has been so magnetized that one pole is at the point *l*, and the other diametrically opposite. Within this ring is another, B, lying in the same plane, but free to oscillate on a pivot at *c*. The cross-bar *b* is of aluminum. This smaller ring is of steel, and is magnetized so that its poles are on the line which joins the poles of the larger ring. A pointer C is fastened to the ring B so that it normally points to the pole of the opposite name on the larger ring. Within the larger ring is a fixed scale A, and within that are the two flat bobbins D D of insulated copper wire. The larger ring carries the vernier G, which in the movement of the ring, slides over the scale. When the electric current is passed through the wires of the coil, the small magnet is moved to the right or left, and with it the pointer C. The larger ring is then moved one way or the other until by the virtual readjustment of the field, the electro-magnetic influence is compensated, and the pointer returns to zero of the scale A. The reading then is the position of the zero of the vernier over the degree mark of the scale A. To get varied effects, one of the wires from the source of electricity is connected with either of the binding posts N, L, or K, while the other is connected with the binding post J, as there are loops to the binding posts from several sections of the bobbins, as shown by the dotted lines.

Figure 3 represents the simplest form of am-meter, or current indicator, which gives by direct reading, the ampères of current, and is rated at 1° per ampère, and has a range of 45 ampères. It is not adjustable to any other rate, although if required they can be supplied to register

1° for every 2 ampères, and their capacity thus doubled. In using this instrument it should be placed as nearly as possible in the magnetic meridian. The needle is deflected by any current; it is brought back to zero by rotating the ring which carries the annular magnet. The amount of current or electromotive force can then be read upon the graduated circle, by means of the pointer attached to the rotating ring. If from the instrument not being in

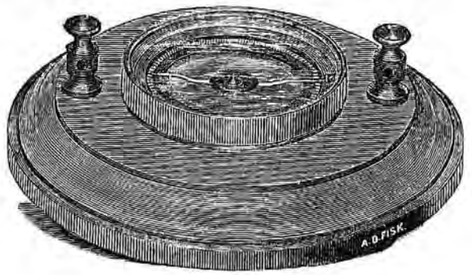


Figure 3.

the magnetic meridian, or from the disturbing action of magnetic surroundings, the ring-pointer and the needle do not meet or correspond, the needle may be brought to zero before the current is passed through the instrument, and the difference noted between the needle and the ring pointer. The current is then put on and the deflected needle brought back to zero, and the number of degrees of movement read by adding or subtracting the original difference of the pointer, according to the direction of the rotation of the ring, or better, by taking opposite readings, by reversing the current, the half-sum giving the true deflection. In electro-plating it is desirable to keep the instrument constantly in circuit, it having practically no resistance, as it then shows at all times the amount of work being done, or detects at once any change in the action of either dynamo or engine. Other instruments are manufactured suitable for different classes of work, but based upon the same principle.

These instruments may be seen in charge of James W. Queen & Co., at the Philadelphia Electrical Exhibition.

ABSTRACTS AND EXTRACTS.

BRITISH GAS INTERESTS BENEFITED BY ELECTRICITY.

The following is an extract from the inaugural address of Mr. Lenton, President of the North British Association of Gas Managers:

"How far other sources of light—and notably electricity—may come into use as competitors, for illuminating purposes, with coal gas, we need not discuss. The hard logic of facts has shown how impossible, in present circumstances it is for electric lighting to compete commercially with gas; and it is difficult to conceive any probability of these circumstances being materially altered. Meanwhile, we, as humble fellow-workers in the same field of adapting the forces of nature to the use and benefit of mankind, may well express our unfeigned admiration for that most beautiful and striking example of it, which the genius and patient labor of many eminent men have produced in the various forms of electric lighting, and especially in the incandescent lamp. I trust that those of the members who have not hitherto had an opportunity of seeing these lamps in operation, and the perfect manner in which they can be controlled, will not fail to avail themselves of the means, kindly afforded them this evening by the Edison and Swan Electric Light Company, for so doing. We, I am sure, have no jealousy of the electric light, but wish it every success in the many special uses to which it is so admirably adapted. We do regret, however, that owing to the action of unprincipled speculators (and, it must be added, to the way in which the public press, in too many instances, lent itself to the publication of extravagant and misleading statements on behalf of these worthies), the legitimate extension of the use of electric lighting has been hindered for probably many years, and the money of a number of credulous persons, to the extent of millions of pounds, absolutely squandered. It seems to me that we gas manufacturers who were threatened, somewhat jubilantly on the part of some people, with total extinction by electric lighting, are, after all, those whom it has chiefly benefited. I think we must honestly confess that it is largely due to the threatened competition of electric lighting that our profession has been thoroughly roused from a condition of 'use and wont' to one of activity and progress, and that spirit of inquiry and 'proving of all things' induced which has already led to such beneficial results."

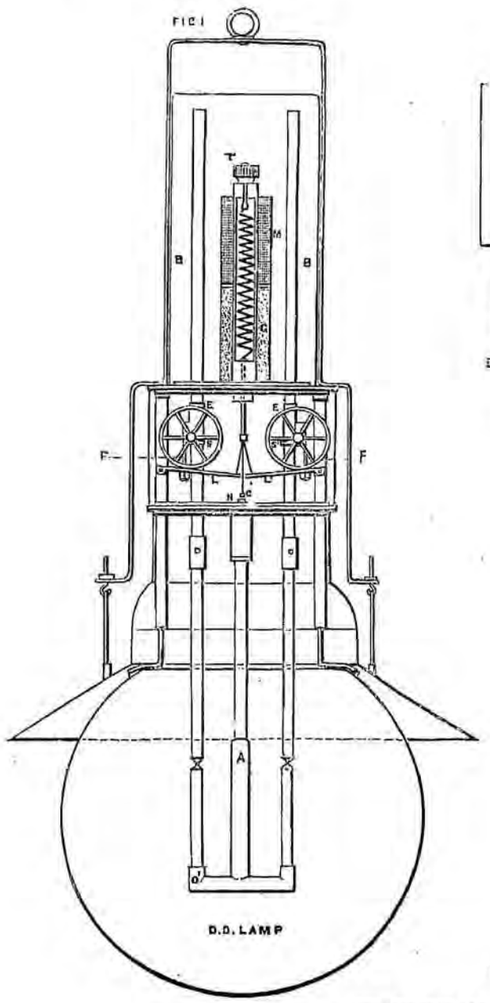
WELDING COPPER.

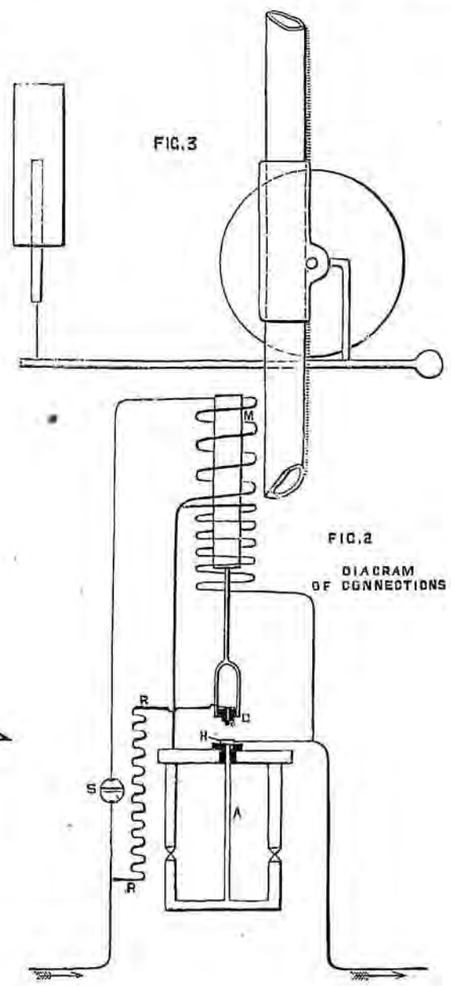
An exchange having recently stated that a mechanic of Kittery, Maine, claimed to have discovered a process by which he welds copper as perfectly and securely as iron, the *Mechanical Engineer* replies: "Welding copper is not a difficult achievement. We welded it eighteen years ago, and so can any one who will follow these directions: Get a can of concentrated lye—Pennsylvania Salt Co.—and put the contents in an iron kettle over the fire. Melt the lye (without water) and when it boils up take it off. Scarf the copper to be welded as you would an iron rod; take a good heat on it and use the lye as a flux, dipping the scarfed ends in it just before bringing to a welding heat. We have welded copper rods ⅜ inch in diameter with this so that no one could tell where the junction was.

THE ARC LAMP OF CROMPTON AND CRABB.

Among the numerous arc lamps which have been invented, there are really but a few possessing claims of sufficient merit to justify the hope that they will continue in use for many years. Many of them, indeed, may be considered as experimental, and even crude specimens of that class. Among the really good arc lamps that of Crompton and Crabb, known as the D. D., or double differential, may be mentioned. It is an improvement upon the old style of lamps manufactured by Crompton & Co., Chelmsford, England, and having been introduced in November last, it has been practically and thoroughly tested. Its general construction is shown in figure 1, while figure 2 is a diagram of the connections. B B′, figure 1, are the two rack rods. Sliding along each of these is a light sleeve, S S′, of gun-metal carrying a spindle to which is attached one of the brake wheels E E′, and the pinion which gears into the rack. A lever, L L′, is pivoted to each side rod, the other end being connected by a chain to the hollow core of the solenoid directly above. The solenoid is differential, G being the shunt and M the main coil; the core being partially supported by a spring, adjustable by means of the screw T. Projecting vertically downward from each sleeve is a stout pin or finger F F′, which serves the following purpose. When the rack rod is drawn up, if the lever be pulled by the solenoid above a horizontal position, the entire weight of the rods and carbons is supported on the edges of the brake wheels, and the friction of these on the surface of the lever is sufficient to prevent their turning, hence the rack rod cannot run down; but if the lever be below the horizontal, the weight is supported by the finger as shown at F, the wheels are free to revolve, and the rack

descends. The current now being switched on by its passage through the main coils of the solenoid, the levers are raised, striking the arc, and at the same time applying the brake to the wheels. The shunt current then flows, and the arc assumes its proper length. If this becomes too great, the increased current through the shunt draws down the core and levers, the brake wheels are left free to revolve, and the arc shortens; conversely, if the arc be too short the levers are raised. The simple expedient of making one finger longer than the other determines which pair of carbons shall begin to burn first, because upon switching on, that pair which has the longer finger will be the last to break contact, and will consequently originate an arc in so doing. When these have burned low the rack R is prevented from falling lower by a stop; hence the arc will lengthen, the shunt current increase, and the other rod R, which can still feed, be allowed to descend until its carbons touch, starting a fresh arc, when everything goes on as before. When the second pair of carbons has burned low the arc lengthens and the shunt increases as before, and the core is drawn down, but lower than when the first pair were burned out, until a stud, C, attached to it makes contact with another, H, connected to the negative pole, cutting the lamp out of circuit and substituting an equivalent resistance. The connections of the lamp and resistance coil are shown in figure 2. The current entering, as shown by the arrows, finds two paths; one through the resistance coil R R and insulated contact piece C, which for the time being is resting upon H, and thus on to the next lamp; the other through the switch S, which we suppose to be closed; the main solenoid coils M, the frame of the lamp, the positive and negative carbons, out by H, and on to the next lamp. The latter portion of the current, in passing round the core of the solenoid, magnetizes it, and draws it up, thereby breaking contact between C and H. At this moment the current has only one path open, namely, that through the switch S, main solenoid, and carbons; and since the whole of it must pass through the main solenoid, the core of the latter is definitely drawn up, establishing the arc between one pair of carbons, as explained above. Should the current be interrupted through the falling out or breaking of a carbon, or the hanging up





CROMPTON'S ARC LAMP.

of a rack rod, the core will fall, and by bringing C and H again into contact, open to the current its former path through the coil R R. The same result will follow if the current be interrupted through the opening of the switch S. In this manner an accident to, or the switching out of one lamp does not affect the rest of the circuit. A peculiarity of these lamps is, that they can be burned in parallel connection from a compound dynamo. If used in this way, the shunt solenoid of each lamp is disconnected from the lamp terminals, so that the feeding is under the control of the main only. With the full length of 19½ in. of carbon, 13 mm. diameter, this lamp will burn from 12 to 15 hours, according to the current passing which may vary from 28 to 6 ampères; the light varying from 6,500 to 850 candles measured at an angle of 30° below the horizontal plane passing through the arc. The electro-motive force required is from 40 to 50 volts.

LITERATURE.

CATALOGUES RECEIVED.

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Rhode Island Telephone and Electric Co., Butler Exchange, Providence, R. I.

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The International Electrical Exhibition, Philadelphia. Burke & McFetridge, publishers.

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CORRESPONDENCE.

NEW YORK AND VICINITY.

Rupture of the Telegraph Pool.—Lives Saved and Lost by Wires.—The "Bucket-Shop" Raids.—Bribery and Corruption in Hoboken.—The Underground Privilege of the Commercial Cable Co.—Electric Lighting by the New York Steam Co.

THE financial embarrassments of the Bankers and Merchants' Telegraph Co, have been quite generally known throughout the country, through the attachments which have been levied by various creditors. Its troubles were precipitated by the failure of A. W. Dimock & Co., and although construction was immediately suspended, the accumulation of indebtedness was too heavy to be met by current receipts, especially after they were diverted into the treasury of the pool. Of course, under these circumstances, the contract for continuing its proportion of line construction could not be carried out, and as the amount of cash required to keep the property out of the sheriff's hands was larger than the Baltimore and Ohio company cared to advance, the rupture was unavoidable. As the interest on the American Rapid bonds is unpaid, and that of its own bonds is not likely to be met by its own resources, the Bankers and Merchants' company will undoubtedly drift into the Western Union fold before snow flies. It is true that the counsel of the Governor Morgan estate argued at Washington last winter that the great corporation had swallowed all the opposition lines it could digest; but, on the other hand, Dr. Green testified that its construction could not keep pace with the growth of business if it was not for picking up such property ready made as opportunity offered. If the Western Union company really requires additional facilities a consolidation is very probable.

An inspector employed by one of the electric light companies while adjusting a lamp on the East River bridge, August 31, received a shock which caused him to release his hold, and he fell to the ground fracturing his skull. On the same day a boy seven years of age fell from the roof of a six-story building corner Hester and Elizabeth streets, and lodged on the wires of a lofty pole line. Having fallen but about ten feet he was able to cling tightly to the wires, and remained suspended fifty feet from the ground, until he was rescued by the heroic efforts of Frank Neumann, a youth of 18 years. The day's record was a curious example of the safety as well as the danger of electric wires.

In pursuance of its warfare against "bucket-shops," at the instigation of the Stock Exchange, the Gold & Stock Telegraph Co. decided to remove its "ticker" from the office of Ellis Morris, a Jersey City broker, which was leased at the rate of $75 per month. Mr. Morris obtained a preliminary injunction restraining the company from interfering with the instrument or disconnecting the wires. The company claimed that the instrument was used merely as a source of supply for the New York "bucket-shops," to which quotations were transmitted by a Morse operator, and asked that the injunction be dissolved.

Judge Van Brunt rendered the following decision:

> Although there are circumstances shown by the defendant's papers which might indicate a violation of his contract with the defendant by the plaintiff, yet in view of the absolute denials contained in the plaintiff's affidavit, I do not think there is any legal evidence of a violation by the plaintiff of his contract.
>
> Mere suspicions are not sufficient to found a legal judgment. There must be presented some legal evidence from which the inference may be legitimately drawn. As to the second motion I am of the opinion that unless the plaintiff pays the rent due for the instrument the injunction must be dissolved. The plaintiff cannot keep possession of the instrument and claim the right to pay no rent, because the service is not what it should be. Injunction must be dissolved, unless the rent is paid within five days. If such rent is paid, then injunction continued, with $10 costs of motion to abide event.

Hoboken, N. J., is also the seat of a disturbance caused by alleged bribery in the Common Council. A few weeks ago the Hoboken American District Telegraph Co. was organized by H. H. Farrier, Robert Parker, Charles Morton, and J. C. Chamberlain of Jersey City. After much difficulty and delay they obtained from the Council a franchise entitling them to establish their lines and transact their business within the municipal limits. Then, it is alleged, they induced a number of other prominent men in Hoboken, including Mayor Herman L. Timken, Councilman Bethuel N. Crane, Julius Schlatter and Henry Gaede, to become stockholders. Mr. Frank L. Clark, of Jersey City, a young lawyer, was also admitted to the scheme.

The incorporators held a meeting soon afterward at Busch's Hotel, in Hudson street, and at that meeting Mr. Clark moved that in consideration of the services rendered by Messrs. Farrier, Parker, Morton and Chamberlain in organizing the enterprise, they be each presented, without cost, with 150 shares of the stock, which was valued at $25 a share. This motion was adopted. At the same meeting Mayor Timken was elected president of the company. A few evenings later the Executive Committee met, and then Parker, Farrier, Morton and Chamberlain surrendered 90 instead of 20 shares of their stock, as much objection had been made by the other stockholders against each of them taking 150 shares as a gratuity. The question arose as to what should be done with this stock. Councilman Crane arose and, after remarking that what he was going to say would be confidential, went on to state that when the ordinance to authorize the company to put up its poles was pending in the council, another company were anxious to obtain the same franchise. In order, he said, to secure it for the Hoboken American District Telegraph Co., he had promised some of the councilmen to let them have shares of stock in that company for $1 a share. Each of the councilmen indignantly denied that he had any knowledge of the stock until after the franchise had been granted. Councilmen Kenny, Grassman and Winges, however, said that Crane had since come to them and offered them each ten shares of stock at $1 a share. They had refused it.

Mr. Crane denied that he had bribed the councilmen or had promised them any stock. He said that he had proposed to the Executive Committee to distribute 90 shares among the councilmen and other influential citizens, in order to get them interested in the welfare of the company.

The underground privilege granted to the Commercial Cable Co., in this city, which was vetoed by the Mayor, has been passed over his veto, and at the same session with the Broadway surface railroad bill. Action on the latter aroused such an outburst of public indignation that no attention has been given to the Cable company's matter, which will probably not be heard from again until the streets are dug up.

The scheme of the New York Steam Co. to furnish electric lights is progressing gradually, and ground has been broken uptown for the establishment of a plant which will operate the Sawyer-Man system.

NEW YORK, Sept. 20, 1884.

CHICAGO.

Magnetic Razors and Strops.—The Self-Adjusting Relay Again Revived.—Chicago Parlor Lightning.—Questionable Recommendations by Electrical Experts.—The Inter-State Industrial Exposition.—The Anti-Magnetic Watch Shield.

POOR electricity! How much it does have to put up with. Here we have belts, and rings, and insoles for shoes and boots, and even electrical clothing was not long since advertised—clothing which had been hung for a specified time in the neighborhood of a dynamo to "charge it," so as to render it highly beneficial to the wearer, "who would thus absorb the all-healing fluid" for the good of his health. Now we have magnetic razors. The process of shaving, according to the "authority," is rendered much more pleasant; the soothing influence of the current generated by a razor which is a magnet is as a balm to the tender follicles, and the healthful effects are wonderful. On the heels of this comes a magnetic razor strop, the last and greatest invention of a Chicago scientist. The strop is made of two parallel surfaces, the inner sides of which are lined with zinc, and at the ends and centre of each of which are plates of copper. The handle is a plunger fastened at half the length of the strop to a hinged plate of copper, in such a manner as when pushed in, the copper forces up the two surfaces and forms a support in contact with the two centre plates before mentioned, giving the two faces of the strop a convex form, which the inventor says possesses the additional advantage of giving the razor a hollowed edge. How many volts the battery is capable of producing I could not learn, nor how many ampères. I presume he didn't know.

My attention was recently called to a form of relay which the inventor claims will stand upon the same adjustment, under all changes of current from a battery of five cells or fifty, because, as he says: "My armature, contrary to the ordinary arrangement, starts at the point of maximum power, and moves farther away from this, instead of toward it, from a weaker field." He accomplishes this by adjusting his armature between the coils, opposite the face, and moving it toward the heel of the magnet, and of course the farther it travels in that direction the less the magnetic force exerted upon it.

A curious electrical phenomenon was witnessed a few days since at a residence on the south side. A gentleman and part of his family were warned by the elements to leave a seat in the dooryard, where they were sociably seated, and all entered the house. An extraordinary electrical disturbance was apparent. Vivid lightning and sharp thunder were almost constant. He had hardly seated himself near the centre of the room when he felt as if touched by some one behind him. As he turned, one of the parties present called his attention to the luminous appearance of the wall, which was gleaming with a pale bluish light. Suddenly this seemed to aggregate into a ball of fire, which ran round the gilt cornice of the room and out through the solid wall near a corner of the ceiling, with a loud report, which has been compared to the discharge of a gun. A hole something like an inch and a half in diameter, where it made its exit, is the only token remaining, for which the gentleman is truly thankful.

Why will practical and theoretical experts in electricity permit themselves to be used as scapegoats by recommending everything brought to their notice? Hardly a circular is sent out into the wide world announcing a new electrical article but the well-known names of prominent electricians, sometimes three or four in a batch, are published with their letters of commendation. It would seem as if these men of note in their professions were holding themselves too cheap, when, for instance, they variously rate a sample of insulation substantially as follows: Infinite—over seven hundred megohms—one hundred megohms—best in the market, etc. I know of a case near enough to be a twin to this, where a test was induced by ever so many just such recommendations from just such men, with a result which in place of being either infinite, or the best in the market, after soaking for only ten minutes, showed an insulation resistance of only 10,000 ohms. Now, I cannot for one moment doubt the accuracy, ability or honesty of these gentlemen—but what are we lesser lights to do when we can no longer depend on the judgment of these experts? It may be urged that in the case I mention the sample was imperfect. I know it was, but it was a sample just the same, and to judge from the sample I would say there is certainly a weasel in the hen-coop somewhere. Among another class there seems to be a widespread desire to say learned and wonderful things "out loud," and these rush into print on every occasion with their "recommends." My attention was called to one of these a few days since, in which the data was given of a galvanometer test with bridge. The coil used had less than 20 ohms resistance, while the three known resistances were respectively 10, 1,000 and 2,000,000 ohms. I felt much like repeating the old school rhyme,

> "Multiplication is vexation,
> Division is as bad;
> The rule of three perplexes me,
> And fractions make me mad."

But I merely thought—Heavens! what proportions, for accuracy.

This is the second week of our Inter-State Industrial Exposition. So far upward of 100 arc lights have been installed in the building on lake front, and the electric light inspector is nearly wild with the changes, additions and amendments that are being made. The field is only occupied this year by the Vandepoele and Sperry machines and lamps. The latter company will put in a few incandescent lamps on a combination system, and the former has a monster focus light high up on the outer front of the building, at the Adams street entrance. Its rays penetrate the gloom far up Adams street like those from the eye of a veritable cyclops, surrounded by his little family of one-eyed monsters.

Among the exhibits there is little in which electricity plays any part, but the anti-magnetic shield of Mr. Giles, of Giles Brothers, deserves notice. At the stand of Giles Brothers, a fine watch forms the armature of an upright horse-shoe magnet, the latter of sufficient strength to cling to the watch when lifted, and weighing nearly or quite a pound. The watch, incased in one of the shields, is thoroughly protected from the magnetic influence, is in first-class running order, and keeping excellent time. There is nothing peculiar in the appearance of these watches, and it is claimed for them that they are proof against the influence of dynamic currents with reasonable care, and under circumstances which would utterly ruin an ordinary watch for time. I am promised an opportunity of practically testing the efficacy of the shield, shortly, after which I shall know more, perhaps.

CHICAGO, Sept. 14, 1884.

BOSTON.

The Signal Service Time Ball.—The Arguments in the Drawbaugh Telephone Case.—The Complaints of the Erie Telephone Stockholders.—Probable Increase of New England Telephone Rentals.—Improvements in the Boston Exchange.—Demonstrations of Lightning.—More Trouble About Pole Lines.—An Interesting Legal Decision in Taunton.

FOR a number of years an object of interest to visitors and tourists has been the Equitable Insurance building, corner of Milk and Devonshire streets. Four elevators convey the passengers from the basement to the roof of the building, which is nine stories high, and in feet 155. From the roof a most splendid view is obtained, combining a wide stretch of land and water. Cambridge, Dorchester, Charlestown and every suburb of Boston lie far below, all plainly visible. Around the city stretches the silver band of water which flows into the harbor and bay, dotted with islands, the pleasure resort of thousands during the heated term. Among the roof attractions of the "Equitable" is the United States Signal Service, where may be seen a bewildering display of signal flags, wind testers, etc., and a time ball, dropped at noon daily by telegraph from the Harvard Observatory. The signal service will remove October 1 to the lofty tower of the new post-office building, where the instruments will be located 175 feet from the ground. As the time ball is now furnished by the Equitable Life Insurance Co., and the signal office is forbidden by act of Congress from using any of its appropriation for that purpose, it now looks as if the hundreds who daily stand and wait, with an ostentatious display of gold and silver watches, for the corroboration of Harvard time with their own, would have to adjourn to the watchmaker's window. The naval observatory people insisted that the announcement of true time belonged to that department, and secured the passage of an act preventing expenditure by the signal service for this purpose, and, dog-in-the-manger style, decline to do anything about it themselves. The time ball is of some service to people in the city, but its greatest value is on account of its giving true time to masters of all vessels in the harbor. Some provision will probably be made by the city or Board of Trade to continue the time ball on the post-office building.

The case of American Bell Telephone Co. vs. Drawbaugh Telephone Co. will have been argued before this reaches your readers, if the time is not changed again. It will probably be some months before the decision is made, judging from previous experience. The printed matter, in the way of evidence and exhibits, comprises eight large volumes and over 6,000 pages; the lawyers briefs (?) will make a respectable annex; and yet there are men *now* who are still ambitious to sit on wool sacks, and wade through the evidence of such clouds of witnesses.

The Erie telephone stockholders have been petitioning their directors and complaining of the management; their petition contains paragraphs commencing "we cannot understand," "we cannot see," etc., and "we believe that something must be speedily done to arrest the present course in the increase of expenses and of indebtedness, or the value of the stock will be entirely wiped out." A meeting was held September 9; the result has not reached us, but the stock jumped the next day from 10 to 20, and receded to 16. There is probably some truth in the recent rumors of increase in prices to the New England Telephone Co. subscribers. One of the officials states, it is safe to say that no telephone will be rented for less than $50 per year. It costs on an average of $40 per telephone for maintenance and service throughout New England, and the company cannot afford to do business on the present basis much longer. Many of the lines are being rebuilt, new magneto bells put in to replace those worn out, etc.

John J. Carty, in charge of the operating room of the Boston Telephone Exchange, has returned from an extended visit to Chicago, where he inspected the new multiple switch-boards for his use, in process of manufacture by the Western Electric Co. He reports that when completed and in operating order the system will surpass any in use. The Western Electric Co. is manufacturing for the Boston Telephone Exchange a 20-mile continuous length of Patterson cable, of peculiar construction, for overhead use. The cable is composed of various sizes of wire, from No. 14 to 22, and varying thicknesses of insulation. The results of talking through the cable wound upon reels is that the larger wires give the best articulation, a noticeable difference existing between Nos. 22 and 16. The cable will eventually be used in 10-mile lengths. During a recent thunder storm the lightning performed some peculiar antics. A building in Salem was struck, on which was a fire alarm telephone wire, the "fluid" followed the entire circuit of the fire-alarm and burned off the wires. At the police station it descended the wire in a large ball and passed out of an open window, wrecking the wire of the fire-alarm: a telephone transmitter was burned. Severe results were experienced in surrounding towns.

Some months ago Western Union telegraph poles were placed through Friend street—"the poles were so large and the sidewalks were so narrow 'twas impossible to get along with a wheelbarrow"—after the fashion of the nursery rhyme. The company erected the poles under restrictions not to remove them, the city having the right to the upper bars for such wires as it may require. The abuttors are protesting, and the municipal committee on electric wires are hearing arguments for and against the removal of the poles. In regard to putting the wires underground, Geo. S. Hale, for the Western Union, thought that when all the other wires, the electric light and telephone, were put underground, there would be no difficulty in getting the telegraph wires there.

A decision important to telegraph companies, concerning their rights on the highways under the laws of this State, was given in the District Court of Bristol Co., held in Taunton the 15th inst. The city marshal of Taunton brought a civil suit against an employé of the Baltimore & Ohio Telegraph Co. for injuring and defacing certain trees standing in a public street, contrary to the form of the statutes of the commonwealth and the ordinances of the city. Judge Fox disposed of the case as follows: That as the telegraph company had obtained rights from the aldermen to place the poles, the exact location of each being fixed, and their height specified, it was their privilege to cut trees where they interfered, and as there was no testimony as to "wanton waste" of trees, there was no criminal complaint proved; and Mr. Tarr, the foreman against whom the charge was sought to be proved, was ordered discharged.

The sign "To Let" has been removed from the offices of the Baltimore & Ohio Telegraph Co., the dust brushed from the windows, and evidences of business are discerned from the sidewalks The consolidation holds off until further notice.

BOSTON, Sept 18, 1884.

PROVIDENCE.

Practical Success of the Standard Multiplex System.—The Baltimore & Ohio Co. Opens for Business.—Tribulations of the Bankers and Merchants' Co.—The New Postal Line.—New Departure of the Providence Telephone Co.—The District Companies.—Electric Light Interests Improving in Providence and Languishing in Pawtucket.—The Financial Telegram Co. Prosperous.—Telephone Securities.

THE 40-mile line of the Boston Multiplex Telegraph Co. is now fairly under way, and I am pleased to say that the system works admirably. The two wires give a result of twelve circuits worked at a fair rate of speed, although, of course, there is not business enough between Boston and Providence to yield much of a revenue, cut up as it is between three telegraph companies and the Inter-State Telephone. The rate of the Multiplex line is very low, too low in fact for profit. The line has been industriously advertised, and when it is completed to New York, as promised, and the company provided with a call-bell system, it will certainly get the bulk of the trade to the points touched. The average business man will always telegraph by the cheapest line. He may suffer delays, as was the case with the "Rapid," but he will persistently cling to the place where he gets the low rate.

The Baltimore and Ohio company, having cut loose from the pool, opened for business on the 18th inst., and claims to be doing an immense business. The delivery number at 7 p. m., on the 15th being 18, effectually disposes of that story. The office is in charge of C. J. Sheehan, assisted by Mr. Osborn as chief operator.

It is said that the Bankers and Merchants' company has been laboring under a legal cloud for some time, although there is nothing definite to be learned. I hear that all employés have been paid promptly, and it is reported that the company will soon be cleared of its financial troubles.

The Postal line is progressing finely. Three copper wires are already strung from Rockport to Hartford, and the prospects are that when the second cable is laid the land lines will be ready for business. The Postal line is stout and well built, notwithstanding the assertion that contract lines are unreliable. If the company remains in the pool with the Bankers and Merchants the wires will probably be brought to Providence.

I hear of a new departure by the brisk and enterprising Providence Telephone Co. It is said that the management intends to open an office on the principal street for public use of the telephone, and will also put new life into their messenger service. The telephone company certainly has the best of facilities for carrying on a messenger service, particularly as it has splendid lines and a larger clientage than any district company can ever hope to obtain. It is rumored that the business will be put in charge of Mr. C. G. A. Peterson, who has long had charge of this branch of the company's business. One or more commercial firms are lessees of telephone lines to Boston, and these will probably be handled at the new office.

The Providence District Messenger Co. having a contract with the Baltimore and Ohio company will not carry business to other telegraph companies, an arrangement by which the new messenger company might profit.

The electric light interests are beginning to look up in Providence. The continued reliability of the Thomson-Houston light has made many friends for the Narragansett company, and its future seems to be bright. In Woonsocket, however, the project drags, and I have heard the stockholders complain of their investment.

The Financial Telegram Co., which intends to use the Field ticker, is on the high road to success. All the necessary funds have been obtained, and the dynamos for Boston have been ordered. The managers state that enough trade has been promised to pay a handsome profit. The system will be started in Boston, Providence and Fall River, and quotations furnished at a price considerably below that of the Gold & Stock Telegraph Co. The stockholders are men of means and energy and nothing seems wanting to make the company a success at once unless the close alliance of the parent company with the Bankers and Merchants should temporarily affect it.

I hear rumors of dealings in opposition telephone stock but cannot as yet trace them to anything tangible. Some time ago it was said that a party in the city interested in the Bell had disposed of his holding and invested in the Drawbaugh.

Continued prosperity attends the Holmes' Burglar Alarm Telegraph under the excellent administration of Mr. E. M. Carhart. The company is slowly but surely gaining a strong foothold among the banks and jewelers, which is certainly just what might be expected in the case of such an infallible and perfect system.

PROVIDENCE, Sept. 16, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city*

QUANTITY AND INTENSITY CURRENTS.

[22]—Your article upon electrical measurement in the July number is just the thing needed by many amateurs, like myself, and the forthcoming article of like kind will be looked forward to anxiously. But one part is not quite understood by myself. I therefore ask an explanation. Speaking of current you say, "quantity" and "intensity" currents are no longer recognized. Why, then, must batteries be connected, carbon to zinc, and so on, and not otherwise; what is the difference, then?

C. E. K., JR.

NEW ORLEANS, LA.

[In the old text-books battery cells were said to be "connected for intensity," when arranged in a single series, the zinc of one to the copper of the next and so on, and "connected for quantity" when all the zincs were joined together, forming one pole, and all the coppers joined together forming the other

pole. The current produced in the former case was called an "intensity current," and in the latter case a "quantity current." Modern electricians, finding these terms to be misleading, have ceased to use them, and prefer to employ other and more appropriate language to express the same facts. A battery arranged as in the first case is now said to be "in series," and when arranged as in the last case, it is said to be "in multiple arc." A battery may also be arranged in two or more parallel rows, having two or more elements in each row, in which case the arrangement is termed a "multiple series." In each case the current produced has a certain electromotive force, acting through a certain resistance, and thereby producing a current of a certain volume, designated as a current of so many amperes. In the first case the resistance of the battery is small, and therefore the current is large; in the second case the resistance of the battery is great, and therefore the current is small. One difficulty with the old forms of expression was that they tended to confound two facts which have no necessary relation to each other—the electromotive force of a current, and the resistance through which it acts—each of which is an independent but equally potent factor in determining the volume, strength, or quantity, as it is variously called, of the resulting current. What was formerly termed a "quantity" current, would now be spoken of as a current of moderate electromotive force working through a small resistance, and an "intensity" current is a current of great electromotive force working through a considerable resistance. Each of these currents, however, may be capable of doing exactly the same work when properly utilized, just as a small stream of water with 100 feet fall will do the same work as a stream 100 times as large having but 1 foot fall, provided a water-wheel of appropriate construction is employed to utilize it.—EDITOR.]

QUESTIONS AND ANSWERS.

[40.] **Oiling Dynamo Belts.**—O. J. P., Danville, Ill., writes:—In running high speed machinery, such as dynamos, with belt direct to engine is it best to oil the belts to make them hug the pulleys? If so what kind of oil is best, and should it be put on side next pulley? Ans.—Use castor oil, on the side of the belt next to the pulley.

[41.] **Magnetizing Steel Bars.**—J. S. D., Elkhart, Ind., says:—I am trying to make a pair of bar magnets according to the directions of Tyndall, but fail to get them of sufficient strength. Will you please describe the manner in which steel bars are magnetized, and whether it can be done effectively without an electrical machine or battery. Ans.—A high degree of magnetism cannot be imparted to a steel bar of any size, except by the aid of a powerful battery or dynamo machine. The most effectual method is to draw them across the poles of a very powerful electro magnet, excited either by a dynamo or battery current.

[42.] **Battery for Electric Bell.**—S. B., Philadelphia, writes:—What is the best form of battery for an electric bell? I have tried several without satisfaction. The bell is operated by a trap, and the wires run under the floor to the kitchen. It is only required for occasional use, but often will not ring in the morning, even when unused during the night. Ans.—The Leclanché battery is best for your purpose, but almost any battery will do the work satisfactorily. The indications are that there is an imperfect connection, probably due to dampness, between the wires at some point between the circuit-closer and the battery. Replace one of them temporarily by a new wire which you are sure is well insulated, and if the trouble disappears, it will show that the fault is in the circuit and not in the battery.

ELECTRICAL NEWS AND NOTES.

THE NATIONAL TELEPHONE CONVENTION.

THE sixth annual session of the National Telephone Exchange Association, convened at Philadelphia, September 16th. There were present nearly 100 representatives from the various telephone organizations of the country, and other interests identified with them; also, from abroad, A. Berthon, Engineer in Chief of the Societe Generale des Telephones, Paris, France, and John Cassidy, Honolulu, H. I. The following officers were elected for the ensuing year:

President, Morris P. Tyler, Southern New England Telephone Company, New Haven, Connecticut; vice-president, William H. Eckert, Metropolitan Company, New York; secretary, W. D. Sargent, New York and New Jersey Company, Brooklyn; treasurer, H. L. Storke, New York.

At the afternoon session the report of the committee on legislation was read by the chairman, W. H Eckert, of New York. The report dealt in the main with the restrictive legislation passed in the several states against the telephone "monopolies." A bill, recently introduced in the Ohio legislature, compelling companies to place their wires underground, had not yet become a law, and in Delaware the legislature had failed to pass a bill levying a tax of ten cents on every pole within the limits of the state, but in other states the telephone people had been far less successful in warding off restrictive legislation. The New York legislature passed a bill, taking effect on January 1, 1884, putting a tax of 2 per cent. on the gross receipts of telephone companies, while in Tennessee a recent bill levies a tax of 50 cents on each connection. Other states had passed similar legislation. In St. Louis the use of the streets is prohibited, even after the passage of ordinances granting such privileges, except upon the agreement of the companies to file with the Comptroller on January 1, of each year, a statement of their receipts, expenditures, profits and general condition, and the payment into the city treasury of 2½ per cent. of the gross receipts until 1890. After 1890 a tax of 5 per cent. will be exacted. In New Orleans, $5 a pole is charged, and the city demands ten free telephones for its exclusive use. In Pennsylvania the legislature imposed a tax of $1 per pole, but no efforts have been made to enforce the law, and it may be contested.

After the report had been read, F. Drake, of Omaha, took the floor and protested against the publication of the facts contained in the paper. "These are matters," he said, "which the public have no right to know, and I contend that to give them publicity is to stand in our own light. To publish the facts concerning these restrictive laws is to set down a precedent for cities where prohibitory action has not been taken. Incited by the meddling of legislatures in other cities, there would be no end of legislation tending to injure our business. I am opposed to this matter becoming public."

C. N. Fay, of Chicago, defended the publication of all or part of the report as leading to a better understanding between the public and the companies. H. L. Storke, of New York, said he had never heard of a company being crippled by restrictive legislation and the public were entitled to know the laws of the several states governing the companies.

John I. Sabin, of San Francisco, vigorously opposed giving the public information, but President Tyler said, and the meeting sustained his decision: "We are enjoying public franchises and privileges and we have no right to hide from the public anything that it is entitled to know. The greatest publicity will work us the greatest good."

A. Berthon explained the operation of the Parisian company of which he is superintendent. In France, he said, the telephone had reached a high state of perfection, having secured a perfect insulation of the wires. All the wires were run through the sewers. The principal apparatus used in Paris is that of the Edison system. Within five years, it is expected, the government will purchase the plant of the telephone company and run it for its own profit. At least, it reserves the right to do so.

The report of W. D. Sargent, chairman of the committee on central office and exchange systems, gave interesting statistics concerning the development of the telephone business throughout the United States. In Baltimore the number of telephonic connections has reached 1,450; New York, 4,210; Brooklyn, 1,846; Cincinnati, 2,238; Detroit, 1,700, and Albany, 1,103. The statistics of Philadelphia were not given.

SECOND DAY.

After disposing of routine business, an exhaustive and interesting report upon aerial cables and underground systems was presented by Thomas D. Lockwood, and comprised the results of experience in various parts of the country which had been obtained in response to inquiries by the committee. A paper was also read by C. N. Fay, of Chicago, giving the results of subterranean tests made in that city. A very interesting discussion of this important subject followed, in which the progress made in different cities was narrated. The merits of hard drawn copper wire were also fully discussed which led up to the question of extra territorial lines. After going over this ground pretty thoroughly, Mr. Fay propounded the inquiry as to how they could be made to pay, and stated that from the experience in Chicago, out of the connections asked for within a radius of 40 miles 5% were lost, up to 60 miles 7% were lost, and over 60 miles 50% were lost. This experience disgusted subscribers. The afternoon session closed with an exhibition of various diagrams of the Parisian telephone system by M. Berthon, assisted by Mr. Lockwood, after which the convention adjourned to meet at Providence next autumn.

THE BANKERS AND MERCHANTS' TELEGRAPH CO. BANKRUPT.

Application was made to Judge Donohue, September 18, to place the above company in the hands of a receiver. This action was taken by Adrian H. Joline, as attorney for Austin G. Day,

in a suit brought for the sequestration of the company's assets and for their equitable distribution among its creditors by a receiver. Mr. Day is a judgment creditor of the company for $26,018.27. An execution issued on his judgment was returned unsatisfied by the sheriff on September 16. His application for the appointment of a receiver and his suggestion of President Mott for the position were supported by Lawyer Joseph Fettretch, who represented other creditors of the company, and they were not opposed by Francis N. Bangs, who represented the company. The creditors of the company who join in the request for the appointment of President Mott as receiver, and the sums they claim to be owing them, are:

William H. Wight	$11,000 00
Edwin Middleton	16,237 45
J. B. Yale, Trustee	30,000 00
Alfred Sully	291,000 00
James G. Smith	13,500 00
John P. Peall	1,250 00
W. S. Myton	150,000 00
De Haven & Townsend	155,000 00
James G. Smith	184,000 00
James G. Smith, collateral	155,000 00
Alfred Sully	1,740,000 00
J. B. Yale, Trustee, collateral	250,000 00
G. P. Smith, Assignee of A. W. Dimock & Co.	68,000 00
W. S. Myton, collateral	900,000 00
Total	$3,972,587 45

THE TELEGRAPH.

The Union Electric Telegraph Co. has been licensed to organize at Chicago; capital stock, $50,000; incorporators, Henry C. Roeth, T. G. Clark, Isaac F. Bangs, Frank G. Pratt, Norman W. Gifford, Martin R. Johnson and William Whitford.

The Standard Multiplex Telegraph Co., doing business between Boston and Providence, has adopted the following novel system of rates: For messages to be delivered by the company's messenger to any point within one mile of the post-office in either city, 25 words or less for 20 cents; each additional word up to 50, one-half cent per word; for all words over 50, one-quarter cent per word. For messages to be stamped and promptly dropped into the post-office for delivery by carrier in either city, 10 words for 10 cents; each additional 5 words or fraction thereof, one cent. For messages not exceeding 10 words, to be written on a postal card at the receiving end and dropped in the post-office for delivery, 5 cents.

THE TELEPHONE.

Domestic.

A contract has been made between Robert Garrett and a number of capitalists interested in the Baltimore and Ohio telegraph and railroad companies and the Globe Telephone Co., of New York, by which the Globe company patents will be put in operation in Baltimore, and the Bell Telephone Co. will be met by a formidable competitor there.

Vice Chancellor Van Fleet, of New Jersey, has granted an injunction restraining the New York and New Jersey Telephone Co. from taking any steps to commence business in Newark, or in any way interfere with or obstruct the business or instruments of the Domestic Telegraph and Telephone Co. The order applies also to the townships of Harrison and Kearny. Both companies use the Bell telephone; and the injunction is directed also against the Bell Telephone Co., the Metropolitan Telephone Co., and the New York and New Jersey Telephone Co., none of which has any office in Newark.

The Erie Telephone and Telegraph Co. has a second time enjoined the city of Fort Worth, Tex., from enforcing ordinances regulating the height of wires. United States Judge Sabin granted the writ. The Marshal had notified the telephone agent to comply with the law or he would cut down poles and wires.

Foreign.

The United Telephone Co., of London, expended on capital account last year $165,000. During the year the revenue increased $137,500, while the expenses increased only $27,500. An annual dividend of eight per cent. was declared. The president, in his report, presented at the annual general meeting recently held, stated that they were beginning to grapple earnestly with the important matter of depreciation, for which they had written off nearly $75,000 this year. Their business was still in its infancy, and they had, therefore, thought it well to transfer $50,000 to reserve fund, and carry forward $25,000. This would make a reserve against depreciation of over $300,000. They had only been in existence for four years. For the first year, ended April, 1881, they had 914 subscribers on exchange lines, and there were 943,000 calls; while in the year ended April, 1884, they had 3,350 subscribers, and the calls had increased to 6,130,000. Private lines in the first year were only 180, whereas now they were 716. As to trunk wires connecting their exchanges in different towns, he could not report much progress.

ELECTRIC LIGHT AND POWER.

Domestic.

The Van De Poele Electric Light Co. has purchased the old plant at Freeport, Ill., and states that it will introduce its light into that place.

The Brush Electric Light Co., of Rochester, N. Y., has in use 1,100 h. p. from the Genesee Falls, which it owns, and is now putting in wheels for 700 more h. p. It proposes to rent the additional power for manufacturing purposes. The company is now running 500 Brush arc lights.

Gas has been found near the works of the Brush Electric Light Co., in Cleveland, O. The flame is from 6 to 8 feet high. A gas well at Rocky River, a few miles from that city, has been in existence for years, and now a number of other parties are drilling at that point.

The Pennsylvania Railroad Co. is experimenting with a view to adopting the electric head-light.

The arrangements have been completed between a syndicate of gentlemen in Detroit and the American Electric and Illuminating Co., of Boston, to build a 200-light station in Detroit, to be equipped with Thomson-Houston lights. Work will begin at once, and 100 lights will be in operation in the course of a few weeks.

At the exhibition lately held in San Francisco, the Thomson-Houston Electric Co. was awarded the first gold medal, and the Brush Electric Co. the second.

The Sault Canal, Canada, is illuminated by electricity. The power is generated by a turbine water wheel, which supplies power by hydraulic machinery to run capstans and to open and shut the gates. It is automatic all through. The pressure is constant all the time. As soon as the pressure is reduced, the pumps start to make up the supply.

The Bentley-Knight Electric Railway Co. has been incorporated in New York, with a capital of $1,000,000. The company is to build, sell and let locomotives, and other rolling stock, for railways in the United states and Canada.

Foreign.

Pilsen arc lamps are used to light the Municipal gas works at Prague.

The arrangements for fitting electric lights in the armor-plated turret on Dover Pier are ordered to be carried out under the superintendence of Captain P. Cardew, principal instructor in telegraphy at the School of Military Engineering, Brompton.

The City of Hull, England, after giving electric lighting a full trial, under the direction of Messrs. Siemens & Co., has found that the cost is about double that formerly expended for gas, and has gone back to gas lighting, with the use of enlarged and improved burners. Hull was enthusiastic over the electric light a short time since.

The English Board of Trade have decided to revoke at once twenty-five of the provisional orders granted by them last year and confirmed by Parliament, for the use of the electric light in London and its suburbs. The result is that so far as London is concerned only eight electric lighting orders now remain in force. Of these eight, no fewer than five have already had their time extended within which to comply with the provisions of the order, and unless the provisions are complied with before the 15th of October next, the orders will lose their value and power, should not a further extension of time be gained.

An exhibition which includes many electrical appliances, and which is lighted by electric lamps, was opened at Steyr, in Upper Austria, recently by the Archduke Charles Louis. The motive power for the electric light machinery is derived from water wheels.

The electric light installation at the South Foreland (Eng.) lighthouse, has now been in operation for about 27 years; it consists of four of Holmes' magneto-electric machines, driven by a 10-h. p. nominal single-cylinder horizontal engine, and Cornish boiler. The engine and boiler are in duplicate. The machines produce a low tension current not exceeding 60 volts, and cost little or nothing for repairs.

The British government has decided to commence the system of lighting barracks by electric light by a trial at the Royal Engineers' barracks at Chatham, during next year. The estimated cost is £5,000 for installation and £500 per annum for maintenance, an annual saving of £400. Should the trial prove successful, the system will be extended.

The chairman of the Gas Light and Coke Co., at the half-yearly meeting on the 8th instant, stated that during the last thirty months £5,331,000 had been spent in electric lighting experiments, and the present price of the stock in the market was £221,000 which was less than 1s in the pound, whereas on the other hand the market price of *their* ordinary stock, which amounted to £5,440,000, was 42s in the pound sterling.

M. Berthon stated at the Philadelphia Telephone Convention, that there were no electric light wires among the other conductors in the sewers. The government will not allow them to be placed there. Electric lighting in that city is very limited.

A steam engineer who has returned from Cuba, has given the following information regarding electric lighting on the island: "I found on some of the estates electric lights, and I saw on one of them a light where the electrician did not understand his business. The dynamo was burnt badly. I asked the engineer about it, and he explained that when they started up the machine the lightning came out, the man ran away and has never been seen since. They have the Edison lights working very successfully indeed in connection with Armington & Sims Co. engines. Mr. Sims has a great many of his engines there working these lights. It is impossible to run electric lights from the regular engines in the sugar mills, the engineers have so much work put upon them. The poor miserable slaves, in burning bagasse, do not shovel it in but take it in armfuls and push it in, but I have seen better arrangements for it on some of the sugar estates—endless rollers carrying it to the furnace."

MISCELLANEOUS.

The Franklin Institute intends to make a thorough report on the present electrical exhibition in Philadelphia. This will be published in book form and illustrated, and will represent the exact scientific work and result of the exhibition. No medals or premiums will be given to exhibitors. A work of great value will be the reports of the electrical commission, appointed by the President, of which Prof. Rowland is the chairman.

SUBTERRANEAN LINES.

The chief of the City Electrical Department of Philadelphia has sent a notice to all the telegraph and telephone companies requiring them to comply with the ordinance which requires the removal of all telegraph, telephone and electric light poles and wires from over, along and across the streets in the city prior to the first day of January, 1885.

SUBMARINE CABLES.

An Australian syndicate has made proposals to the Hawaiian government regarding the laying of a cable from Brisbane, Australia, to San Francisco via the Sandwich Islands. A bill has been prepared by a committee of the Hawaiian legislature and passed to a third reading, granting a subsidy of $20,000 per annum for 15 years, in favor of the enterprise.

FINANCIAL.

NEW YORK, September 22, 1884.

The past month has witnessed a practical collapse in the Bankers and Merchants' Telegraph Co., and the developments which are being made in the application by the creditors for the appointment of a receiver are not calculated to stimulate faith in such enterprises. There is little tendency on the part of the public to deal in miscellaneous electrical securities. The manner in which many of these companies have been organized has done much to foster this feeling. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	157 00	159 00	Molecular	3 00	9 00
Am. Speaking	90 00	120 00	New England	25 00	28 50
Currier-Tele. Bell	3 00	—	New York	—	80 00
Colombia & Pan	24 50	25 00	New York & N. J.	50 00	60 00
Continental	10 00	—	N. Y. & Penn	40 00	65 00
Dolbear	5 00	10 00	Peoples	6 00	10 00
Erie	16 25	16 50	do. N. E.	1 25	2 00
Globe	5 00	7 00	Southern Bell	—	125 00
Hudson Riv.	40 00	75 00	Southern N. E.	—	175 00
Inter-Cont.	50	1 50	Tropical	1 50	2 00
Mexican Central	—	2 00	W. L. Tel. & Telph.	1 00	1 25

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Cable	53 50	55 25	Manhattan Telegraph	10 00	85 00
American Rapid	20 00	50 00	Mexican	125 00	147 00
Bankers & Merchants	4 00	7 00	Postal	3 50	4 00
Com'l Tel. Co., common	—	75 00	do. bonds	20 50	30 13
Harlem Dist. Tel. Co.	—	2 50	Western Union	92 75	92 87½

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
Brush	50 00	80 00	Excelsior	8 00	—
Brush III.	30 00	45 00	Swan	60 00	90 00
Edison	65 00	83 00	U. S.	60 00	90 00
Edison III	30 00	75 00	do. III. Co.	15 00	50 00
Edison Isolated	40 00	60 00	United Globe	60 00	70 00
Edison European	1 00	15 00			

The Western Union Telegraph Co. has declared its usual quarterly dividend of 1¼ per cent., payable October 15.

The interest due on $3,000,000 bonds of the American Rapid Telegraph Co. was not paid Sep. 15.

The Michigan Iron Works, Light and Power Co., of Grand Rapids, Mich., has failed. Also the American Electric Co., of San Francisco.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

U. S. Circuit Court—Southern District of New York.—*Roosevelt* v. *Western Electric Co.*

1. The purchase of a patented article from the patentee confers upon the buyer the right to use the article to the same extent as though it were not the subject of a patent, but the sale does not import the permission of the vender that it may be used in a way that will violate his exclusive property in another invention.

2. When the article is of such peculiar characteristics that it cannot be dealt in as a trade commodity, and cannot be used practically at all unless as a part of another patented article of the vender's it would be against good conscience to allow an injunction to a vender under such circumstances; but this is not true of the article in question.

Wallace, J. The case made by the motion-papers is this: The complainant's patent is for an improvement in electric batteries consisting of a prism and other elements, and the claims are for the prism and for various elements, in combination with it. The defendant is selling an electric battery which contains the prism, in combination with the several other elements which are covered by the claims of the patent, having purchased the prisms from complainant, but having obtained the other elements of the battery from other sources.

If it were true that the prisms are not capable of any use except in combination with the other elements covered by the several claims of the patent, the complainant can nevertheless insist that the purchaser should only be permitted to use them as substitutes for prisms which have been deteriorated or destroyed, or to sell them to others. They could be used in this way without infringing the complainant's rights.

The purchase of a patented article from the patentee or owner of the patent confers upon the buyer the right to use the article to the same extent as though it were not the subject of a patent, but the sale does not import the permission of the vender that it may be used in a way that will violate his exclusive property in another invention. When the article is of such peculiar characteristics that it cannot be dealt in as a trade commodity, and cannot be used practically at all unless as a part of another patented article of the vender's it would be preposterous to suppose that the parties did not contemplate its use in that way. It would be against good conscience to allow an injunction to a vender under such circumstances. He would be estopped from asserting a right which the purchaser must have understood him to waive.

Upon the argument of the motion the case seemed to be like the one last stated, but it is not such a case.

The motion for an injunction is granted.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From August 19 to September 16, 1884 (inclusive).

Alarms and Signals:—*Call*, W. P. & J. H. Curl, August 19, 303,626. *Signaling Apparatus*, J. U. Mackenzie, Aug. 26, 304,209. *Heat Indicator for Grain Bins*, W. H. Power, 304,279. *Fire Alarm System*, O. H. Norton, Sep. 2, 304,351. *Electro-Mechanical Signaling System*, M. Toulmin, 304,583. *District Call Box*, W. Fix and C. Hermann, 304,518. *Circuit Closer for Burglar Alarms*, A. Iske, Sep. 9, 304,732.

Commutators:—*Apparatus for Automatically Opening Closed Circuits*, J. P. Tirrell, Sep. 2, 304,376. *Circuit Closer*, G. Pirnie, 304,557. T. W. Bryant, Sep. 16, 305,045; J. H. Holmes, 305,310. *Switch Board*, E. W. Smith, Sep. 9, 305,025.

Conductors, Insulators, Supports and Systems:—*Conductors*, C. T. Jackson, Aug. 19, 303,735; T. A. Edison, Aug. 26, 304,087; F. D. Cady, 304,170; E. D. McCracken, Sep. 2, 304,530. *Device for Laying Wires in Underground Conduits*, W. Pyle, Aug. 19, 303,749. *Insulator-Supporting Bracket*, C. Neblett, 303,877. *System for Distributing Energy*, W. A. Shaw, 303,891. *Cable*, F. P. Duplain, 303,924. *Machine for Making Glass Insulators*, E. F. Krell, 303,936. *Clip for Aerial Cables*, A. Wright, 303,961. *Composition for Insulating Wires*, C. G. Muskat, Aug. 26, 304,020. *System of Distribution*, T. A. Edison, 304,085. *Means for Controlling Induced Currents in Conductors*, E. D. McCracken, Sep. 2, 304,540. *Lead Press*, W. A. Shaw, 304,570, 304,571. *Connection for Circuit*, J. Baker, 304,593. *Insulating Device*, G. L. Broomhall, Sep. 9, 304,699. *Non-Inductive Cable*, M. E. Shaffer, Sep. 9, 304,759. *Insulator for Lightning Rods*, J. A. Ruth, 305,020. *Coupling for same*, S. Bradley, Sep. 16, 305,140.

Clocks:—*Secondary*, C. E. Barschig, Sep. 2, 304,595.

Dynamo Machines and Motors:—*Dynamos*, J. Olmsted, Aug. 19, 303,744; F. J. Sprague, Aug. 26, 304,146; T. A. Edison, 304,083; C. J. Van Depoele, Sep. 2, 304,378; A. G. Waterhouse, 304,382, 304,383, 304,384. *Regulator for*, J. W. Langley, Aug. 19, 303,866. *Regulator for Fluid Motors for*, L. G. C. Hippolyte and P. G. R. Pueroult, 303,620. *Automatic and Self-Adjusting Bearing for*, C. H. Palmer, Aug. 26, 304,232. *Mechanism for Transportation of Goods*, F. Jenkin, Sep. 16, 305,194.

Galvanic Batteries:—*Jar and Method of Insulating the Same*, I. D. Fuller, Aug. 26, 304,235. *Dry Pile*, J. A. Thiebaut, Sep. 9, 304,764. *Voltaic Battery*, 304,807. *Self-sustaining Battery*, W. A. Shaw, 305,022. *Carbon Battery*, T. W. Bryant, Sep. 16, 305,046.

Lamps and Appurtenances:—*Lamp*, E. Boettcher, Aug. 19, 303,614. *Lamp Mechanism*, E. Thomson, 303,808; Sep. 16, 305,413. *Arc Lamps*, same, Aug. 19, 303,702; T. G. Turner, Sep. 2, 304,473; J. J. Skinner, 304,672, 304,673; E. A. Sperry, Sep. 9, 304,966; N. McCarty, Sep. 16, 305,096; E. Grauert, 305,175. *Incandescent Lamps*, T. A. Edison, Aug. 26, 304,086; W. Holzer, Sep. 16, 305,191. *Focusing Lamp*, C. J. Van Depoele, Sep. 2, 304,377. *Electric Light Regulator*, W. Robinson, Sep. 2, 304,455. *System of Lighting*, E. Weston, Sep. 9, 304,882, 304,883, 304,884. *Reflector for Incandescent Lamps*, P. H. Klein, Sep. 16, 305,200.

Measurement:—*Meter*, T. A. Edison, Aug. 26, 304,082; E. Weston, Sep. 9, 304,881; C. L. Clarke, 304,907.

Miscellaneous:—*Pneumatic Carriers*, A. Brisbane, Aug. 9, 303,803; R. Gilham, Aug. 19, 303,834, 303,835, 303,836. *Thermostat*, W. J. P. & G. L. Kingsley, 303,893. *Thermo-Regulator*, J. A. Lakin, Sep. 2, 304,330. *Bathing Cabinet*, L. Von Dolcke, Aug. 19, 303,959. *Indicating Device for Elevators*, C. L. Clarke, Sep. 9, 304,908. *Self-Registering Target*, J. Boone, Aug. 19, 303,911. *Anti-Incrustator for Boilers*, S. G. Cabell, Sep. 9, 304,989. *Cigar Lighter*, R. N. Dyer, Sep. 16, 305,164.

Protectors:—*Protecting Electric Light System from Lightning*, T. A. Edison, Aug. 26, 304,084.

Railways and Appliances:—*Railway*, T. P. Chandler, Sep. 16, 305,147. *Signals*, 305,359.

Storage Batteries:—*Production of Pipe-Line and Other Batteries*, W. A. Shaw, Sep. 9, 305,023.

Telephone Systems and Apparatus:—*Transmitters*, D. Drawbaugh, Aug. 19, 303,627, 303,628; A. F. Congdon, 303,810; T. J. Perrin, 303,948. *Telephones*, D. Drawbaugh, 303,629; A. F. Congdon, 303,809. *Exchange System and Apparatus*, 303,714. *Mechanical Telephones*, J. F. Sims, Aug. 26, 304,212. *Switch Board*, P. J. Rosseau, Aug. 26, 304,135. *Signaling Attachment for Telephones*, A. J. W. Munch, 304,121. *Sound Reflector for Telephones*, F. D. Torre, Sep. 2, 304,413. *Operator's Receiving Telephone*, W. I. Richards, Sep. 2, 304,667. *Multiple Switch Board for Exchanges*, C. E. Scribner, Sep. 9, 305,021. *Earpiece*, W. R. Miller, 304,843.

Telegraphs:—*Automatic Circuit Closer for Keys*, A. A. Stoneburner and J. H. Kasper, Aug. 19, 303,956. *Unison Apparatus for Printing Telegraphs*, A. A. Knudson, Aug. 26, 304,007; W. B. Van Size, 304,051. *Means for Rotating Type Wheels of*, G. M. Phelps, 304,025. *Transmitter for*, G. B. Scott, 304,037. *Printing Telegraphs*, W. B. Van Size and C. L. Buckingham, 304,052; H. Van Hoevenbergh, Sep. 2, 304,475. *Transmitter*, R. Anderson, Aug. 26, 304,059. *Means for Overcoming Static Troubles in Telegraphs*, F. W. Jones, 304,100. *Autographic Telegraph*, M. H. Wilson, Sep. 16, 305,259. *Transmitter for Unskilled Operators*, T. Ames, Sep. 16, 305,262.

BUSINESS ADDRESSES.

THE ELECTRICIAN

AND

ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$1.00
Six Copies,	"	5.00
Great Britain and other Foreign Countries within the Postal Union	"	1.50
Single Copies,		.10

[*Entered at the Post Office at New York, N. Y., as second class mail matter.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of the* ELECTRICAL PUBLISHING CO. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, 115 *Nassau Street, New York city.*

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NEW YORK, NOVEMBER, 1884.

THE DRAWBAUGH TELEPHONE CONTROVERSY.

WE think that no intelligent and candid person, after carefully reading through the eight thick volumes of evidence and exhibits, comprising nearly 6,500 octavo pages, which have been taken within the past four years by the U. S. Court, in order to determine whether Alexander Graham Bell or Daniel Drawbaugh was the first inventor of the speaking telephone, can help being impressed with the truth of two propositions: first that the claimant Drawbaugh and the 366 witnesses who testified in his behalf have utterly failed to make out a case which can by any conceivable possibility prove to be sufficient to overthrow the Bell patent, and second that the whole case indicates the existence of one of the most extraordinary and wide-spread conspiracies for the purpose of destroying a patent which has ever occupied the attention of a court of justice in this or any other country.

The whole case lies in a nutshell. To defeat a well established patent on the ground of prior knowledge and use it must be established beyond the possibility of a doubt that some other person had invented and actually constructed an operative apparatus and had applied it to some useful purpose within the knowledge of the public. To this eminently sound rule of law there has never been, so far as we are aware, a single exception. In the present case the defendants have produced a single pair of operative magneto-telephones only, which they claim to have been made by Drawbaugh before the date of the Bell patent, but he himself refuses to state under oath when these were made, or whether or not they were made before the date of the Bell patent.

Among his vast array of witnesses, only *two* could be found willing to swear to having heard speech through these instruments before the summer of 1876. The deposition of one of these witnesses conclusively shows that the alleged occurrence took place after the summer of 1876, and the deposition of the other proved that any statement he might make must necessarily be utterly unworthy of belief.

We have but little doubt that these facts alone, to say nothing of the corroborative evidence, are quite sufficient to control the decision, and hence we are convinced that the judgment of the Court cannot well be otherwise than in favor of Bell. We publish elsewhere a detailed analysis of some of the more important features of the case. It will repay careful reading by all who are interested in the final result of this most unprecedented legal controversy.

ELECTRIC LIGHTING AT THE PHILADELPHIA EXHIBITION.

WHEN we take a general view of the late electrical exhibition at Philadelphia, we are able to see with considerable clearness, the direction which the progress of the development of electrical science is now taking, and which it seems likely to take in the immediate future. This exhibition, as is well known, was intended to embrace every variety of invention, in every form in which electricity could be practically applied to the useful arts. Upon a cursory view of the exhibition the intelligent observer was at once impressed by the fact that it was to all intents and purposes an exhibition of apparatus for electric lighting. The telegraph, the telephone, the electric time service, not to mention the innumerable other applications of electricity which have until within a comparatively recent period, occupied so large a share of the attention of inventors, were completely dwarfed by the array of electric illuminating apparatus and accessory devices and materials. It is true that there was quite a display of underground conduits and conductors, some of which were of a promising character, although the majority were fairly beneath criticism both in conception and execution; there were also important exhibits of railway signaling apparatus, municipal police and time telegraphs, and other matters of the kind, but nevertheless the exhibition as a whole may be regarded as essentially an exemplification of the present state of the art of electric illumination in the United States.

To an observer attempting to forecast the direction of future development of electric lighting, the early decadence of the arc system of lighting is most clearly apparent. Its displacement by the incandescent system is beyond question only a matter of time and of very short time at that. We do not wish to disparage the arc light. It has done good service in the past, and in some places and under some circumstances has proved conspicuously successful, but the inherent objections to its use are so many and so serious as to render it quite impossible that it should be able to maintain itself hereafter in competition with such

magnificent incandescent lamps as were publicly shown for the first time at this exhibition.

The three most important and interesting exhibits of electric lighting systems and apparatus were without question those of the combined Edison Electric companies, the United States Electric Lighting Co., and the individual exhibit of Edward Weston. Besides these the Thomson-Houston Electric Co. presented an unpretending but exceedingly well arranged and instructive exhibit, while the Brush Electric Co., the Union Switch and Signal Co. and a number of other exhibitors, made displays extremely creditable in themselves, although less striking than the three first named. Each of the leading exhibits upon analysis presents certain prominent characteristics peculiar to itself. The Edison display was extensive and prominent, and was evidently designed to appeal directly to the popular taste. Its salient features were well calculated to amaze and delight the crowds who flocked to the electrical exhibition as a new spectacular sensation. The chromatic glory of the towering column with its 3,000 incandescent lights; the barbaric splendor of the ornamented chandeliers, hung with clusters of lamps simulating fruits embedded in mazes of metallic foliage, the huge proportions of the "Jumbo" dynamo, the illuminated darkey who distributed circulars to the delighted spectators, and most conspicuous of all the image and superscription of the "wizard" himself confronting the main entrance of the building; while they served to delight the unthinking multitude, awakened in many minds a shadow of regret that the handiwork of the inventor was so effectually overshadowed by the devices of the too ingenious advertising agent. The exhibit of the United States Co. on the other hand, although equally extensive and embracing every pattern of dynamos, lamps, and accessory devices, which could by any possibility be required in practical service, was business-like, practical and utterly devoid of all sensational effects, unless an illuminated sign upon the wall in which the name of the company appeared in letters formed of incandescent lamps may be so considered. The essential features of the display were the dynamos, lamps and fittings, and every extraneous object which might tend in the least to distract the attention of the observer from these essential features of the system, was rigidly suppressed. But to the scientist and the intending purchaser this exhibit was of absorbing interest. The shapely, compact and accurately finished dynamos, automatically supplying a uniform current with equal facility to a single lamp or to several hundred, the high incandescence of the lamps themselves, the simple and tasteful elegance of the brackets and fittings, all betokened the hand of a designer skilled alike in the domain of science and of mechanism.

More remarkable than either of these, however, was the individual exhibit of Edward Weston. Here were assembled many of the results of the labors of this young man, who though not so well known to the general public, either in this country or abroad, as some of his principal competitors, has within the past few years, in the seclusion of his laboratory, occupied himself with an unremitting series of experiments and investigations the results of which cannot fail to give him a place among the foremost electricians of the age. From a strictly scientific point of view, there can be no doubt that the exhibit of Mr. Weston was the principal feature of the exhibition. It embraced a large collection of special laboratory and measuring apparatus, many of the instruments being of original design, and of the most elaborate and perfect workmanship; detached portions of lamps and dynamos illustrating their construction and the various stages of their manufacture; a complete working plant in full operation publicly illustrating for the first time the operation of exhausting incandescent lamps, and of treating the filaments by the hydro-carbon process, and above all the magnificent incandescent lamps of 600 candle-power, here exhibited for the first time, which may without hesitation, be pronounced the scientific sensation of the exhibition.

In making special mention of these three principal exhibits, we do not in the least intend to disparage the work of other inventors, perhaps of equal merit, who were not fortunate enough to command the means to make an extensive display. We speak of these, as the representative features of the exhibition, which serves to mark the progress thus far attained, and to point out the lines along which future development will extend.

It is much to be regretted that there was so little evidence to be found in the exhibition of any essential progress in a field which affords scope for a wider practical utility than even that of electric illumination—the employment of electricity for the transmission of energy. It is true that many examples on a small scale were to be found, in which not merely sewing machines and fans, but power looms, power planers, printing presses, and rotary pumps, were driven by electric motors, yet we did not observe any attempt to transmit more than 5 or 6 h. p., at the most, which is hardly a step in advance of what was shown by Gramme at the Paris exhibition of 1878.

The general impression, therefore, which is left upon the mind by the Philadelphia exhibition, is that the art of incandescent lighting in general is making rapid progress; that the incandescent system has already become a successful competitor with gas in many situations, especially in isolated buildings of considerable size, and in manufacturing establishments where power is used for other purposes; and that in its recent improved form it is certain to largely supplant the arc light in what has been regarded as its own field. The use of the incandescent lamp for universal domestic lighting in cities and towns has unquestionably passed beyond the experimental stage and has become simply a question of cost of production. It seems to be well established, moreover, that for lessening the cost of production we must depend almost solely upon improvements in the lamps, not only in the way of decreasing the cost of manufacture, but of increasing the amount of light produced per h. p. of energy, by the use of a carbon which will sustain a higher temperature. If the lamps can be run at a higher potential, we can at the same time diminish the cost of the conductors, which is now one of the most serious items of expense, and which has hitherto proved an insurmountable obstacle to the commercial success of station lighting. It is in this direction—that of reducing the cost of production and increasing the facility of distribution—that Mr. Weston has labored with so much assiduity and success; a success which will, perhaps, be more widely appreciated after the lapse of a few years than it is at the present time.

DID IT PAY?

THE uniform policy pursued by the Western Union Telegraph Co., during the past few years, of paying a regular dividend of 7 per cent. has been modified by the recent announcement of a 6 per cent. dividend. The market price of the stock has not at any period been maintained at a figure which would indicate the faith of investors in the company's ability to pay the higher rate. The ostensible object of the change is the accumulation of a surplus for extending lines and adding wires, and for the purpose of gaining possession of certain opposition lines, which it is believed will soon be closed out at forced sale. It has also been asserted that a surplus would soon be required to cover the expense of placing wires underground in certain localities. Among other causes, however, is a diminution of the profits which is ascribed to the strike of its employés in 1883, in opposing which, the extraordinary sum of $500,000 was disbursed, with consequential expenses incurred by loss of patronage which cannot be estimated. This is not the first time the treasury of the company has been drawn upon for a like purpose, and unless a change of policy takes place it is by no means improbable that similar outbreaks may take place within the next decade. Although the cost of the strike of 1869-'70 has never been officially published, its effect upon the dividends of the company was still more marked. In 1868 the dividend was 2 per cent., in 1869 4 per cent. No further dividend was declared until that of 1874. The amount required to pay 4 per cent. on the capital stock at that time was about $1,600,000, and it appears probable that the expense of the strike was sufficient to at least render it prudent to pass the dividend of 1870. An examination of the statistics published in another column, shows a decrease of messages in 1870 of 777,287 from the record of the previous year. The receipts exhibit a corresponding decrease of $178,180.34, while the expenses show an increase of $342,655.57, making a total diminution of profits of $520,835.91. The profits for the fiscal year 1884 show a decrease of $1,029,912.88.

It is fair to assume that each of these strikes cost the company a million dollars. If they are to recur at intervals of 14 years, the annual expense of refusing to recognize the right of the employés to combine, amounts, with interest, to about $130,000. Of course it will be asserted that the demands for increased compensation would probably exceed this sum, but if a fair computation could be made of the better service secured by the retention of skilled employés who are now continually seeking other employment, we are satisfied that, financially considered, a more liberal policy would be found equally successful.

THE BENEFITS OF INSTANTANEOUS COMMUNICATION.

THE gradual effect which is being brought to bear upon the world's commerce by electrical communication is by no means generally appreciated. The equalization of market prices throughout the civilized world by its agency has, however, been frequently commented upon. A recent financial article in the London *Times*, directs attention to the important fact that capital in every form has greatly deteriorated in value owing to the increased production, the greater facilities for transport, and the more accurate means of knowing every season what the yield of the earth is likely to be. Electricity enables the user of jute at Dundee to shake hands with the producer in India over the middleman's head. The depreciation in the value of capital has become so pronounced all over the world that the interest on the national debts of all the leading countries is in process of being reduced. The same influences have also shortened, and perhaps intensified our political campaigns, the telephone and telegraph being now brought into such effective service as to materially change the conditions under which a canvass is conducted. An expert political manager says that the campaign work that 20 years ago required two months' time, can now be accomplished in three weeks. At the same ratio of progress there is a faint hope that it may eventually be dispensed with altogether.

AN INVENTION WITHOUT A MARKET.

A SANGUINE inventor laboring under the supposition that deafness was an infirmity for which a remedy would be considered a blessing, has brought out an alleged electrical device for that purpose, which he conceals in a cane. Not only does the instrument give immediate relief, but it is claimed to bring about a permanent cure, by its mysterious influence upon the afflicted organ. This was really the crowning triumph of the inventor's work, for sensitive people although deaf might object to ramming a cane into the ear whenever they desired to listen to conversation, while they might temporarily submit themselves to such humiliation for a brief period in the seclusion of their homes, for the sake of ridding themselves of such expedients forever. Intoxicated with his success, and remembering that even so well-known a remedy as "Polyform" was rendered more valuable by the endorsement of a "wizard" a sample of the audiphone was forwarded to Mr. Edison whose partial deafness is generally known. Several weeks elapsed and still the looked for certificate did not appear. Fortunately a diligent reader of the New York *Sun*, anxious to ascertain if there was any virtue in the invention sent an inquiry to the editor of that journal. A reporter was at once detailed to ascertain the views of Mr. Edison upon its merits. He was surprised to ascertain that the distinguished inventor had not found leisure to give it a trial; that he had no desire to be relieved of deafness; in fact that he would not permit himself to be cured for $10,000. The reasons he gave for this unexpected statement should satisfy every busy man that congratulations rather than sympathy should be extended to the deaf. "There are," said Mr. Edison, "lots of things I don't want to hear; cars and carts, and licensed venders in the morning; bores; political speeches, cats, telephones and impecunious borrowers of money." There are of course certain disadvantages attendant upon such an infirmity, but it has probably been the wish of nearly every individual that he might occasionally be deaf. Possibly there might be a demand for a machine to produce temporary deafness, and no doubt a fair market could be worked up for it, by the persistent efforts say of a few book canvassers.

ARTICLES.

THE CLAIM OF DANIEL DRAWBAUGH.

BY F. L. POPE.

Among the numerous suits which have been brought by the American Bell Telephone Co. for the maintenance of its rights as owner of the speaking telephone patents of Alexander Graham Bell, there have been some three or four, the results of which taken together will practically establish the permanent status of the patents. In an article published several months since we discussed some of the aspects of such of those cases as had up to that time been decided, and will now make but a brief reference to them. The first suit of importance was brought against Dowd in 1878, the result of which was in the nature of a compromise, and indicated nothing more than that the Western Union Telegraph Co. possessed certain prior inventions and rights which were liable to conflict more or less with those of the Bell company, and which were regarded as of sufficient value to render it important for the last named organization to acquire control of them. The result of the decision in the case of Spencer in 1880, was to the effect that the Bell patents were not anticipated by the published researches of Philip Reis and other experimenters, and that the apparatus described in Bell's patent was an operative speaking telephone. In the case of Dolbear in 1883, the defense was not directed against the validity of the patent, but was based on the ground of non-infringement, so that the controversy in fact related to the scope of the patent. The decision in this case was substantially that any method whatever of transmitting articulate sounds, according to which such sounds are reproduced through the medium of undulatory vibrations of electricity, whether static or dynamic, is within the meaning of the claims of the patent.

The case of the American Bell Telephone Co. against the People's Telephone Co., which has recently been before Judge Wallace of the U. S. Circuit Court in this city, on final hearing, has attracted wide-spread attention not only on account of the magnitude of the commercial interests involved, but by reason of the unprecedented number of witnesses who have been brought forward, and the enormous volume and extraordinary character of the testimony introduced by the defense to establish their main allegation, which was substantially that the Bell patents were void because of prior knowledge and use of the electric speaking telephone by one Daniel Drawbaugh, of Eberly's Mills, Cumberland County, Pennsylvania.

We have purposely refrained from comment upon the characteristic features of this most remarkable case, until the whole of the evidence on both sides had been brought forward and discussed in the arguments of the respective counsel before the court. This having been done, we are now in a position to be able to form some opinion as to the probable result of the litigation.

The history of the present case as gathered from the depositions of witnesses and the arguments of counsel, is briefly as follows: In the early part of 1880, Marcus Marx, Moritz Loth, Simon Wolf and F. A. Klemm commenced the manufacture and sale of telephones under patents which had been granted to Klemm and others. It appears that in May 1880, one E. D. Chellis of Harrisburg, Pennsylvania, together with Messrs. Lysander Hill and M. W. Jacobs, who had been counsel for Chellis in an interference case before the Patent Office, and who had thereby become well acquainted with Drawbaugh as a party in the interference, procured from him, apparently without tangible consideration, an assignment of three-quarters of his claim to certain telephone inventions, which claim after a brief negotiation they transferred to Marx and others, part of the consideration being $20,000 in money. This was followed by the filing of an application for a patent on behalf of Drawbaugh, on July 21, 1880 (in which he laid claim to the essential features of the telephone), and the organization of a corporation called the People's Telephone Co. having a nominal capital of $5,000,000. Subsequently the Bell company commenced an action against the People's Telephone Co. for infringement, the bill of complaint having been filed in October, 1880. The defense, which has been conducted principally by Messrs. Hill and Jacobs as counsel, is indicated in substance in the defendant's answer to the bill of complaint, which alleges among other things:

That long prior to the alleged inventions by said Alexander Graham Bell, and long prior to the respective inventions of said Gray and said Edison, said Daniel Drawbaugh, then and now residing at said Eberly's Mills, constructed and operated practical working electric speaking telephones at said Eberly's Mills, and exhibited their successful operation to a great number of other persons resident in his vicinity and elsewhere; that the said electric speaking telephones, so constructed and successfully and practically used by him, as aforesaid, contained all the material and substantial parts and inventions patented in the said patents No. 174,465 and No. 186,787, granted to said Bell; and also contained other important and valuable inventions in electric and magnetic telephony, and were fully capable of transmitting, and were actually used for transmitting articulate vocal sounds and speech between *distant* points by means of electric currents; that some of the original machines and instruments invented, made, used and exhibited to many others, long prior to the said alleged inventions of said Bell, or either of them, are *still in existence and capable of successful practical use*, and are identified by a large number of persons who personally tested and used and knew of *their practical operation and use in the years* 1870, 1871, 1872, 1873, 1874, and both subsequently and prior thereto; that certainly more than fifty, and probably not less than one hundred persons, or even more, were cognizant of said Drawbaugh's invention and use of said telephones, and of his claim to be the original and first inventor thereof, prior to the alleged inventions of said Bell or either of them; that said Drawbaugh for more than ten years prior to the year 1880, was miserably poor,—in debt, with a large and helpless family dependent upon his daily labor for support, and was from such cause alone, utterly unable to patent his said invention, or caveat it or manufacture and introduce it upon the market.

It is apparent that if the facts alleged in this answer are fully established by the testimony, they finally put an end, not merely to the Bell patent, but to all possible patents controlling the fundamental principles of the speaking telephone; for by the provision of the statute, two years' public use of an invention in the United States, either with or without the consent of the inventor, prior to his application for patent, is an absolute bar to such a grant. Hence the notorious fact that at a date more than two years prior to the application of Drawbaugh, a large number of telephones were in use in different parts of the United States is sufficient to effectually prevent the issue of a controlling patent to Drawbaugh. It follows, therefore, that this suit can have but one of two results, either to sustain the Bell patents or to throw the use of the telephone open to the public.

The vast importance of the decision in this case, may therefore be readily comprehended. If it re-affirms the validity of the patent, it is scarcely possible that the latter can be successfully attacked hereafter on any ground, but if it is adverse to the Bell claim, the fundamental invention becomes the property of the public.

The question may be asked—why does the patent law contain the provision above referred to, respecting two years' public use of an invention? This question may best be answered by another one, namely, what is the nature and object of a patent? A patent is simply a contract between the patentee and the public at large, represented by the government of the United States. The consideration on the part of the patentee is the production of a new and useful invention and the full disclosure thereof to the public, which disclosure is a necessary condition to a granting of the application, by means of which the public is enabled to practice the invention after the expiration of the patent. The consideration on the part of the government is a grant of an exclusive right to manufacture and use the invention for a limited term of years, which grant the patentee is

permitted to protect and enforce through the legal machinery of the federal courts. The fundamental policy which underlies the United States patent law, as interpreted by the courts, declares that the substantial rewards of invention belong of right to the person to whom the public is actually indebted for the resulting benefits. Applying this doctrine to the case under consideration, there can be no question that for its knowledge of the speaking telephone, not only this country, but the world is indebted to Alexander Graham Bell, while to his associates who early recognized the value of the invention and acted upon a belief in the validity of his patents, the public is indebted for its early and extensive introduction into commercial use. Thus it is clear, that from Mr. Bell and from the owners of his patents, the public has received, not only a knowledge of the invention, but the benefits of the capital, labor and business experience necessary to its enjoyment; in short all which it can possibly receive from any inventor. The simplest considerations of justice and equity clearly require that no evidence of prior knowledge or use, falling short of that which should conclusively show that the public had otherwise acquired that knowledge which the patentee was bound to give as a consideration for his monopoly, should defeat his right to the patent. The courts have over and over again said that they will not overthrow a valuable patent, upon which capital has been invested in good faith, and from which the public has received substantial benefit, except upon the clearest evidence that the public was already in possession of the invention prior to the date of its conception by the patentee.

The date of Bell's invention of the speaking telephone, or at least of the mental conception which was afterwards embodied in the invention, appears from the evidence adduced to have been as early as October, 1874. In March, 1875, he discussed the possibility of the transmission of speech by electrical vibrations with Professor Henry. In June he made an instrument. He began the preparation of his specification in September, completed it in October, and filed it in February 14, 1876. In accordance with numerous decisions of the courts, it becomes imperatively necessary for Drawbaugh, in order to make out his case, to prove the construction and public use of an operative and commercially useful speaking telephone prior at least to June, 1875, and we have only to inquire with what success he has done this.

The history of Drawbaugh's inventions, according to his own deposition and the depositions of the witnessess who testified in his behalf, is as follows:—He says that his first transmitter was made in 1866 of an ordinary tea cup with a bladder stretched over the top for a membrane; a metal rod extended down from the membrane, having at its lower end a plate resting on a mass of powdered material, under which again is another metal plate. The electric current traversed the powder and the metal plates, and was varied by the pressure of the plate upon the powder, when the membrane was spoken to. Many substances were tried, of which pulverized plumbago gave the best

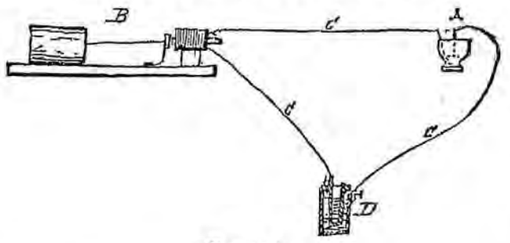

FIGURE 1.

result. His first receiver, also asserted to have been made in 1866, is composed of a tin mustard-can fastened to a board and having a membrane stretched across its mouth. A string from this membrane led to an armature supported on a spring in front of a rude electro-magnet of the usual form. Figure 1 is a sketch of this contrivance made by himself. In 1867 or 1868 he claims to have made a transmitter the remains of which were produced in evidence and are shown one-fourth size in figure 2. This, he says, is substantially the same as the cup transmitter except that the lower plate is made adjustable by supporting it upon a rod passing up through the mouthpiece. The receiver was modified by omitting the spring and attaching the armature plate directly to the membrane. The remains of this instrument are shown in figure 3; the membrane and the armature which is said to have been glued to it no longer exist.

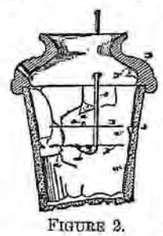

FIGURE 2.

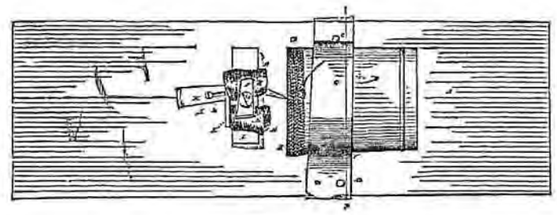

FIGURE 3.

The next instrument is a magneto telephone, the remains of which, shown in figure 4, are all that has been preserved. This instrument is asserted to have been made in 1871; a reproduction of it put into the case and sworn to by Drawbaugh is shown in figure 5. An instrument said to have been made in 1873 or '74 is another form of the same instrument; nothing is left but the case, the diaphragm and magnets having disappeared. This is shown in figure 6. The instrument shown in figure 7, one-half natural size, having a wooden diaphragm and neutral electro-magnet, is said to have been made in the last half of 1874. Figure 8 is a section, and figure 9 a rear view (half size) of a hand magneto-telephone, containing an electro-magnet mounted on a curved permanent magnet, having an iron diaphragm and a mouthpiece with a thin air space. Figure 10 is another instrument of similar dimensions and design. These are both well made and well finished instruments, and are said to have been made in the spring of 1875. Early in 1876, he says, he made the transmitter shown one-fourth size in figure 11 and 12; the electrodes are of hard carbon held together by spring pressure, and an induction coil is employed for transferring the vibrations to the main line circuit.

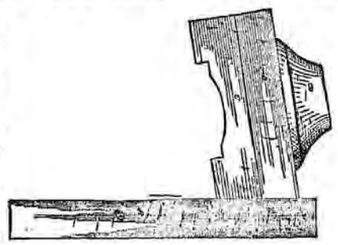

FIGURE 4.

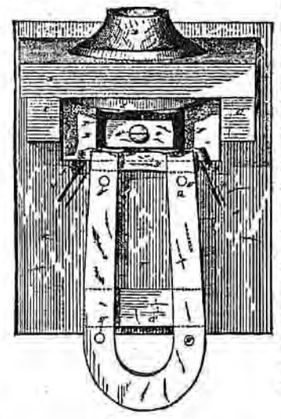

FIGURE 5.

The history of the invention as set forth in the de-

positions is, that Drawbaugh told one witness in 1864–'65 that he was constructing a talking machine; that some persons heard speech in the first half of 1867, that with unskilled men—ordinary farmers and laborers—at the transmitter or receiver, complete sentences and newspaper advertisements were then transmitted and correctly understood. In 1868–'69 he continued to improve the instruments, and had them sufficiently developed to patent as early as 1869–'70. When he first heard of Mr. Bell, in 1876, he claims to have had several sets of telephones fit for commercial use, such for example as those shown in figure 8 to 11 inclusive, containing all the improvements of detail and minor inventions which are now found in the best commercial instruments, and which are the results of several years of invention by a score of different inventors.

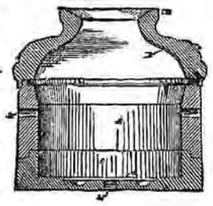

FIGURE 6.

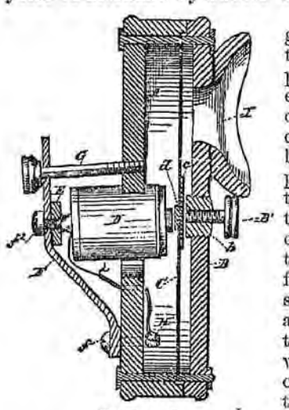

FIGURE 7.

It would require a far greater amount of space than we have at our disposal to attempt to present even the briefest summary of the overwhelming array of evidence brought forward by the complainants to disprove the essential allegations of the witnesses for the defense; but we have endeavored to select from the mass all that is needful for the purpose. It may be stated at the outset that no attempt was made to prove that Drawbaugh's apparatus was ever used at any time or for any purpose other than that of experiment, or to gratify the curiosity of casual visitors. It is not pretended that he ever used it in a single instance even for his own business. The exhibits produced, which are said to have been made between 1870 and 1874 (shown in figure 1 to 6), are mere wrecks;

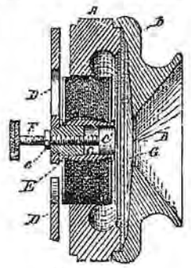

FIGURE 8.

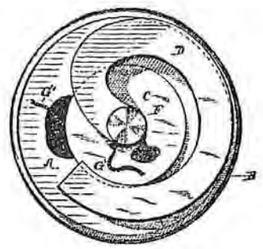

FIGURE 9.

not one of them is in working condition or capable of transmitting a sound; there remains in fair condition one receiver, shown in figure 7, but that is all. The evidence as to the essential operative parts of these instruments rests on Drawbaugh's memory alone. Out of the 238 witnesses examined in his behalf not one could give any intelligible description of the details of the apparatus.

The defendants presented what purported to be recent reproductions made by Drawbaugh of the alleged originals, with the missing parts restored; and asserted that they would transmit speech. The complainant's counsel, Mr. Storrow, challenged them to repeat the tests in the presence of witnesses. The alleged reproductions did not conform to the descriptions, but were much better. They were tested for three days under conditions far more favorable than could possibly have existed at Drawbaugh's shop, and the results obtained proved, conclusively, that no witnesses at Drawbaugh's shop *ever heard an intelligible sentence* through the receivers shown in figures 3 and 7 when coupled with the transmitter shown in figure 2, or through the alleged magneto instruments, figures 5 and 6. The results not only proved beyond doubt that the instruments are entirely insufficient to anticipate the Bell patent, but, what is far more important, they proved that all the witnesses, including Drawbaugh himself, who have sworn that they heard speech through them are unworthy of credit. This alone disposes of the greater part of the witnesses as well as of the instruments. The small magneto instruments shown in figures 8, 9 and 10 are the earliest claimed to have been made which are sufficiently perfect in their operation to serve to legally anticipate the patent, but in regard to these, Drawbaugh himself testified that he did not know in what year they were made, nor would he positively assert that they were made prior to the Bell patent. *The tests above referred to demonstrated that the case must turn on the date of these two instruments, yet among* 238 *witnesses only two*

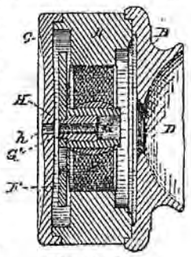

FIGURE 10.

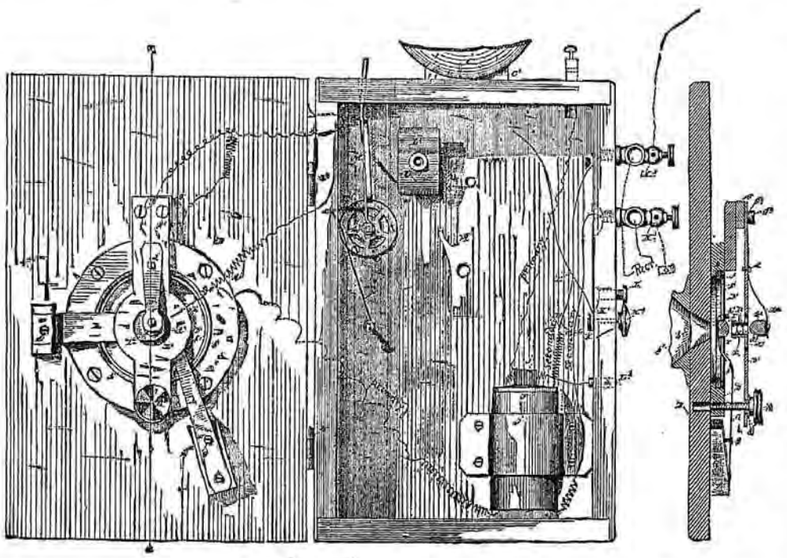

FIGURE 11.

FIGURE 12.

could be found who were willing to say that they heard speech through these instruments before the date of Bell's patent, and the testimony of both these witnesses was pretty thoroughly discredited.

The testimony of Drawbaugh himself, though quite voluminous, is of the most nebulous, evasive and unsatisfactory character. He appears to have been a skilful mechanic, with some inventive ability in the way of making small improvements on existing machines; of fair intelligence, but very limited education. He had lived all his life at Eberly's Mills, and his inventions had been mainly in the way of wood-working and mill machinery. The most striking characteristic of his whole deposition is its studied and remarkable vagueness. He is never sure of anything. One wearies with the eternal reiteration of the phrases, "I can't remember," "I won't be too positive," "It may have been, or it may not," etc. He is totally unable to give the slightest information in respect to the one thing which no real inventor ever forgets, the way in which the invention came to him. Once only in the course of his long deposition was an attempt made to elicit from him some statement as to the mental growth of the invention. The question related to the variable resistance transmitter.

Q. Do you remember how you first obtained knowledge of the fact that low conductors, when under pressure would conduct the current more freely than when not under pressure, that is to say, did you learn it by reasoning it out and then testing it, or by accidental discovery, or by reading it, or by hearing it from some one, or how?

A. *I don't remember how I came to it. I had been experimenting in that direction. I don't remember getting it by accident, either; don't remember of reading it. I don't remember of any one telling me of it; I don't suppose any one told me.*

This is the best account that this man is able to give of his alleged discovery of one of the most striking scientific facts connected with the operation of the telephone, yet he asks it to be believed that he, alone and unaided, invented the soft carbon transmitter, the hard carbon or microphone transmitter, the magneto telephone, in short, the long series of instruments shown in our illustrations, covering the entire field of telephony, although he cannot give the slightest information as to what led him to the invention of any one of them, or what led him to pass from one form to another. This fact alone must be regarded as sufficient to disprove his claim.

In this connection we would call attention to the curious resemblance, which it is impossible to regard as accidental between some of these exhibits and well known forms of instruments. Compare, for example, the instruments in figures 4 and 5 with the box telephone of Bell, described in the *Scientific American* in 1877, and the magneto-telephone of Dolbear described in his little book published in 1878. Compare the instruments 7, 8, 9 and 10 with the "tobacco-box" telephone of Phelps, made in 1878, and above all, compare the instrument shown in figure 11 and 12, alleged to have been made in 1876, with the Blake transmitter first introduced in 1879! The conclusion inevitably forces itself upon the mind that these exhibits are copies of the instruments they resemble. Nobody alleges that the others copied Drawbaugh, and the history of the several inventions is so well known to everybody as to conclusively disprove any supposition of the kind.

There are other collateral circumstances, almost too numerous to mention, all tending to disprove the theory of the defense. Between 1874 and '76 Drawbaugh published an advertising card giving a list of his inventions, 16 in number, but there was no telephone among them. Holsinger, a newspaper writer, published an article about his inventions in 1875, but did not mention the telephone. The *Baltimore American*, in 1878, published an article about Drawbaugh and his inventions, made up from information which he furnished himself, which stated that he had tried to transmit sounds, but "had never transmitted speech, and never expected to." In May, 1878, Drawbaugh visited the telephone office in Harrisburg, said that he was trying to improve the telephone, borrowed one from the office and took it home to study, but never so much as intimated he originated the invention. Drawbaugh's autobiography, a most entertaining production, which he furnished for publication in the history of Cumberland county in 1878, proves, by his own statement, that he was then endeavoring to improve the telephone, which had been invented by somebody else. In 1879, in giving testimony in an interference case, he enumerated a long list of contrivances he had made, with a view to show that he was an originator, and not a mere improver. Among these, however, he did not mention the telephone. *Nor does he attempt to offer any explanation why he should not have mentioned it on these different occasions.*

From the beginning of 1875 to the fall of 1877, Drawbaugh's shop was occupied by a company formed to manufacture a patented axle. During this time the Bell patents were issued and his telephone attracted the attention of the world. It is alleged that during this time Drawbaugh made his first practical machine, and several of his most perfect microphones. If the story were true, every member of the axle company and every workman in their employment would be able to prove it beyond question. As a matter of fact they conclusively disprove it. Not one member of that axle company ever talked through a telephone or tried to listen through one, or ever saw any apparatus whatever there for transmitting speech. These were intelligent men, and could not failed to have been deeply interested at once if there had been anything of the sort presented to them.

The claim that Drawbaugh's long delay in seeking to patent or introduce his alleged invention was owing to his abject poverty is most conclusively disposed of. It is proved by abundant evidence that he was able, without the slightest difficulty, to obtain partners and plenty of means for bringing out other inventions, and that he, personally, during the time in question, received many thousands of dollars from these inventions; that he owned two houses, living in one himself and renting the other to a tenant; that his house was as well furnished and his family as well fed and clothed as any in the village. Acquaintances of Drawbaugh, who, from their position and standing, could not fail to have known of his telephone if it had existed, and who would have been only too willing to have aided the inventor if they had known of it, were called as witnesses to disprove its existence. Among these were such well-known telegraph men as A. R. Keifer, of the Pennsylvania Railroad, and S. C. Wilson, of the Northern Central Railroad. Theophilus Weaver, a patent solicitor of Harrisburg, and many others testified to the same effect.

Indeed it appears that all the money he required to make an application for a patent was the amount of the government fee—$15. He had no need to pay attorney's fees. Witness his business card, printed in 1874–'76, and produced in evidence:

DANIEL DRAWBAUGH,
INVENTOR, DESIGNER,
AND
SOLICITOR OF PATENTS.
ALSO MODELS NEATLY MADE TO ORDER.
EBERLEY'S MILLS,
CUMBERLAND COUNTY, PENNSYLVANIA.

All these isolated facts taken in connection conclusively disprove the existence of any electrical telephone in the hands of Drawbaugh prior to the date of Bell's invention. The testimony indicates that *he did have a mechanical or string telephone* at an earlier date, and that upon this slender foundation of fact there has been reared an enormous superstructure of fraud. We might refer to innumerable other fragments of evidence pointing to the same conclusion, but we have, perhaps, given enough to convince any intelligent person that the claims of Drawbaugh are of a kind that cannot, by any possibility, ever be sustained by a court of justice, nor will they be permitted to defeat the just rights of an inventor who has conferred upon his fellow men the inestimable benefit of such an invention as the speaking telephone.

THE BROOKS UNDERGROUND TELEGRAPH SYSTEM.

BY F. L. POPE.

It is now more than 20 years since David Brooks, who was at that time superintendent of the lines of the Atlantic & Ohio Telegraph Company in Pennsylvania, first directed the attention of telegraphic engineers to the value of certain petroleum products as insulators for electrical conductors. At that date the electric telegraph had been in operation in the United States for some 20 years, and almost every material in the least degree adapted for purposes of insulation had been the subject of experiment, in some cases with a greater or less degree of success and in others with the most disastrous results. At the time of which we speak, there were practically only two substances, glass and vulcanized rubber, which had proved to be of any permanent value for this purpose, and the results attained by the use of these was very far from being satisfactory.

Mr. Brooks, after making a careful investigation of these products, and many experimental trials, definitely determined to insulate his lines by means of paraffin. This peculiar product, which was formerly obtained with difficulty, has been available in great quantities and at a comparatively low price ever since the discovery of the oil fields in Western Pennsylvania. It is a heavy hydrocarbon, its constituents being about 85 per cent. of carbon to 15 of hydrogen. It melts at 112° Fahr. Its non-conducting or insulating properties are very great, and it is strongly repellant of moisture in every form. The employment of a material possessing such physical characteristics necessitated the invention of insulators of wholly new design. A long continued series of practical experiments and tests, in the course of which many difficulties were met and overcome, resulted after a number of years in the production of the well-known Brooks paraffin insulator, by which a degree of insulation on aerial lines was attained a hundredfold greater in wet weather than had ever been possible with the non-conducting substances previously in use. Mr. Brooks subsequently retired from the telegraphic service and devoted himself for many years to the commercial introduction of his insulators with a gratifying degree of success.

It is scarcely 10 years since the conviction began to force itself upon the minds of American telegraphic engineers that an efficient and commercially practicable method of laying and insulating underground telegraph lines must be found and adopted at no distant period. The rapid multiplication of overhead wires, especially in the larger cities, and on the converging lines of road and railroad in their immediate vicinities, had become an inconvenience of no small magnitude, not only to the public at large but in a scarcely less degree to the telegraph companies themselves. It was admitted at once that some better means would need to be devised than the cumbrous, inconvenient and enormously expensive system of gutta percha wires and conduits, which at that date had alone proved efficient in other countries. The problem was attacked in various ways, and by many inventors, among others by Mr. Brooks, who undertook to devise a system in which the effective insulating medium should be composed of the petroleum products with the properties of which he was so thoroughly familiar. The general features of a system were soon developed, and Mr. Brooks obtained his first patent on July 13th, 1875, for an underground wire or cable clothed with absorbent and insulating substances, and surrounded by a pipe within which a liquid insulating medium is maintained under constant pressure. This patent embraces the essential characteristics of the plan, but from that date until the present the inventor has assiduously devoted himself to the work of perfecting and improving its details, until the system, as now presented, appears to meet in a most admirable manner, all the essential requirements of the telegraphic service.

The leading characteristic and fundamental principle of this invention, is that of insulation by the *total exclusion of moisture*. Every one acquainted with electro-magnetic apparatus is perfectly familiar with the fact, that an exceedingly thin covering of silk or other textile material wrapped upon an electric conductor is sufficient to insulate it thoroughly from parallel conductors in close proximity, even when traversed by the most powerful currents of dynamic electricity which the metal is capable of carrying without becoming actually overheated, provided that such insulation is kept absolutely free from moisture. This is illustrated in the case of the ordinary electro-magnet or the inductorium. Mr. Brooks conceived that a great number of conductors of ample thickness and conductivity for telegraphic purposes, separated from each other only by a thin envelope of textile material, might safely be enclosed in a metallic tube of very moderate size, and effectually insulated from each other, provided the access of moisture could absolutely be prevented. In order to effect this result he hit upon the happy expedient of filling the pipe with liquid paraffin or paraffin oil, in itself a substance which, when properly refined and especially prepared for the purpose, is a much higher insulator than dry air, and of maintaining a constant pressure upon the liquid within the pipe, so that in case of a leakage, although a portion of the oil might flow outward, it would still be impossible for a particle of water or moisture to enter.

In addition to its exceptional non-conducting properties, paraffin oil has been found to present still another characteristic which greatly enhances its usefulness for this particular purpose, namely, its low specific inductive capacity. Oil suitable for use in this system can now be obtained, which in addition to the qualities already referred to, has a greater specific gravity than water, and hence when mingled with it tends to settle to the bottom of the vessel rather than rise to the top, a characteristic which obviously tends still further to decrease the liability of moisture to enter the pipes, even if by any accident the normal pressure should fail to be maintained. A jar containing a sample of oils illustrating these peculiarities was shown in connection with the Brooks exhibit, at the recent electrical exhibition in Philadelphia, of which an illustration is given in figure 1. Within the jar will be seen the

FIGURE 1.

FIGURE 2.

heavy paraffin oil at the bottom, above this the water, and at the top a different oil of less specific value than the water. Whenever the jar was shaken up the contents would immediately redistribute themselves until they reached the condition shown in the illustration.

In figure 2 is illustrated an interesting and instructive

experiment, which was also shown at the exhibition, and which affords a most convincing proof of superiority of paraffin oil even to dry air as an insulating medium. Two copper wires of No. 18 B. W. G., covered with one wrapping and one braid, to about No. 10 B. W. G.—being in fact a very common sort of office wire—were twisted tightly together and immersed in a quantity of paraffin oil contained in a glass vessel, the bared ends of the wires extending above the surface of the oil being separated as shown in the drawing. When the opposite ends of these wires were connected with the respective terminals of a Toepler-Holtz induction machine, a continuous and vivid

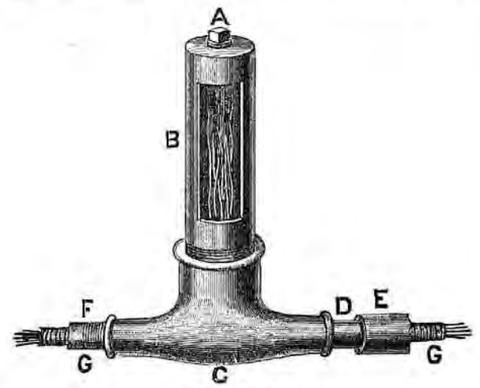

FIGURE 3.

spark passed between the ends of the wires as shown, and it was not until these ends had been withdrawn from each other to a distance of 4 cm. (1.5 inches) that the spark broke through the textile covering beneath the oil at the point where the wires were twisted together, and even then the insulation was nearly restored after the lapse of a few minutes. This experiment demonstrates *first*, that paraffin oil offers a far greater resistance than dry air, to the passage of an electric current, even of the highest potential; *second*, that wires thus insulated and laid in oil in close proximity to each other within a tube, may be effectually guarded against the effects of atmospheric electricity by the use of the ordinary lightning arresters; and *third*, that the permanent insulation of the conductor is not seriously impaired, even in case a temporary injury is caused by atmospheric electricity. Vegetable fibre when carbonized by an electric discharge, although itself a conductor, is nevertheless soluble in the oil and soon disappears.

We illustrate in the present article some of the details of the Brooks system which will enable it to be readily understood. The copper wires used for telegraph or telephone conductors may conveniently vary in size from No. 16 to No. 22 B. W. G. These are wrapped in many instances simply with a double coating of cotton, which has been found to answer an excellent purpose, and any required number of them are then bound together, forming a strong, flexible cable. Some admirable cables designed for this system have recently been manufactured at the Silvertown works near London. One of these has 130 No. 16 B. W. G. tinned copper wires, each of which is covered with a double wrapping of flax, and bound into a cable, the cable itself being enveloped in a tightly braided coating of jute. Another cable from the same manufactory, shown at the exhibition, contained 40 conductors of No. 16 B. W. G., and 360 of No. 20 B. W. G., the cable being of such size as to pass freely into a pipe 6.3 cm. (2.5 inches) in diameter. The cable is made up and drawn into the pipe in lengths according to circumstances. No difficulty has been found in putting down the cable in lengths of 61 km. (2,000 ft.), so of course the lengths may be made as short as required. Figure 3 shows the form of joint-box formerly used which has now been superseded by an improved form which will shortly be described. It is introduced here merely to illustrate the manner in which the ends of adjacent sectional cables are brought up and spliced. Figure 4 shows the construction of a splice-box, A, hand-hole and lateral outlet, E, in each direction, capable of accommodating 400 wires. These enter the box through the main conduit C, which consists of a lap-welded iron pipe 6.3 cm. (2.5 inches) in diameter. These boxes are inserted at suitable distances apart wherever required. They are of cast-iron and have an inside diameter of 17.8 cm. (7 inches). D is a movable cover or plug which screws into the top of the box, A, thus rendering the wires easy of access. Branch wires may be taken out of either side of the box through an

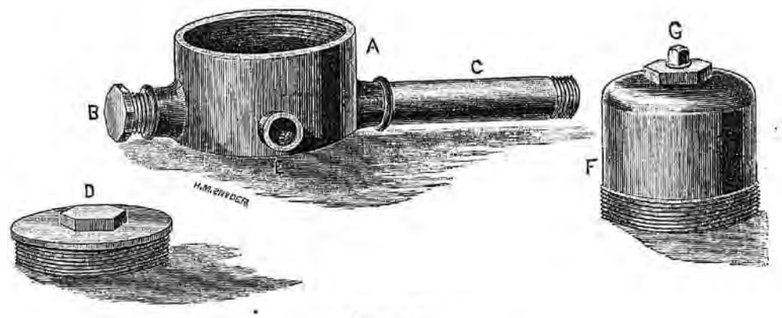

FIGURE 4.

outlet, E. When the box is to be used for splicing the ends of adjacent cables, sufficient room for the operation is obtained by the use of a cast-iron dome, F, which is substituted for the cap, D, and is provided with a removable plug, D, for filling the box with oil after the splice has been made.

Oxydation of the outside of the pipe is usually prevented by enclosing it in a wooden trough or boxing large enough to admit it, and then filling the space between the pipe and the box with pitch. When protected in this manner there is no apparent reason why the pipes and their contents should not remain in perfect order for 50 years, as the latter are hermetically sealed, and protected from air, light and moisture, and the mineral oil can undergo no organic change. The prospective durability of lines

laid under this system is an important point in its favor, as iron wires, whether galvanized or plain, are destroyed with great rapidity in large cities by the chemical action of the acids derived from the combustion of coal, so that it is found that the whole plant actually requires renewal as often as once in 10 years, to maintain it in fair working condition.

The controlling consideration in any system of underground conductors, must necessarily be *first*, efficiency, and *second*, economy. The efficiency of this system appears to have been pretty thoroughly tested. In 1877, a pipe several hundred meters in length and containing half a dozen wires was laid across the Brandywine Creek, at Wilmington, Del. These wires are still working and are apparently in perfect condition. Mr. D. Lessels, who, since 1865, has had charge of the underground lines of the post-office telegraphs in Glasgow, Edinburgh and other cities in Scotland, in a letter written early in the present year, gives a most favorable account of a line of four miles on the London and Southwestern Railway, containing forty conductors laid on the Brooks system. In Philadelphia, a line was laid in June, 1883, of 155 wires extending from the corner of Third and Chestnut streets, to the new Pennsylvania railroad station in Broad street, a distance of 2 miles, and another cable of 33 wires from Third and Chestnut to Kensington station, about 2½ miles more. These cables contain commercial telegraph circuits equipped with quadruplex apparatus, together with railroad Morse wires and telephone wires. No inductive embarrassment whatever is experienced upon the telephone wires, which are double line or metallic circuits. When the earth is used as a return, inductive disturbances are perceptible, though to a considerably less extent than on overhead wires of equal length.

Not the least important recommendation of this system is its very low cost, not merely in comparison with any other efficient system of underground wires, but even in comparison with aerial lines carrying a large number of wires. This will appear from the following statement of the contract price for laying a mile of Brooks cable in the city of Philadelphia :

COST OF 1 MILE OF TRUNK LINE, 400 WIRES, BROOKS SYSTEM.

Cable of 400 No. 20 B. W. G. conductors (80c. per foot)	$4,224 00
2½ inch heavy lap-welded pipe (22c. per foot)	1,161 00
Opening, closing and repaving trench	800 00
Wood trough filled with pitch (7c. per foot)	369 60
500 gallons oil at 14c.	70 00
Labor—screwing up pipe, splicing, putting in cable, etc., say	100 00
Total cost	$6,724 00
Cost per conductor, per mile	$16 81

A copper wire of No. 20 B. W. G. is equal in conductivity to the average of the iron wires used on aerial lines for telegraph purposes. In case it is required to bring the wires into every adjoining house—which could be done by using the splice-box and hand-hole, shown in figure 3, every 45 feet, the cost of these splice-boxes would not add to the cost of the pipe over $200 per mile, or 50 cents per mile for each conductor.

These are American prices, but in England the prices are so much lower that the total would probably be over 50 per cent. less than the prices given above.

Another important consideration in favor of this system which should not be overlooked is the rapidity with which it can be laid down ; for example, 2,000 feet of cable containing a large number of wires were laid in Philadelphia in a single day, and the street pavement replaced and put in condition for traffic between 7 A. M. and 6 P. M.

The Brooks system was shown at the Philadelphia exhibition, telephonic communication being kept up between the exhibition building and Kensington station, 5 miles distant, thus enabling those interested to determine for themselves the freedom of the circuit from the extraneous sounds caused by the inductive action of the numerous telegraph and telephone wires in the same conduit.

For the information of electricians, the following tests of insulation and electro-static capacity are given which were made May 14th, 1880, by M. Aylmer, on a specimen of Brooks underground cable laid in November 1879, at Versailles, near Paris (*La Lumière Électrique*, ii. p. 241).

No. of the Conductor.	Insulation resistance in megohms per kilometre.[1]	Capacity in microfarads per kilometre.[2]	No. of the Conductor.	Insulation resistance in megohms per kilometre.[1]	Capacity in microfarads per kilometre.[2]
1	178.5	0.106	13	223.1	0.106
2	258.0	0.087	13	223.1	0.106
3	223.1	0.087	14	210.0	0.109
4	238.0	0.087	15	223.1	0.106
5	198.3	0.106	16	238.0	0.100
6	198.3	0.106	17	223.1	0.109
7	198.8	0.106	18	223.1	0.106
8	198.3	0.106	19	223.1	0.106
9	223.1	0.109	20	223.1	0.109
10	223.1	0.109	21	223.1	0.109
11	223.1	0.109	22	223.1	0.106

1. Insulation resistance in megohms per mile may be found by multiplying the results in the table by 0.62.
2. Capacity in microfarads per mile may be found by dividing the results in the table by 0.62.

THE CONSTRUCTION OF LINES FOR ELECTRIC CIRCUITS.

BY THOMAS D. LOCKWOOD.

A series of articles written at the present time upon electrical line construction which did not refer to aerial cables in something more than a cursory manner, would be obviously incomplete, since such cables now constitute an increasingly important element in systems of electrical communication.

The idea of bunching a number of insulated telegraph wires together, so as to economize space and facilitate construction, and of suspending them in the air, is by no means new.[1] As early as 1795, a chronic inventor of that period, Don Francisco Salvá, of Barcelona, read before the Academy of Sciences in that city a memoir describing a system of electric telegraphy, in which he refers to multiple cables as follows : "It appears, however, little short of impossible to erect and maintain so many wires ; for even with the loftiest and most inaccessible supports, boys would manage to injure them ; but as it is not necessary to keep them very far apart, they can be rolled together in *one strong cable*, and placed at a great height. In the first trials made with a cable of this kind, I covered each wire with paper, coated with pitch, or some other idio-electric substance, then tying them together, I bound the whole with more paper, which effectually prevented any lateral escape of the electricity."

It does not appear that this plan went into use at that time, or in fact for 65 years thereafter, when aerial cables were introduced by Wheatstone, and erected in London to accommodate the numerous lines working his magneto dial instruments. Wheatstone subsequently patented his arrangement of cables and his method of suspending them. (See Br. Patent, Oct. 10, 1860, No. 2462.)

Until the advent of the telephone, and the almost infinite increase of electrical wires in our cities consequent thereon, overhead cables were not much known in this country, and were only used in sporadic cases, the only instances of their employment known to the writer being the kerite cables of the Gold and Stock Telegraph Co., New York, extending about a third of a mile between the operating room, 195 Broadway, and the inspectors' room,

1. *Vide* Fahie's History of Electric Telegraphy to the year 1837; p. 104. London and New York, 1884.

61 Broadway ; and the cables of the Law Telegraph Co., also in New York, in the district immediately surrounding their central station on Fulton street. At present their use is universal. Aerial cables have become indispensable to the telephone business because they bring a good many lines into a small space; they are light in proportion to the useful effect; and, by their use, crosses are in a great measure avoided. When cables of suitable character and construction are employed, and properly suspended, their use is to be commended. Copper has so far been universally used as a material for the conductor, and will probably continue to be so employed. The number of conductors per cable has been greatly varied, as few as five conductors having been used, while as many as a hundred are now frequently bunched in a single cable. Several sizes of conducting wire have also been made use of, Nos. 20, 22, 20, 18 and 16 being the most popular. In telephone work the length of the cables is a serious consideration, the majority of those in use being but a few hundred feet long, and arranged to extend through the densely wired district of the central station only—although occasionally we find them over a mile in length. We know from sad experience that the several lines interfere with one another when they are run in parallelism for any distance, and that the currents traversing one line set up induced currents in adjacent lines ; so that words transmitted over one line are heard in receivers connected with others. This often happens when the different lines are not cabled, but the effect is intensified in cables because the different wires are necessarily so near together. To obviate this annoyance special arrangements have been adopted which we shall refer to hereafter.

Insulation also demands our attention. It is of the highest importance that we secure a material which, while forming an effectual bar to any conductive transfer of electricity between the different conductors of the cable, will have a low inductive capacity. Of course each conductor must be insulated throughout its entire length. Cables must be also mechanically protected from the effects of the atmosphere and the elements. Let us now consider the several essential features enumerated, and, inasmuch as it is almost exclusively in telephonic line construction that cables are used, it will be understood that the following ideas refer more particularly to that branch of electrical communication.

Considering first the conductor, and bearing in mind that we have already stated the usual material, and the usual sizes employed, we may reasonably inquire whether any size is better than another, and whether experience has demonstrated any number of conductors in a single cable to be a better working number than any other. In the first place, it does not appear that any special note need be taken as to the size and number of conductors in cables of less than 500 feet or thereabouts in length. The only evils to be looked after in such limited stretches are those of leakage and induction. These we will look into presently. For cables of considerable length—certainly for any which are over 1,000 feet in length—the size of the conductor enters materially into the state of the case. We are fully aware that many aerial cables have been suspended with conductors of Nos. 26 and 22 size B. W. G. The fact need not prevent us from giving it as our decided opinion that such sizes are much too small to do good work. The element of conductivity is much more nearly related to successful telephony than many people suppose, as is proved by the case with which telephonic conversation was carried on over the heavy copper-plated wire of the Postal Telegraph Co. between New York and Cleveland and Chicago, and more recently on the copper line of the American Bell Telephone Co. between Boston and New York. At one time there was a great tendency among telephonic constructors to build lines of very light steel and iron wires, of all sizes, from No. 14 down to No. 20, the latter size being much used in some of the country exchange districts, and having the comparatively enormous resistance of about 287 ohms per mile. In addition to the extreme fragility of such construction, and its delicate and temporary character, it was found that although the cry was frequently raised "that resistance did not trouble the telephone," resistance did actually become quite a cogent factor as soon as extra territorial lines began to multiply, and subscribers to one exchange begun to converse with subscribers to others. Consequently the use of any iron or steel wire of a gauge smaller than No. 14 has been discouraged, and even that is in our opinion too small. But why are these considerations introduced here? Is not this an article on cables? We shall see the relevancy of the foregoing remarks when we find that the approximate resistance of a No. 26 wire of copper (even when pure, which it never is) is 150 ohms per mile ; that the resistance of No. 24 averages 99 ohms per mile ; that of No. 22 about 64 ohms, and that of No. 20 about 38 ohms, the smallest of these resistances thus being considerably greater than that of No. 12 galvanized iron wire. If now it be wrong to use an iron wire of high mileage resistance, it seems but logical to assume that to use a copper wire of equal resistance per mile is also and equally wrong, and that therefore any of the above sizes are too small to be employed, except as temporary expedients and for very short cables. The experience of the writer leads him to believe that a No. 18 B. W. G. copper wire is the smallest that should be generally used as a cable conductor. Moreover it should be remembered that as the conductivity increases it is much easier to maintain good insulation, and that therefore the *insulation* resistance of a No. 18 wire (the wire itself averaging about 23 ohms per mile) may fall to a much lower point without reducing the practical efficiency of the line, than could possibly be the case with a smaller conductor. It will no doubt be objected by some that it is injudicious to increase the size of telephone wires, because by so doing a greater surface is exposed to inductive interference ; induction, all things being equal, being proportional to the superficial extent of the conductive service exposed to the disturbing wire or conductor. To this, it may be replied, that the advantage of high conductivity gained by increasing the size of the wire preponderates so greatly over the disadvantage of the slightly increased inductive surface that the latter need scarcely be regarded. Let us suppose a case : We have a copper wire, say No. 31 gauge, the diameter of which is .010 of an inch, or 10 mils, the resistance per mile being about 546 ohms, and its weight per mile 1.597 lbs. The circumference of any circle being to the diameter approximately as 22 is to 7, the circumference of our supposed wire proves to be a little over .0314 of an inch, and it thus has a surface of about 1,989 square inches, or nearly 14 square feet per mile. The conductivity, or conversely the resistance, depends on the sectional area, or what is the equivalent of the area, the weight. Squaring the diameter, we find the sectional area to be approximately 100 mils. Let us now take another wire having a diameter of exactly double that of the first (we find by Table IV, Prescott's *Electricity*, that No. 25, B. W. G., answers our purpose). Now the resistance of No. 25 copper wire is given as 136.4 ohms per mile, and it has a diameter of 20 mils ; it consequently has a circumference of .0628 of an inch, and a mileage surface of 3,979 square inches, avoiding fractions, or 27.56 square feet. The sectional area we find, however, by the same table to be 400 circular mils, and the weight in pounds per mile is 6.3888. Thus we plainly see that while the surface has only doubled, the sectional area and the conductivity have quadrupled, showing most conclusively that it is advantageous to use reasonably large conductors, and that the gain in conductivity is by no means counterbalanced by an equal loss, arising from retardation due to electro-static capacity, or by any inductive influence depending upon the extent of the surface of the conductor. Now, as to the number of conducting wires which may be com-

prised in a single cable. As has been said, 100 wires have frequently been cabled together. This would seem to be too large a number if the best results are desired. In the first place, with a smaller number, there is less temptation to use a wire which is too small; second, the thickness of insulating covering may be greater without unduly increasing the size of the entire cable, which is an advantage, because the thicker the insulation the lower its specific resistance need be, and the less the induction, whether static or dynamic. Moreover, when there is an extremely large number of wires all in one cable, the conditions are very favorable to retardation, because each wire is surrounded by a great many others, all of which are connected to earth at both ends, which tends to give a high electrostatic capacity to each wire. This is of course lessened if we employ a smaller number of wires, as the mass of the outside metal coating of each wire is thus diminished, and the resistance of said mass is increased.

These considerations, then, point to the conclusion that there is another limit (in addition to the size of the cable) to the number of wires which should be included in a single cable of a quarter of a mile or upwards in length. The writer's opinion is that 50 should be a maximum.

(To be continued.)

PROGRESS OF ELECTRIC RAILROAD SIGNALING IN THE UNITED STATES.

The only railroad in the United States which has been equipped throughout its entire length with automatic electric block signals is the Providence and Worcester. The system which has been adopted by this company is that of the Union Switch and Signal Company of Pittsburg, Pa., the characteristic feature of which is the maintenance of a continuous electric circuit through the rails of the track from one end of each block section to the other, normally holding in a position indicating "safety" the signals guarding the entrance of the block, which indication is changed to "danger" either by the interruption of the circuit, as by the breakage or removal of a rail, or the shunting of the electric current from the electro-magnet, as by the presence of a locomotive or train in the block section. In order to obtain an idea of the practical value of the electric automatic system from those most interested and best qualified to judge of its merits as a safeguard against accident, a circular was recently issued by the management of the Providence and Worcester R. R., to all the locomotive runners on the line, to which numerous replies were received. The *Railroad Gazette* says:

We have examined these letters, which seem to be sufficiently frank and unreserved, and it is curious to note with what unanimity they bear testimony to the fact that they all "*feel safer* running over the road," that being the point apparently which has most impressed them, as is most natural. The replies are not strictly unanimous, for one man "don't think you can trust the," and "don't feel as safe as if there were more brakemen on the trains with a good man to flag"; but the general tone of all the remaining twenty-two is given in the following response: "They are the greatest possible help in running trains. The past winter in cases of dense fog and blinding snow storms I have found them to be of the greatest possible aid, enabling me with perfect ease to avoid delay and run at the usual rate of speed, which I should not have felt safe to do before they were adopted. At night they are to the locomotive engine what the lighthouse is to the mariner, and in my opinion are indispensable."

Another man says: "On one occasion I was brought to a stop by a broken rail when the only warning I received was an electric signal set at danger. Not only are its benefits felt while running, but also in shifting and making up trains. Therefore, while I think it adds to the cares and duties of an engineer, by furnishing more points to be carefully watched, yet it creates a feeling of safety and security not otherwise obtainable."

Another says "I can see them at a greater distance than a man with a red flag, owing to their elevation, and they are more likely to be seen in time, because we look for them every day in the same

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perfection than anything I have seen. In no case have I entered a block when occupied without the signal showing danger." On the other hand, several mention instances when the apparatus failed to work and showed a danger signal unnecessarily, and also several point out that they should not be implicitly relied on, but a flag put out in case of need as an extra precaution.

The use of electric block signals however, is not by any means so extensive upon American railroads as might reasonably be expected from the length of time the apparatus has been in use, and the unquestionable great value and utility of the system as evinced by the strong commendations which it receives from the managers of the lines upon which it has been introduced. The *Railroad Gazette* publishes a table of statistics upon this subject, from which we learn that the automatic block system of the Union company, including the insulated rail circuit, is now in use on 30 different railroads, covering 537.75 km. (334.75 miles) of track and operating 423 signals, in addition to which 3 roads are using the improved apparatus recently introduced by the same company in connection with the rail circuit, known as the "electro-pneumatic block," covering 85.3 km. (53 miles) of track divided into 70 block sections.

Much greater progress has been made in the introduction of the interlocking apparatus, which is applied to switches, junctions, crossings and station yards, and to some extent as a method of controlling the block signals also. Electric locking is now usually applied by the Union company to its interlocking apparatus with manifest advantage. By this means the interlocking apparatus is temporarily controlled by the train through an electrically actuated lock, so that the apparatus cannot be shifted in the slightest degree by the signal man after a safety signal has been given by him to a train, until after such train has passed beyond the point of danger. According to the list given in the *Gazette*, the Union Switch & Signal Company have erected no less than 136 interlocking machines, embracing 2,120 levers, for moving switches, locks and signals. Electric locking though of comparatively recent introduction, has already been applied to 33 of these machines and is coming to be regarded as such an indispensable safeguard, that it is probable that few interlocking machines will hereafter be erected, without embracing this essential improvement.

The present depressed condition of the business of the country has not only prevented the expansion and development of railroad traffic during the past year, but in many cases has seriously diminished it, and it is therefore almost a matter of surprise, under the circumstances, that any considerable business is being done in the way of increasing the number of safety appliances upon the leading trunk lines. With a revival of business which shall increase the traffic of our railroads, we look to see at an early day an enormous increase in the line of electrical business which has been so successfully prosecuted by the Union company.

ELECTRIC LIGHTHOUSE EXPERIMENTS IN ENGLAND.

The recent advances in the science of illumination have led to some interesting experiments in lighthouse work, the results of which will soon be made public. Three experimental lighthouses have been erected at South Foreland, England, for the use of the electric light, gas and oil, respectively. The electric apparatus consists of arc lamps and three magneto generators, made by Baron de Meritens. The lamps are placed one above another in the tower. The carbons used are compound, being made up of many small carbon rods of square section, copper plated; also the Siemens "core carbon," made of gas carbon, having a central rod of graphite. Each lamp has an estimated power of 30,000 candles. The second tower is fitted up with Mr. Wigham's gas burners. To supply these, a small gas plant has been erected near by. The tower contains 4 burners, one above

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The total number of jets on each burner is 108, making a total of 432. The outer rings may be removed when less light is required, so that each burner may be used with 28, 48, 68, 88, or 108 jets. A talc chimney above the flame produces the necessary draught. The intensity of the light when the jets on all four burners are used, is stated by the inventor to be equal to 12,000 candles. The third tower is at present devoted to the oil and gas burners invented by Sir James Douglass. One oil burner has 6 concentric wicks with a power of 720 candles; a second has 7 wicks and a power of 1,000 candles. There are 3 burners in the tower placed one above another. Each tower is provided with lenses for both fixed and revolving lights. The highest power of the gas tower is a quadriform light, of the others a triform light. There are also gas burners from the Sugg, and from the Siemens companies which will be tested. For observing and testing the power of the lights, a line of observation has been laid out in the direction of Deal, and three stations fitted up as photometric observatories, at the respective distances of ½, 1¼ and 2 miles from the towers. The lights are focused on one of these huts, and are measured in all conditions of weather by means of the pentane unit of light devised by Vernon Harcourt. When the weather is too thick to admit of direct comparison with the unit, the lights are compared with each other by means of a polariscope-photometer in which the ordinary image of one light is brought to equality, by means of a Nicol prism, with the extraordinary image of another light. In ordinary weather a ray from the lighthouse tower enters a hole in a shutter and falls on a portion of a paper disc; a contiguous portion of the disc is illuminated by the pentane candle fixed on one side of the opening in the shutter. The disc is arranged to be moved to and fro until equality of illumination is reached, when its distance from the candle is measured, which in conjunction with the known distance from the lighthouse gives the necessary data for calculating the illuminating power of the light. By these measurements, taken at different distances in various states of the atmosphere, the penetrative power of the several illuminants will be determined. It has been asserted that the superiority of the arc light, would render it especially desirable during the prevalence of fog. This, it is now said, is not the case, and the question of relative penetration is the most important point which is to be settled by the experiments at South Foreland. It has been suggested that in thick weather the eye can detect a large area of low illumination more readily than a smaller area of higher illumination, and that the electric light, with its smaller lenses, suffers from this reason in comparison with the gas and oil lights with larger lenses. Mr. J. Munro, in a communication to *Nature*, however, gives what appears to be a more probable explanation of the cause, and what is still more important, suggests a remedy. He says: "M. M. Janssen Angström and others have shown that vapor of water in the atmosphere reduces the intensity of the violet end of the spectrum in a general manner, and the red end in a more special manner. An examination of Angström's map of the telluric lines in the solar spectrum will show that while the extreme red and all the blue ends of the spectrum are much darkened by absorption lines, there is a zone from between B and C to δ which is comparatively free from them. This region includes the orange rays, and part of the red and yellow. It is the most luminous part of the spectrum, and contains the rays which will penetrate farthest in a fog. Hence it is that the sun appears redder as it sinks towards the horizon, and loses more of its blue rays in the thicker atmosphere. Gas and oil lights are richer in these penetrative rays than the arc light, which is peculiarly rich in the blue rays easily absorbed. Hence a gas jet can be seen a long distance in a fog, though like the sun, it appears redder in tinge than usual. An arc light, on the other hand, is not seen far, however penetrating [illegible] I have often observed

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on London Bridge in a fog, that the arc lamps become of a blank white; the brilliant arc seems to disappear, and the carbon points, slightly reddened, glow through the mist. The arc with its blue rays is the part which suffers most, and hence the larger the incandescent points in comparison, the likelier the light to penetrate. The ordinary electric incandescent lamp has, according to the late R. Sabine, 20 per cent. more orange rays than daylight, a fact which may account for its greater penetrative power than the arc; but, owing to its cost, it is debarred from lighthouse work. On the whole it would appear advisable to employ the spectroscope in the South Foreland experiments, in order to find out what the absorptive action of mists is on arc, gas and oil lights. If it should turn out, as above indicated, that the arc fails in penetration from lack of certain yellow, orange and red rays, it might be useful to try the effect of supplying the needful rays by mixing certain salts with the carbons."

LITERATURE.

REVIEWS.

Magneto-Electric and Dynamo-Electric Machines: Their Construction and Practical Application to Electric Lighting and the Transmission of Power. By Dr. H. Schellen, Director of the Real Gymnasium at Cologne, etc. Translated from the third German edition by Nathaniel S. Keith and Percy Neymann, Ph.D., with very large additions and notes relating to American machines, by Nathaniel S. Keith, Secretary of the American Institute of Electrical Engineers. Vol. I, with 353 illustrations. New York: D. Van Nostrand, 1884.

The extraordinary progress which has been made within the past few years in the industrial application of the dynamo-electric machine, especially in electro-metallurgy, electric illumination, and last, but no means least in importance, the transmission of mechanical energy, has had the inevitable result of stimulating the production of an enormous volume of literature relating to the subject, of more or less value—generally less. A succession of would-be authors, each anxious to be first in the field, have loaded the shelves of the electrician's library with books consisting mainly of a crude and ill-digested mass of extracts from the reports of exhibitions and the catalogues and advertising circulars of manufacturers, abounding in erroneous descriptions and still more erroneous theories. In these works we find repeated again and again, the venerable blunders with which constant reiteration has rendered us so familiar, accompanied by equally venerable engravings of machines of which some never had an existence, and others have sunk into deserved oblivion.

It is encouraging, however, to notice that a marked change in the character of electrical literature is becoming perceptible. Several works have recently been published of real and permanent value, not only to the theoretical electrician, but to the electrical engineer and the practical workman as well

Dr. Schellen, the author of the present work, whose lamented decease was chronicled but a few days since, was director of a technical institution at Cologne, Germany, and is best known among electricians as the author of one of the earliest as well as the best treatises on the electric telegraph, which has gone through a great number of editions and still retains its place as one of the leading works on that subject. It would, perhaps, be difficult to name any one person better qualified to prepare a work of this particular kind than was Dr. Schellen. It is true that the character of the book shows him to be a theoretical rather than a practical man, for his lack of thorough familiarity with the conditions of actual work occasionally betrays him into obvious errors. In the present volume, which has been translated from the German by Nathaniel S. Keith and Percy Neymann, the original work has been carefully edited by Mr. Keith and many such errors corrected. The editor has also added a considerable amount of new and valuable matter descriptive of American machines and practice, which greatly increases the value of the work to American readers. The number of dynamo and magneto machines which have been devised by the ingenuity of inventors is so great as to render it hopeless to attempt to describe them all in a single work. In making a selection the author states that the considerations which have guided him have been either novelty in principle, extensive technical application, or a great degree of historical or theoretical interest. Part I is devoted to a preliminary explanation of the physics of electricity and magnetism. This portion of the work is exceedingly well written and contains matter of considerable value to the student.

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We do not remember to have seen any instance in which the reactions of the solenoid and movable core, so much used as a regulating device for arc lamps, is more lucidly explained and illustrated. The engravings in *fac-simile* of magnetic spectrum showing the lines of magnetic force under different conditions will well repay careful study and comparison. Part II treats of methods of electric measurement and of measuring instruments. The portion relating to the dynamometer, and the methods of determining the power imparted to the dynamo, is unusually full. The American editor has added descriptions of the Kent and Brackett dynamometers, the latter of which is unquestionably the most convenient and accurate apparatus yet devised for this purpose. The photometer and the manner of its use are also well described. The portion of the chapter relating to electrical measurement proper is however hardly what we have a right to expect in a work of this character, no reference being made to some of the most important instruments for measuring large currents, such, for example, as the graded galvanometers of Sir W. Thomson.

Parts III, IV and V are devoted to magneto and dynamo electrical machines. In this work, for the first time, so far as we are aware, the evidence in favor of each of the several claimants to the discovery or invention of the self-exciting dynamo has been brought together in a form convenient for discussion and comparison. It is very well known that the discovery of this principle was announced independently about the same time by Dr. Siemens and Professor Wheatstone, but it is not so well known that Moses G. Farmer, the well-known American electrician, was also an independent discoverer of the same principle. It appears that Siemens exhibited his machine, illustrating the principle in question in December, 1866, and prepared a paper which came before a meeting of the Berlin Academy of Sciences in the middle of January, 1867. The original paper translated from Poggendorff's *Annalen* is given in full. On February 14, 1867, Professor Wheatstone read a paper before the Royal Society on the same subject. The evidence in support of Professor Farmer's claim has never before, so far as we are aware, been published in full. In a letter to Mr. Keith, dated February 10, 1882, Professor Farmer states that in 1866 he constructed his first dynamo machine upon a plan which he had conceived two or three years previously. In the latter part of that year he gave an account of his experiments in a letter written to Mr. Henry Wilde, of Manchester, England, as shown by the following interesting extract from the proceedings of the Manchester Literary and Philosophical Society (volume 6, page 107).

Mr. Wilde has also received a letter on the subject of his recent experiments in magnetism from Moses G. Farmer, of Salem, Mass., U. S., dated Nov. 9th, 1866, in which he says that he had obtained an increase of 31 per cent. in the powef of a magneto-electric machine by transmitting the current from the armature through coils of wire surrounding pieces of soft iron forming the prolonged extremities of the permanent magnets of the machine. Mr. Farmer in the same letter adds: "I have built a small machine, in which a current from the thermo-battery excites the electro-magnet of your machine to start it, and after the machine is in action a branch from the current of the magnets passes through its own electro-magnet, and this supplies the magnetism required. It is not exactly like a person standing in a basket and trying to lift himself, because the electricity proceeds from the conversion of the mechanical energy, which must be continually supplied. Neither can it in any wise be likened to the various schemes for producing perpetual motion, but depends on the principle that the actual energy of the mechanical force, conjointly with the potential energy of the magnet, can develop a greater amount of potential energy than is originally resident in the magnet, or in other words, it is a method of converting part of the actual energy of the prime mover into the potential energy of magnetism."

As a further contribution to the history of the dynamo, Mr. Keith has added a translation of the article of Dr. Pacinotti published in 1864 in *Il Nuovo Cimento*, containing a description of his continuous current electro-magnetic machine.

The descriptions of the modern machines have been prepared with care and are sufficiently well illustrated. We find for the first time descriptions of some of the modern American machines, which although in extensive use have not heretofore found their way into the books, such as the Thomson-Houston, the Fuller-Gramme, and the Weston constant potential machines. In the description of the winding of the Von Alteneck machine we find a repetition of the statement that the original form of winding was an unsymmetrical one; we have reason to think that this is a mistake which originally arose from a superficial study of the drawings of Von Alteneck's patent, rather than of the machine itself. It seems probable that the plan of winding given as the invention of Frölich was in reality the same as that actually used by Von Alteneck, but which had been wrongly illustrated. It is, perhaps, to be regretted that a machine of so much theoretical interest as the so-called Arago disc machine of Professor Seeley was not more fully described in its details. The monster steam-dynamo of Edison marks the first decisive step in the advance from small to large machines, and is therefore of much historical interest, but the author intimates, what for a long time has been no secret among well-informed electricians, that the large Edison machines in their actual performance have fallen far short of the expectations which were entertained for them; although these are rated as having a capacity of 1200 16-candle lamps, it is doubtful whether they can be depended upon for much more than half that number. The final chapter in the book is devoted to a classification of dynamo-electric machines and a discussion of the theory involved in their construction and operation, which is mainly a compilation of the results of the investigations of Dr. O. Frölich and Marcel Deprez.

We must call attention to one serious fault in the translation or editing of this work, which, with a little care, might easily have been remedied. We refer to an indiscriminate use of the terms electromotive force, tension and intensity, which is eminently well calculated to confuse the ordinary reader Take, for example, the statement on page 344, that the Weston armature is calculated to produce currents of low *tension*, but of great *intensity*. Here the word "tension" is obviously used in the place of "potential" or "electromotive force" and "intensity" in place of "quantity." We might point out a number of other instances of the same kind. The weights and dimensions throughout the book are sometimes given in English measure and sometimes in metric measure, which is extremely inconvenient for the student. A better method, which we are glad to see is rapidly coming into use among scientific writers, is to give the weights and dimension in metric measures, followed by the English equivalent in brackets. This is especially proper in electrical work, inasmuch as the accepted electrical units are based on the metric system. We do not find that the value of the standard ohm as ultimately established by the Paris congress, or the latest determination of the value of the ampère by Lord Rayleigh are given. These, perhaps, have been too recently published to admit of their incorporation in the body of the work, but might, we should think, have been advantageously added in an appendix.

The mechanical execution of the work is excellent. The illustrations are abundant and for the most part well designed, and, although to a certain extent lacking in finish, are on the whole very creditable.

A NEW ELECTRICAL DIRECTORY.

O'Beirne Brothers, of Fort Wayne, Ind., propose to publish an electrical directory for 1885, which, in the words of their circular, "shall contain a correct address of all Electric Light Companies incorporated and doing business under the laws of the respective States, and Provinces, of the United States, Mexico and Dominion of Canada, giving a list of the officers and date of organization, with amount of capital stock and the system of lights used: also the extent of their business, present and prospective, and any other important data of general interest.

"The directory shall be of the standard size, bound in boards with design and workmanship finished in an artistic manner."

CATALOGUES AND PAMPHLETS RECEIVED.

Watts, Campbell & Co., Newark, N. J. Manufacturers of improved steam engines, with Corliss valve gear.

Curt W. Meyer, New York. Manufacturer and importer of experimental and philosophical apparatus and supplies.

Rhesa G. Dubois, Washington, D. C. Hand-book of information regarding patents, with illustrated descriptions of leading types of telephones, dynamos, arc and incandescent lights, definitions of electrical terms, tables, etc.

Washburn & Moen Manufacturing Co., Worcester and New York. Fifth edition of their vest pocket compilation of telegraph statistics and miscellaneous information, which every electrician will find convenient for reference.

Anderson Brothers, Peckskill, N. Y. Manual of Telegraphy for beginners. Intended especially to accompany their simple form of Morse instruments and batteries, containing also a chapter on electro-mechanical telegraphy.

Patent Self-binding Insulator Co., Birkenhead, England. Illustrated description of the numerous advantages of the Lewis Self-binding insulator.

CURRENT PERIODICAL LITERATURE.

Under this title we shall give in each issue references to the more important papers on electrical and allied subjects, which appear in contemporary periodicals.

Electrical Review (London), Sept. 20.—Causes of death by Intense Electrical action.—*C. M. Gariel.* Sept. 27.—The Portrush Electric Railway. (illustr.)—*A. de W. A. Traill.* Oct. 11.—On a Standard Tangent Galvanometer —*Prof. Silvanus P. Thompson.*

The Electrician (London), Sept. 20.—Endless Solenoid Galvanometer and Voltameter (illustr.)—*Prof. Jas. Blyth.*

RECENT PUBLICATIONS.

Anderson, J. A. The Train Wire. A discussion on train dispatching, Chicago. *The Railway Age Publishing Co.*

Billmanson, A. Elektriciteten och dess tekniska användning till de tekniska skolornas och den blidade allmänhetens tjenst. Stockholm, 1884. 2 vols. 128+230 p.

Blavier, E. E. Etude des courants telluriques. Paris, 1884. 30 p. Plates, 4°.

Cassagnes, G. A. Steno-Telegraphy, Paris, 1884. 11 p. Plates, 8°.

Chauvin, V. Orgnaisation der elektrischen telegraphie in deutschland für die zwecke des krieges. Berlin, 1884. 111 p., map. 8°.

Electric Lighting, American system of. Boston: *Am. Electric and Ill. Co.*, 1884. 120 p., illustr., 8°.

Franklin Institute. Official Catalogue of International Electrical Exhibition. Philadelphia, 1884. 24+92+97 p.

Hoppe, Dr. E. Geschichte der elektrizitat. Leipzig, 1884. 622 p. 8°.

Jenkin, Prof. F., F. R. S. Telpherage (reprinted from the Journal of the Society of Arts, May 16, 1884). London, 1884. 15 p. 8°.

Preece, W. H., F. R. S. The effects of temperature on the electro-motive force and resistance of batteries. (Proc. Roy. Soc. No. 244, 1883.) London, 1883. 15 p. 8°.

Prescott, G. B. Dynamo-electricity; its generation, application, transmission, storage and measurement. New York: *Appleton*, 1884. 867 p., illustr., 8°.

CORRESPONDENCE.

NEW YORK AND VICINITY.

Cable Festivities at Coney Island.—The Hoboken Bribery Case.—The Pneumatic Tube Line to 23d Street.—A Fire Alarm Superintendent in Trouble.—Increase in Electric Street Lighting.—Competition Among the Gas Companies.—An Effective Burglar Alarm.—Illness of Supt. Scott.—An Electrical Man for Congress. Telegraphers Join in the Tammany Parade.—A New Quotation System.—The Metropolitan Telephone Company Contracting for Subterranean Lines.

ALTHOUGH the laying of short submarine cables is now quite an ordinary event in the vicinity of this city owing to the numerous river crossings of the various telegraph companies, the landing of the shore end of an Atlantic cable as near by as Coney Island was made quite a festive occasion by the courtesy of the Commercial Cable company's management. The "season" having terminated, special arrangements for transportation and subsistence were made and 600 invitations issued, which resulted in the gathering of about 200 people at Manhattan Beach, Oct. 16, to witness the practical completion of the latest cable enterprise, which has been successfully carried through by Messrs. Mackay and Bennett. To those who are familiar with such operations it was no disappointment to learn that the actual landing had been delayed; and after about two hours spent in gazing upon the steamer Faraday, which lay a couple of miles from shore, examining the neat little cable house recently erected, and the various preparations made for future work, the visitors fell in behind the band which led them not unwillingly to the pavilion where an ample lunch had been prepared for the entertainment of the guests. Among those present, whose faces are familiar in New York electrical circles were George G. Ward, Superintendent of the Commercial Cable Company, J. H. Emerick, Jas. R. Beard, C. B Hotchkiss, F. W. Jones, J. H. Bunnell, F. W. Cushing, R. W. Pope, Joseph Edwards, D. S. Robeson and many others. Speeches were made by Messrs. Ward, Lyon, Muirhead, and Baron Stuckle. Later in the afternoon a high wind sprung up, and it was considered prudent to postpone the landing until the following day. The connection with this city will be made by a subterranean line through Brooklyn, crossing East River Bridge, and thence to the office at 21 Wall street.

The unpleasant relations between the Mayor and Common Council of Hoboken caused by charges of corruption in connection with a new district telegraph company, have not yet been smoothed over. The franchise was rescinded by the Board for the reason that the Mayor had charged that it was obtained by bribery.

The pneumatic tubes between the Western Union main office and the branch at Fifth avenue and 23d street, are now ready for business, and there is a prospect that local telegraphy will eventually be revolutionized by this system, which is being gradually extended. There is an immense field for inter-communication in this city if a service could be organized to meet the demand. It is encroached upon by the post-office as well as the various telegraph, telephone and messenger companies, but none of them cover the field in the manner which might be done.

The superintendent of the fire alarm telegraph in Jersey City has been charged with improper practices in demanding from the Pennsylvania Railroad Co. $60 for replacing the fire alarm box destroyed by the fire at the ferry house in August. When asked by Supt. Pettit if $50 would not be sufficient, he at once acquiesced, and when asked for an itemized bill, presented one in the name of a Mr. Eaton, who charged $17 for wire and $33 for the lineman's services. A little more familiarity with the caution exercised by railway corporations in the payment of such bills would perhaps have prevented so bungling an attempt at making a raise.

The use of the arc lamp for street lighting is gradually extending in this city, the Board of Aldermen having recently decided to adopt the electric light in Houston street from Avenue B to the East River, and in Avenue C, from Houston to 14th street. Over 3,700 gas lamps have been displaced by electricity, but no reduction in the price of gas has been made, until the recent combination which in view of the threatened competition of the Equitable Gas Light Company, proposes to reduce the price of gas from $2.25 to $1.75 per 1,000 feet. As the delivery of gas on the premises of their customers costs but 90 cents per 1,000, it will be seen that a very handsome profit will still continue to be realized by the old companies. No provision has yet been made for displaying the names of streets at the corners, as was formerly done by the use of transparent signs on the gas lamp posts, which was an excellent arrangement. The naked iron posts divested of their globes still stand in the streets and will probably remain there until it is finally determined whether the electric light companies will place their wires underground or discontinue the business of street lighting.

The recent arrest of two burglars in Brooklyn through the agency of a burglar alarm, naturally calls attention to the fact that burglary as a profession has been pretty effectually stamped out in this city, a result due to the very general extension of electric protective systems. So reduced has the field of operations become that a printing office was recently entered by burglars, but the plunder obtained was not of sufficient amount to be noticed in the daily papers.

Superintendent George B. Scott of the Gold and Stock Telegraph Co., has been seriously ill for several weeks and confined to his house. His many friends will be pleased to learn that the prospects of his recovery are very favorable. He has devoted himself arduously to the perfection of his new printer, and the contract for 800 of these instruments has been awarded to Bergmann & Co. It is now 12 years since the improved Calahan printer was introduced, and although the necessity of a faster instrument has been apparent for several years, nothing had been brought out until the Scott instrument, which seemed to be a sufficient improvement to warrant the expenditure of perhaps $40,000 which will be required to make the change.

Mr. Michael Breslin, chief batteryman of the Gold and Stock Telegraph Co., has been nominated for Congress by the workingmen of the 12th Congressional district in this city. His nomination will be endorsed by the People's party; and if also acceptable to the Republicans, with whom he has affiliated for many years, he will consider himself on the road to Washington. If his honesty and intelligence, his commanding presence, his earnestness and ability to express his opinions in open debate were as generally known in his district as they are to his old associates, he would be elected regardless of his party proclivities.

In the Tammany democratic procession, October 21st, was a battalion of telegraphers, bearing the motto "Jay Gould cannot control our votes."

The stock indicator, patented by Albert Buttles Smith, July 8th, 1884, has been put into practical use by the Dexter Stock Indicator Co., for the purpose of supplying petroleum quotations. It is a visual indicator, the tens, units and fractions being arranged on separate drums, so as to be read perpendicularly, the fraction drum being the lowest. It can be utilized for stock quotations by using a separate indicator for each stock, but as such an arrangement would require a multitude of wires it is doubtful if it could be made satisfactory in every respect. These instruments may be seen at the Electric Stock Exchange.

The Metropolitan Telephone & Telegraph Co. has contracted with the Electrical Construction and Maintenance Co. of Philadelphia, to run 800 underground wires (on the Brooks system) from the Spring street exchange. Four hundred will run south through Mercer street, and 400 across Broadway and down Crosby street, the numbers gradually decreasing as the wires are led out to subscribers. The cables used are to be manufactured at the Silvertown works, and will contain from 50 to 150 wires each, with connection boxes every 45 feet.

NEW YORK, Oct. 24, 1884.

PHILADELPHIA.

Closing of the Electrical Exhibition.—Electrical Primer Extraordinary.—Final Exercises Not on the Programme.—Electric Clocks.—Medical, Surgical and Dental Apparatus.—Proposed Underground Line of the B. & O. Telegraph Co.

THE Electrical Exhibition was brought to a successful close on Saturday evening, the 11th of the present month. To accommodate the public the hall was kept open until 11:30 P. M., and some visitors arrived after the usual closing hour—ten o'clock, and with very few exceptions the exhibits were maintained intact up to the last moment. Those who attended, therefore, had an especially good opportunity to examine the exhibits.

Although special pains had been taken to furnish electro-technical information for the benefit of the general public, by the publication of a series of primers from the pen of Prof. Houston, the wants of the professional electrician had been neglected. This omission was supplied during the last week of the exhibition by the mysterious appearance of "Primer of Electricity, No. 0," which fully bore out the promise of its brief introduction, which announced that "this primer contains an immense amount of useless misinformation condensed in wonderful and unavailable form." It was devoted to the following subjects:

I. DYNAMITE ELECTRIC MACHINES.
II. ELECTRIC LIGHTS.
III. ELECTRICITY.
IV. ELECTRIC CIRCUSES.
V. BATTERIES.

The character of the work may be determined from perusing the following diagnosis of electricity contained in it:

"The identity between lightning and electricity was discovered within a convenient distance of this building by Benjamin Franklin. The identity between Jersey lightning and applejack was probably discovered by his son William, whilst Governor of that Province. This may also be demonstrated at a convenient distance from this building by those who wish to try it."

The latent spirit of humor which prevailed, was developed by

the circulation of this primer, so that shortly after eleven o'clock a large number of exhibitors and attendants began to display on their breasts red silk badges, bearing the initials "M. E. O. K." This represented the "Mystic Electrical Order of Kazoos," which had been formed in a spirit of fun to mark the close of the exhibition. Just before the close the members formed in procession and marched around the building to the music made by horns, "Kazoos" and drums. After the procession they held a burlesque meeting, at which humorous speeches were delivered. It was a kind of relaxation after several weeks of hard work and anxiety, and the participants included not only the young men, but several distinguished electricians. The display afforded rare amusement to the hundreds of spectators still lingering about the building.

The examiners will continue their work of testing for several days, and perhaps weeks, and for that purpose the engines will be kept at work, but no one is to be admitted to the building except on business connected with the work of the examiners or for the removal of exhibits.

At a meeting of the Franklin Institute, shortly after the close of the exhibition, Colonel Charles H. Banes said the profits from the exhibition would be about $10,000, and that 13,162 pupils from the public schools of this city visited the exhibition, and pupils from sixty-five colleges and schools outside of the district. The total number of visitors was 285,000. Of this number 22½ per cent. was complimentary, being mostly members of the Institute. The largest number in attendance was 17,047, on October 7th, and the smallest, 2,880, on September 3d. The average attendance was 8,507.

Although the October issue of the ELECTRICIAN AND ELECTRICAL ENGINEER contained descriptions of a great many of the exhibits at the exhibition, there are still others that deserve mention. Among these are the "Electric Clocks," of which no less than four different systems were represented, each serving a different purpose. Some of the clocks shown are really electric motors driven by electricity but governed by the pendulum. Another class, known as time telegraphs, is composed of regulating clocks driven by weights or springs, which transmit their motions to dials by a current of electricity. Another system uses a current of electricity to govern or correct the time of other mechanical clocks from a central regulator; and, finally, a telephone clock is exhibited which transmits to telephone subscribers the exact time by means of sound.

There were quite a number of "Time Locks," "Watchmen's Time Detectors," etc., on exhibition. The time lock for safes was represented in the gallery by W. E. Pierce, of Philadelphia. In this time lock the movement of the hands makes an electric contact which releases the bolts of the safe and allows them to respond to the proper combination. Two clocks are used, one of which may be set to any desired hour, the other being used for opening the safe at a particular hour if the first should become inoperative. The battery and wires are included inside the safe.

J. S. Bailey, of Pennsylvania, exhibited a despatching clock for use on street or other railways. Upon the dial are arranged concentric rings, divided into any desired number of sections, with the intervals so arranged as to allow of the insertion of small pins. These pins serve to electrically connect with the minute hand of the clock. As contact is made a gong may be struck or a signal displayed at any desired minute of time. By an automatic arrangement the contacts on the hand may be shifted so as to reach the pins set upon the inside of the concentric rings, instead of the outside. This allows a change of time of starting on Sundays from that on other days.

The American Watchman's Time Detector consists of a paper dial ruled radially for the hours, which is revolved like the hands of a clock before a series of electro-magnets. Each of these magnets carries an armature provided with a steel stylus, which indents the paper when the circuit is closed. The watchman is required to close the circuits at regular intervals, and from suitably placed boxes on his route. The dial is locked up in the superintendent's office and reveals on the following morning any neglect. One of these dials used by the night watchmen at the exhibition is in actual service by the exhibition managers. It is the invention of Mr. G. H. Ransom, of Cleveland, Ohio.

The Novelty Electric Company exhibited the Fuller and Holyer Watchman's Time Detector which punctures a paper disc in a similar manner, also Ahern's Instantaneous Watchman's Detector, which rings a bell in any desired position if the watchman neglects his duty, thus immediately notifying his employer of his neglect. A tell-tale for the use of pilots is also shown, which is intended to be connected with the go-ahead and reversing gear of the engine of steamships. Two electro-magnets act upon the same armature. By the movement of the throttle the current is switched into one or the other of the magnets, causing a movement of the armature and a consequent signal upon the dial of the apparatus on the bridge.

The "Electro Medical Apparatus" on exhibition was quite plentiful.

Otto Flemming, of Philadelphia, exhibited a great variety of medical batteries, adapted for all the various uses, including large cabinet batteries, such as are used in hospitals, supplied with every possible convenience and appliance for interrupting, reversing, measuring and modifying the current. The ordinary small and compact medical batteries and cautery batteries, used for surgical operations, are shown. Two Toepler-Holtz static electrical machines, and a Dubois-Reymond coil are also noteworthy. The cases of electrodes shown comprise almost every form of modern electrode. The Jerome Kidder Manufacturing Company, of New York, exhibited a case of the batteries and electrodes manufactured by them, including the various forms of plunge and tip batteries for immersing or removing the plates from the electrolyte. The Smee and the bi-chromate batteries are the forms employed. These are included in physicians' portable batteries of various forms, and adapted to all the various uses of medicine.

James Glass, of Philadelphia, had also a full display of medical batteries and faradic machines of a variety of forms, as well as electrodes suited to various applications of electricity.

The Smith & Shaw Electric Company, of New York, exhibited two forms of bi-sulphate of mercury batteries. The pocket cell battery has the cell composed of hard rubber, in which is included one element. When not in use it is stoppered with a rubber cork. The zinc electrode is furnished with a similar cork, so that when inserted in the cell it forms a complete stopper to the cell, and consequently all spilling of the fluid is avoided. The dumb bell battery is of similar construction, but is made in the form of the ordinary dumb bell, that its use as a generator of electricity may be combined with gymnastic exercise.

The S. S. White Dental Manufacturing Co., of Philadelphia, exhibited various forms of incandescent lamps adapted to the examination of various cavities of the body, including the mouth, the nose and the larynx. These consist of a mirror set at a suitable angle, in the handle of which, directly in front of the mirror, is a tiny incandescent lamp. The mirror being placed in proper position the current is switched into the lamp, when the light is reflected by the mirror over the walls of the cavity it is desired to examine. The observer's eye is shielded from the direct rays of light by the handle of the instrument. The lamps are of the Edison type and are similar to those used for the illumination of microscopic objects by Walmsley & Co.

They also exhibited a historical display of electro-magnetic dental engines, the inventions of Green, Star and Bonwill, and manufactured by them. The electro-magnetic engine is simply a motor adapted to the drilling, grinding, polishing and filling of teeth. The earlier forms were all "pluggers" or mallets delivering a great number of blows with an instrument which can be held in the hand and directed like a pen. The Griscom double induction motor allows the use of electricity for all the various purposes of modern operative dentistry. It is mounted upon one end of a flexible shaft whose extremity is adapted for the reception of various tools.

Dr. W. G. A. Bonwill exhibited a historical display of his inventions, including the electro-magnetic and the mechanical mallet used with his surgical engine. A variety of forms of the surgical engine were shown from the earliest form to the latest improvements.

The Bowman Fire Hose Telegraph is designed to allow the pipeman to communicate with the engineer. Enclosed in the interior of each section of hose is a communicating wire which forms a connection by simply screwing the sections together. A spring is arranged upon the nozzle of the pipe which completes the circuit to an electric bell at the engine, the ringing of which directs the engineer to supply more or less water as occasion requires.

Now that the "Exhibition" is over, we can find a little time to devote to other matters. "Underground Telegraphy" seems to be the all-absorbing question hereabouts just at present and in a few weeks the Baltimore and Ohio Telegraph Co. proposes to lay an ordinary six-inch water pipe on Chestnut street, from Fourth street to the Delaware, and on Second and Third streets, between Market and Walnut, for the purpose of testing an underground telegraph system. The Western Union Telegraph Co. is doing nothing in this direction. The cable of the Standard Underground Cable Co, containing 2 wires, and laid in Fairmount Park, from the Belmont pumping station to the Belmont Reservoir, has been tested and operated very successfully for telephone purposes. The system is known as the Waring patent, and is in operation in Washington, D. C., and other cities. The cable in the park is about a mile in length, and contains 2 small wires.

PHILADELPHIA, Oct. 19th, 1884.

CHICAGO.

Priority of Inventions.—Devices for Raising and Lowering Arc Lamps.—Another New Insulating Material.—Telephone Claimants.—More City Legislation Against Overhead Wires.—Proposed Illumination of a Racing Park.—The Chicago and St. Louis Post-Offices Not Yet Lighted by Electricity.

IN the matter of inventions it is becoming every day more difficult to decide who was the originator of some particular device in electrical, no less than in other classes of mechanical applications, and in the former category there are just now more "Tichborne claimants" than in most others. No sooner does some one announce that he has arrived at an important result, or has made a suggestion which is likely to bear electrical fruit, than some unsuspected party, like a jack in the box, pops suddenly up and lays claim to the device, the conception or the suggestion. I am reminded of this fact quite forcibly by the remarks of Prof. Rowland before the National Conference of Electricians, in considering the subject of "Lightning Protection," when, according to the published report, he presented Maxwell's ideas. These, according to the learned professor, are so similar to the system described in an article, page 161, of the present volume of this journal, and accredited to M. Melsens, of the Belgian Academy of Sciences, that the question naturally arises: "Which is the justice, and which is the" —— other fellow? So, again, of the suggestions of light standards. Prof. Draper long since mentioned platinum, heated by an electrical current, as a standard, and Schwendler has subsequently proposed the same thing. It was also suggested in October, 1879, in *La Lumière Électrique*, by a correspondent who made the suggestion without knowing of Draper's proposition until sometime afterward, and who at the time of writing supposed himself the sole possessor of the idea—the original Dr. Jacob. There is one vexed question in arc lighting—that branch which a friend has designated as "domestic arc lighting"—the hanging of lamps so that they may be lowered and raised readily for trimming and adjusting. To avoid the long, ungainly loops of wire leading to the lamp, which swing ungracefully and with more or less danger of "ground," from rods, awnings, etc., outside of buildings, and are untidy as slack clotheslines indoors, and at the same time allow of perpendicular variation—this has been evidently a hard problem, judging by the various attempts at its solution. First comes the long loop, swinging in the wind, and menacing the passer-by with a sort of hangman's threat. Then a cross bar with a counter weight, to take up the slack when the lamp was in place, but which yielded when the lamp was hauled down, and permitted the descent of the latter. Then came a naked cable arrangement one end of which either side the lamp ran over a metal pulley to which the line wires were attached, so that in whatever position the lamp might be, the contact, from line to pulley, naked cord and lamp was always maintained. Weights at the free ends of this cable balanced the lamp. Next, an arrangement substituted for the last, naked wires not being allowed by the Chicago ordinance, and which is doing good service. In this form the line wire is brought to the metal shaft of the roller. The roller is double, one half winding the balance cord when the lamp is pulled down, its winding being reversed to that of the cable, which runs from the lamp to the roller shaft. So much for one half of the lamp, and the other half is similarly arranged, the whole brought to the hanging board, which is fastened to the wall in the ordinary manner. These two forms emanate from the Vandepoele Co. But the end is not yet. Messrs. T. & J. W. Ward, of Chicago, have applied for a patent on an irregular six-sided box, the upper side having a larger face than the other sides, about 14 inches long and 6 inches high. Two terminals attach to the lamp cords, a small cord controlling a ratchet dog within the box, the conducting cords being wound upon the shaft, or rather 2 shafts, one within the other, in such a manner that when the lamp is drawn down, the slack is furnished by one of these, and when the lamp is run up, the unwinding spring takes up the slack, while the ratchet dog holds the weight of the lamp. The best point in this arrangement is the fact that the cords are perfectly insulated from both frame and shaft, the connection being made directly to the lamp on either side. This comes from the Excelsior people, Mr. J. W. Ward being their manager here.

One more insulated wire has made its appearance, since my last, which for low current is as good as any of the many which have latterly come to the surface. It is waterproof and flexible, but like the "great majority," will burn. In this statement permit me in parenthesis to say there is no reference to Calvanism. The insulating material in this instance is gum copal, treated chemically by a process only known to the inventor, who claims that he can thus produce a cheap, and it certainly *is* a good, insulated wire for everything but dynamo currents. What we most earnestly desire, and as positively need, is a flexible, fire and waterproof wire for these currents. The experience of the Delany multiplex, at the Philadelphia Exhibition, where the regulations governing the installation of wires proved a dead bar to the success of that exhibit, instances this in a very marked degree. In this case the rules were so altered as to permit the use of paraffin wire, and required one entire Sunday's labor, changing from fire-proof to inflammable insulation.

It seems as if the telephone controversy is doomed to have as many lives as are usually attributed to the cat family, and that family the Kilkenny variety. It begins to look as if the monopoly's success will really be better for the community than its defeat, for should the Bell company be overthrown, the avalanche of telephones and "hello" systems which will follow will be overwhelming, for these are as plenty as washing machines and churns. But should the Bell claims be sustained, there may be peace in the land, though purchased at monopoly prices. There is, however, I think, one system which may yet loom up, after the Drawbaugh case is settled, but of which I am not at liberty to say much just yet, embodying new points and principles which have not thus far been subjected to the crucial test of wig and gown-points which are claimed to be entirely without the bailiwick of the Bell company.

The central plant idea received a set back at the last meeting of our council, through the adoption of an order instructing the City Superintendent of Telegraphs and the Commissioner of Public Works to put a stop to all crossing of streets and alleys until further orders from the council. I think this order will be modified so soon as some practical and uniform method of handling the matter can be devised. Several central plants of no mean dimensions are ready to commence as soon as the franchise matter can be settled. In the meantime I learn of an arc plant of 350 lights on the Jockey Club Racing Park grounds, which has been contracted for jointly by the Excelsior and Western Electric companies. It is refreshing to see some fraternal feeling cropping out among "electricity manufacturers." It somehow or other always looks as if the subtle current permeated the personnel of the companies as well as their machines. I presume it's in accordance with the law of electrical attraction and repulsion—like repels like. The moral effect of this enterprise may very likely become a matter of serious import. The main object to be attained by turning darkness into day on a race track is to afford an opportunity for many who cannot spare time during daylight to attend the class of entertainments which may be given out of doors, upon spacious grounds away from the heart of the city. Races of all kinds, out-of-door concerts, summer garden varieties, etc., are contemplated, and should these be conducted properly the enterprise must be a grand success, and under proper restrictions and management, a very attractive and popular resort may be the result. Time alone can tell.

Permit me to check another evidence of premature newspaper enterprise on the part of an electrical journal. Despite the statements recently made, the Chicago post-office is *not* and the St. Louis post-office is *not* illuminated by electricity. They are both being wired by the United States people, and by another month or so will be so lighted. Up to this date not a spark has been generated for the use of either plant, and the engine for Chicago has not yet arrived.

CHICAGO, Oct. 14, 1884.

BOSTON.

The Daft Electric Railway at Mechanics' Fair.—Electric Lighting Exhibits.—A Boom in Bell Telephone Stock.—The Fuller Electrical Co.—Subscribers' Attempts to Improve the Blake Transmitter.—Preparations for the Electrical Exhibition.—Affairs of the Erie Telephone Co.—Gradual Dissolution of the Lowell Syndicate.

AMONG the principal attractions at the Mechanics' Fair Building, on Huntington avenue, is the electric railway, carrying passengers day and evening, operated by the Leo Daft generator and motor. The exhibit is made by the Massachusetts Electric Power Co. The generator obtains its power from a shaft which supplies motion to the general machinery at the exhibition, and is bolted to the floor, covered wires running to the iron rails of the road. The motor is located in a box-like structure (with a "cow-catcher" in front) upon which, on an easy seat with the governing switches directly before him, sits the "motoneer." The motor is attached to a convenient and pretty car, in which the passengers sit back to back. It is well known that the Daft dynamo is a combination of the Siemens and Gramme types with improvements; a low tension current being generated. These parties state that it costs $6.50 per day to run a street car in Boston, and that by electricity the same work could be done for $1.35, which is surely margin enough for profit. The company has at present in Boston one central generator located at 72 Federal street, connected to receivers in a printing office and a stamp works. Other installations are contemplated.

The fine art gallery at this fair is illuminated by the Edison incandescent lamps; their dynamo in the basement receives its power from an Armington & Sims steam engine. The general building is lighted by the American Electric & Illuminating Co., using the Thomson-Houston arc lights.

The arguments of the counsel for the Bell side in New York, in the celebrated Bell vs. Drawbaugh case, seem to have been very convincing to the friends of the present "monopoly"; the stock of the company which had been fluctuating between 155 and 160, rose in sympathy with the bracing tones of Messrs. Storrow and Dickerson's voices to 189, at which figure a few cold mortals not lifted to the clouds by heated anticipations dropped one share or so, expecting to realize during the wait for the decision of Judge Wallace. From what I can gather, the expectation is quite general that the final decision is not a great way off. I heard of one broker saying that he was anxious while he held any of the Bell stock, for fear the stuff would be worthless, and

yet could not sleep nights for thinking how badly he would be "left" in case the Bell company won the suit. Two years ago the stock went to 200, on a "gamble"; in the event of success that figure would seem small, by comparison.

At the Institute Fair, one can scarcely turn a corner, without seeing one of the Fuller Electric Co's dynamos. They have a very handsome exhibit; beside the machines "around loose," they have six of various sizes as one exhibit, all running in a very animated manner. Their arc lamps are liberally distributed about the building. Mr. J. N. George, formerly superintendent of the Boston Telephone Exchange, is the Boston agent for this company.

Boston and vicinity have been flooded during the last two months with "resonators" to be applied to the mouth-piece of the Blake transmitter, with careful instructions for the use of the same Parties who denounce the high prices for telephone service, cheerfully roll out two dollars for a resonator. The telephone exchange people grumbled about their use until the American Bell Co., investigated the matter, and gave orders that the appliances should come off, and no more be put on. The new quarterly list of exchange subscribers contains a page of "caution" to patrons, warning them not to purchase such things. The exchange people say that when the resonators are on the transmitter, an adjustment of the electrodes should be made, and as the subscribers take the resonators off and replace them optionally, the transmitters are never properly adjusted, and the operators are subjected to delay and annoyance. Some of the subscribers state that they have had good success in speaking at long distances with the resonators. Of course in these things the patent claims are on details, and as they can be varied extensively, a large crop of them may be expected.

Preparations for an electrical exhibition in the building of the Mechanics' Fair are being made; it is announced to open Nov. 24, after the present fair has closed its season. Many of the Philadelphia exhibits are expected. The building offers superior advantages for an electrical exhibition, there being plenty of room and light. There are engines' shafting and every appliance for power; the basements are roomy and convenient for locating dynamos and heavy machinery, enabling exhibitors to avoid communicating the vibrations of such apparatus, to the inconvenience of their neighbors, as has been the complaint at Philadelphia. Coming so late in the season and after other similar attractions, of course there will not be quite the novelty there otherwise would be, but in any event the "subject matter" of the exhibition will attract a good attendance.

Erie telephone stock is dull, its heaviness arising presumably from information of the inside working of affairs. The directors have been at loggerheads for some months, and matters have been left at loose ends to such an extent that rumor says the report for the quarter just ended will show a heavy increase of expenses and corresponding decrease of net receipts. It is said that since the general manager resigned, the whole board of directors has undertaken the management. At an excited meeting in Lowell, the 16th inst. Mr. Ingham resigned his position, thus leaving Mr. Glidden, as the only representative of the notorious syndicate. It is said the Erie company is largely in arrears to the American Bell Co., for royalty on telephones. If the latter company should foreclose, the former would be in the condition of a shop-keeper without goods. At this meeting the probability of the property being placed in the hands of a receiver was suggested.

General Manager L. N. Downs, severed his connection with the New England Telephone Co., October 1st. Vice President Ingham, succeeds Mr. Downs *ad interim*.

BOSTON, Oct. 18, 1884.

WASHINGTON.

Rejection of the Experimental High Lighting System.—Overhead Wires not to be Tolerated.—The Value of the Arc Light as a Bug Catcher.—Important Discoveries of Unknown Insects, and Increase of the National Collections.—Local Telegraph Affairs.

THE 45 days' experiment, by the Brush-Swan Electric Light Co. of this city, of lighting Penna. avenue, which is our principal thoroughfare, by the high-light projecting plan, terminated with the close of last month by the rejection of the system by the Commissioners of the District; and the avenue is again dependent upon the gas company and the moon for its illumination. At the termination of the Brush-Swan contract the United States company (local) submitted a proposition to light the avenue and certain other streets for a year without charge, provided permission was given them to run air lines for the purpose, which would incidentally enable them to reach private establishments with their wires, but the authorities are so wedded to the underground system that this liberal offer was refused.

The Brush-Swan Co. has expressed its determination to lay underground wires but has taken no steps in that direction as yet. Meanwhile its apparatus is lying idle.

A curious effect of the brilliant lights displayed from the dome of the Capitol was the collection of myriads of insects of every known and many unknown species, which almost filled the air surrounding those lights. With these came the spiders, and in the absence of rain during the entire period, these multiplied with astonishing rapidity; their webs covered the building and were soon filled with the carcasses of insects to such an extent as to give to the building an ancient moss-covered look, as though it had withstood the ravages of time for a century, although the white marble surface had all been gone over and cleaned with sandstone earlier in the summer. So injurious to the appearance of the building was this conglomeration of insect remains that the removal of the electric lights of the United States company (ordinary 2,000 c. p. lamps, which light in pairs the three approaches, north, west and south) is contemplated.

Like every other evil these insects brought their grain of good, and the entomologists were made happy. Large additions were made to the collections at the National Museum and the Agricultural Department, many of them insects never before seen in this locality, picked from among the mass that perished and fell upon the roof nightly. The insect nuisance is likely to be one of the features to be taken into consideration in the introduction of the electric light.

The Baltimore & Ohio Railroad Co., after repeated postponements, caused by the varied changes in the attempts at consolidation, has commenced the demolition of the building it has so long occupied as a telegraph and ticket office, corner 14th street and Penna. avenue, and a new and handsome structure will soon take its place.

In telegraphic matters things seem to have settled down to legitimate competition between the Balto. & Ohio, and the Western Union companies. The status of the Bankers and Merchants is not such as to draw much new business, and what it gets is due more to the popularity of the manager than to good will to the line. The Mutual Union "alibi" does not seem to meet with much success, its real character being very generally understood.

WASHINGTON, Oct. 19, 1884.

PROVIDENCE.

Public Telephone and Messenger Office.—The District Companies.—The Cutting of Rates by Competing Telegraph Companies.—The Baltimore and Ohio Telegraph Company.

THE project of the public telephone office mentioned in my last letter has assumed definite shape, although the details have yet to be arranged.

The Southern New England Telephone Co., has leased a fine office on the fashionable thoroughfare nearly opposite the office of the Baltimore and Ohio Telegraph Co., and will run in the two copper wires which are now working between Boston and New York, and open for public business. Whether or not the Providence Telephone Co. will place their messenger business in the same quarters is as yet undecided, but it is believed that such an arrangement will be consummated.

The Providence Telephone Co. is conducted on business principles, and as its nearly 3,000 subscribers can testify is managed with rare skill and is eminently successful with its plant. Its superintendent is an old telegraph man who will be quick to discern any advantage which may accrue to the company by the establishment of a large district plant. It is true that the District business is now pretty well cut up. The Providence District Messenger Co., has now nearly 600 boxes in operation, and is industriously extending its system. It has an exclusive contract for five years with the Baltimore and Ohio Telegraph Co., at a good figure, for the collection and delivery of messages, but I hear that this contract has not interfered with their taking messages to the Western Union when the customer so directs. The Western Union has 2 or 300 boxes in operation, and the Bankers and Merchants a little larger number. The Bankers and Merchants' company is rebuilding its entire district system. It is substituting the new black rubber, closed circuit boxes for the old open circuit "Rapid" boxes, which have been in use 3 or 4 years. From this I should argue, that although in the hands of a receiver the B. and M. does not intend to give up business. The change will make the system one of the best if not *the* best in the city. I hear that the company intends to put in not less than 500 of the new boxes. The three commercial companies here are busily engaged in cutting rates. The B. and O. opened the war on the 27th ult by making the rate to New York and all its New England points 25 cents for 20 words. This cut was quickly followed by a similar reduction on the part of the B. and M. The Western Union advertised no reduction, but privately notified customers that it would carry to Boston 10 words for 15 cents. In spite of this, I hear that strangers were mulcted at the regular rate of 25 cents for 10 words unless they made a protest, when the new rate was given. A feeble attempt was made to play the Mutual Union foil by a branch office in the Butler Exchange, where customers were told they had four wires, and could handle business promptly. Telegraph men knew that this office was on a single loop, hence the four wire story had a very diaphanous foundation.

Customers tell me that all the companies are adopting the pernicious system of rebates, and that large competition discounts will be given to secure trade. To-day both opposition companies are advertising a rate to Boston of 15 cents for 10 words. To-morrow we may see another cut. These reductions have had a disastrous effect upon the Multiplex company, which although it has a still lower rate of 25 words for 20 cents, is unprovided with a call bell system and is forced to see its business dwindle away. The upshot of the whole matter will be that a combination will shortly be made, rates will be put back to a high figure, and the public have again an opportunity to meditate upon the unstable philanthropy of corporations. The B. and O. office here reports in the stock phrases of opposition lines to be doing a great business. It certainly has an elegant office, handsomely furnished, but the job of running in its wires particularly to the switch which is in plain sight of customers, is not a piece of work which would take the first premium at the World's Fair. This company's Boston line is still incomplete. Its building which was started so vigorously seems to have received a sudden quietus. At the Bankers and Merchants' office it is said that the legal complications which were annoying the company in this city, have been adjusted, and that business is running along smoothly.

PROVIDENCE, Oct. 16, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city*

THE ALLEGED GREEN ELECTRICITY REPUDIATED.

[23]—In the September number of the ELECTRICIAN AND ELECTRICAL ENGINEER, page 184, you published an extract from the *Adrian, (Mich.) Times*, relative to "amateur cyclones," produced by Prof. Douglass, of the State University of Michigan. The following from Prof. Douglass, should I think, be put on the track of that statement. C. C. HASKINS.

Chicago, Sept. 23, 1884.

[COPY.]

"Dear Sir: Yours of Sept. 20 this received. The article you refer to I am in no way responsible for. I have never perpetrated any such nonsense, and do not know who is the author of it."

Yours truly, SILAS H. DOUGLASS.

Ann Arbor, Mich., Sept. 22, 1884.

A DYNAMIC BUT NOT A LIGHTNING PROTECTOR.

[24]—In your number for Sept., T. D. Lockwood asks for information relative to my statement, that with electro-magnetic protectors, before the armature can be moved and ground the line, enough current will have passed to do the damage.

He tried it with a Brush dynamo, and it protected every time. Hence he concludes that the device is a safe one.

So it is, as a protection against dynamos. But as atmospheric electricity is infinitely higher in tension, and very limited in volume, the apparatus is worthless against atmospheric storms. I know it, for I learned it by sad experience, over thirty years ago.

C. H. HASKINS.

Milwaukee, Sept. 23, 1884.

QUESTIONS AND ANSWERS.

[43.] **Effect of Electric Arc.**—W. A. V., Cleveland, O., asks:—Is there any substance such as asbestos, for example, which will not fuse or decompose in the electric arc? **Ans.**—Every known substance is either fused or volatilized by the heat of the electric arc.

[44.] **Danger from Electric Light Wires.**—J. W., St. Louis, asks:—Whether it is true, that there is any danger to firemen in the discharge of their duties, from electric light wires with which they may happen to get in contact. **Ans.**—Practically no danger at all. It is possible that remote contingencies might occur, which could render such a result possible, a statement which would be equally applicable to steam boilers or horse cars. Although electric light wires are now numerous in all large cities, there has as yet been no instance recorded, of the injury of any person not an employé, except in case of wanton and inexcusable meddling with the wires, and we think this is sufficient to show that there is no real basis for the statements of sensation mongers such as the one you enclose.

[45.] **Renovating the Leclanche Battery.**—J. W. P., N. Y., writes:—I have a battery of several Leclanché cells (disc form), which have been filled too full and the solution has overflowed the porous cups. What can be done to remedy the difficulty? **Ans.**—Soak the porous cells thoroughly in warm water acidulated with muriatic acid.

[46.] **Electrical Engineering.**—T. F. L., Brooklyn, E. D., N. Y., says:—I would like to become an electrical engineer. Will you please inform me how I can? **Ans.**—See our reply to question 16, page 93 of present volume of ELECTRICIAN AND ELECTRICAL ENGINEER (April number).

[47.] **The Dynamo, How Made and How Used.**—J. P. McC., Cincinnati, Ohio, writes:—Having become interested in the articles under the above title which appeared in your journal in November and December, 1883, I beg to remind you of their non-completion. I hope that this subject will be taken up and continued until we are made familiar with the latest developments in this direction. I can assure you many others share the same wish. **Ans.**—We commenced negotiations with the author for the right to re-publish this series of articles in full, but upon learning that they would appear in book form at an earlier day than we could possibly complete them with the space at our command in this journal, we decided not to resume their publication. We are informed that the work will be ready shortly, of which due announcement will be made.

[48.] **Books on Electro-Metallurgy.**—E. E. B., North Attleboro, Mass., writes:—What are the best books on electro-metallurgy, which begin at the beginning and give all the information necessary to make a thoroughly practical colorer and electroplater in all branches, including fine gold, red gold, silver, nickel, oxydizing etc. **Ans.**—The following are the leading works on this subject. Gore's *Art of Electro-Metallurgy*, $2.50, Urquhart's *Electro-plating*, $2.00, Watt's *Electro-Metallurgy*, $1.00, and Wahl's *Galvanoplastic Manipulation*, $7.50. The publishers of this journal will forward any of these books upon receipt of price. The last named work is the most recent as well as the most extensive and complete. Either of the smaller works will however, serve a very good purpose.

ELECTRICAL NEWS AND NOTES.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The Association of Railway Telegraph Superintendents held their third annual meeting at Philadelphia on September 17th. Representatives from fifteen railway companies were present, and thirteen new members were elected. Several changes in the constitution were recommended by the committee appointed for its revision, and after considerable discussion, adopted. The most important question brought up was upon telegraphic train orders, and the authority of telegraph superintendents in that branch of the service. The majority were of the opinion that they should have charge of everything appertaining to telegraphic orders through the chief despatchers, and division operators Others believed that the despatchers should be under the jurisdiction of the transportation department, excepting so far as their duties were devoted to circuit management.

Resolutions of thanks were adopted complimentary to the retiring president, Mr. W. K. Morley, for his successful organization of the association. The following officers were elected for the ensuing year: C. Selden, Baltimore, President; E. C. Bradley, Columbus, O., Vice-President; P. W. Drew, Chicago, Ill., Secretary and Treasurer.

Cleveland, Ohio, was selected as the next meeting place, June 17th, 1885.

AMERICAN TRAIN DESPATCHERS.

W. M. Marshall, president of the American Train Despatchers' Association, in accordance with the resolution passed at the annual meeting, has appointed a committee of over fifty names, representing despatchers on all of the leading lines of the country, with R. B. Woolsey, chairman, St. Louis, Vincennes and Terre Haute Railway. The committee is to make a report on uniform train orders and station telegraph signals. In his circular Mr. Marshall says:

"It is desired that each member of the committee will communicate fully to the chairman his views in regard to a uniform system of orders for running trains by telegraph, and a uniform station telegraph signal, inclosing copies of such orders as he is in favor of having adopted, stating the signal he prefers, and, if a stationary signal, whether it should when not in use, stand at all right or danger.

"Giving fully the reasons why he favors such orders and signals, and stating whether or not they are in use by the road on which he is employed.

"I would suggest that when this letter has been prepared it be submitted to the superintendent of the road which the member

represents, with a request that he will signify if it meets with his approval, and if, when the association has adopted a code of orders, he will recommend their use on his road.

"I will be glad to hear from persons not on the committee in regard to this subject, and if their views are of sufficient importance they will be presented to the committee and taken into consideration at the next meeting of the association."

TELEGRAPH LITIGATION IN TEXAS.

A press despatch from Texarkana, Ark., Oct. 15, says: The contest between the Baltimore and Ohio Telegraph Co. and the Western Union Telegraph Co. over the attempt of the former to extend its rival system of telegraphs into Texas has been raging with more or less violence for the past 30 days. The general telegraph laws of Texas are very favorable to competing telegraph lines, and under those laws the Baltimore and Ohio Telegraph Co. instituted proceedings to condemn a right of way between Texarkana and Sherman over the Texas and Pacific Railroad. The court awarded the railroad company $10 per mile damages, but gave the Western Union Telegraph Co. nothing. The Baltimore and Ohio Telegraph Co. deposited with the court the amount of the award and constructed its lines upon the Texas and Pacific Railroad. The Western Union Telegraph Co. then applied to Judge Gaines, of the Texas State court, for an injunction to restrain the Baltimore and Ohio Telegraph Co. from occupying the Texas and Pacific Railroad Co.'s right of way through Lamar County until further adjudication of the condemnation proceedings. The injunction has just been denied, the court holding that commissioners having made an award, and the amount been deposited with the court, the construction of lines could proceed without further hindrance. The Western Union also applied to Judge Gaines for an injunction to restrain the Baltimore and Ohio from prosecuting condemnation proceedings in Fanning and Red River Counties; also to Judge Estes for a similar injunction as to Bowie County, on the plea that they should be protected from a multiplicity of suits. These applications were also denied.

STATISTICS OF THE WESTERN UNION TELEGRAPH CO.

Year.	Miles of Poles and Cables.	Miles of Wire.	Offices.	Messages.	Receipts.	Expenses.	Profits.
1866..	37,380	75,086	2,250				
1867..	46,270	87,391	2,565	5,879,282	$6,568,925 36	$3,944,005 63	$2,624,919 73
1868..	50,183	97,594	3,219	6,404,595	7,004,560 19	4,362,749 32	2,641,710 87
1869..	52,009	104,584	3,607	7,034,933	7,316,918 30	4,568,116 85	2,748,801 45
1870..	54,109	112,191	3,972	7,157,646	7,138,737 09	4,910,772 42	2,227,965 54
1871..	50,032	121,151	4,606	10,046,077	7,637,448 85	5,101,787 19	2,532,661 66
1872..	62,033	137,199	5,237	12,444,499	8,467,095 77	5,666,863 16	2,700,232 61
1873..	65,757	154,472	5,570	14,450,832	9,383,018 51	6,575,055 82	2,757,962 69
1874..	71,585	175,735	6,188	16,329,356	9,202,053 08	6,755,789 88	2,506,920 15
1875..	72,833	179,490	6,565	17,158,710	9,564,574 60	6,335,414 77	3,229,157 83
1876..	73,533	183,832	7,072	18,720,567	10,034,089 66	6,635,473 60	3,399,509 07
1877..	76,955	194,323	7,500	21,158,041	9,812,352 61	6,672,224 94	3,140,127 67
1878..	81,002	206,382	8,014	23,018,894	9,861,355 23	6,309,812 53	3,551,542 70
1879..	82,087	211,560	8,534	25,070,105	10,959,649 46	6,159,209 37	4,800,440 09
1880..	87,945	223,534	9,077	29,215,500	12,782,804 53	6,948,956 74	5,833,937 79
1881..	110,340	267,171	10,737	32,500,000	14,808,543 85	8,488,264 13	6,908,279 72
1882..	131,000	374,308	12,068	38,842,347	17,114,105 92	9,996,005 92	7,118,070 00
1883..	144,294	432,726	12,917	41,181,177	19,454,902 98	11,794,553 40	7,660,348 58
1884..	145,037	450,571	13,761	42,076,220	19,032,939 60	13,032,503 90	6,610,435 70

THE WESTON MAMMOTH INCANDESCENT LAMP.

THE United States company has recently installed several plants equipped with Weston's new incandescent lamp of 125 candle-power. One of these is in the basement corridor of the Equitable building at 120 Broadway, and consists of a small dynamo and 12 lamps arranged in multiple arc. Seven of these lamps displace the 5 arc lamps formerly used and are found to give a much better distribution of light.

Another plant of 20 of these lamps has been running for some weeks in the waiting room and restaurant of the Broad street station of the Pennsylvania railroad in Philadelphia. These lamps are fed by a Weston arc dynamo, and are arranged in 5 series of 4 lamps each, or 20 lamps in all.

A very fine installation has just been completed in the wholesale clothing establishment of Smith Gray and Co., on Broadway, Brooklyn, E. D., a new building perhaps 100 feet square. Two floors are lighted with 47 lamps of 125 candle-power each, arranged in multiple arc. Indicator cards taken from the engine showed a consumption of 0.4 h. p. per lamp; a very high efficiency.

THE TELEGRAPH.

Domestic.

A renewed long-time contract has been signed between the Western Union Telegraph Co. and the Chicago, Burlington & Quincy, whereby the Western Union has exclusive control of the wires of the Chicago, Burlington & Quincy lines.

The Atlanta Burglar-Alarm Co., capital $25,000, has been incorporated in Atlanta by W. D. Luckie, E. P. Howell and others, of Atlanta, Ga., to manufacture, own and operate electrical burglar alarm apparatus.

The fire alarm system of Boston has been greatly improved during the past few months, by the addition of three independent box circuits, so that now all the permanent fire companies, excepting those in East Boston, Dorchester and West Roxbury, receive the alarm direct from the box and do not have to depend, as previously, upon receiving the alarm from the headquarters at the City Hall. It is the intention of Superintendent Flanders to extend this system when an additional appropriation is secured.

Foreign.

The Exchange Telegraph Co., of London, which has had in use about 400 Edison printers for quotation purposes, has been consolidated with its competitor the Electric News Co., which has been in operation about three years The latter corporation has used the Van Hoevenbergh printer, which will now be adopted by the consolidated companies. A sufficient additional number of instruments are to be manufactured at the Silvertown works.

THE TELEPHONE.

The Rogers Telegraph & Telephone Co., which was incorporated in New York in April last, is a combination of the interests of the Pan-Electric and American Postal Telegraph Co.'s. Gov. J. W. Denver, of Ohio, is president, and J. Harris Rogers, of New York, supervising electrician. It's New York office is at 39 Broadway.

The Bell and McDonough telephone companies in Utica, N. Y. has served notices on the Baxter telephone subscribers that they will be prosecuted for infringing their patents.

ELECTRIC LIGHT AND POWER.

Domestic.

The contract for lighting the new steel cruiser Atlanta has been awarded to the United States Electric Lighting Co., of New York, and that for lighting the steel cruiser Boston to the Brush Electric Co., of Cleveland, Ohio.

The Reading Electric Light Co., Reading, Penn., has found it necessary to reduce its prices.

The Sawyer-Man Co., of New York, has recently established a plant of 100 incandescent lamps in the tack factory of the Thayer & Judd Co., at New Bedford, Mass.

The Brush Electric Light Co., of Cleveland, is putting in 575 Swan incandescent lamps to light the New Albany Woollen Mills, New Albany, Indiana, to be run from a Brush dynamo. The New Albany Woollen Mills are the largest west of Philadelphia.

At a meeting held at Columbus, Ohio, on Sept. 17th, the gas engineers of Ohio formed themselves into a State Association. A large representation was present and quite an animated discussion was held concerning the future rivalry of the electric light with gas. General Hickenlooper, of Cincinnati, was elected president of the association.

William McGowan was instantly killed at the Thomson-Houston Electric Light Co.'s engine rooms at Syracuse, N. Y., Oct. 22d.

The U. S. Electric Light and Power Co., Portland, Oregon, have just started their system of arc lights which is giving complete satisfaction. They use 3 Westinghouse engines of 60 h. p. each. They have a capacity of 150 arc lights which are to be increased and the incandescent system is to be generally introduced; the lights of the U. S. company were adopted after careful examination of the various other systems.

The Brush company's tower in Portland which was on exhibition for some weeks did not prove a success.

The tower lights of the Brush company in Victoria, B. C. have not given satisfaction to the people. There is no idea of abandoning electricity as a means of illuminating the streets, but it is strongly urged that the lights be distributed on poles in the usual way.

The Brush arc lights in San Francisco are giving much better satisfaction than they did up to a few months ago. The station has been overhauled and the power improved and the lights show a very marked improvement.

The Anaconda Mining Co. at Anaconda, Montana, one of the largest copper mines in the world, has adopted the U. S. arc light system after an active competition with the other companies; the plant is now being erected.

W. B. McAlister, Pembroke, Ontario, has recently purchased a 20-light arc machine of the U. S. company and a small incandescent machine. The arc lights were started a few evenings ago and gave such complete satisfaction and such a demand was made for additional lights, that the incandescent plant was exchanged for an additional 20-light arc machine to supply the demand for arc lights. The incandescent lights will be introduced later.

The Citizens' Electric Light Co., has closed a contract with the Akron Manufacturing Co. for the purchase of the latter's manufactory in Akron, O. The electric light company, which has a five years' contract with Akron to furnish electricity for street lighting purposes, will make extensive improvements in the present large building and will erect a brick power house adjoining.

The Daft Electric Light Co., of Greenville, N. J., recently sold the electric railway motor "Volta" with a dynamo and all necessary appliances to the Massachusetts Electric Power Co. The company is finding its resources taxed to the utmost to supply the demand for electrical apparatus for the transmission of power.

Foreign.

The gas company of Leipzig has received a concession from the municipality for a central station to generate electricity for both lighting and power.

Sugg's gas burners have been introduced into Hull, England, to take the place of the Siemens electrical system.

The *Gas Engineer*, commenting on the removal of the Jablochkoff electric lights from the Thames Embankment, says: "Beyond the illumination of a few private establishments, the electric light in London may be said to be *non est*."

Ottawa, Ont., is to be lighted by the Thomson-Houston system, under a contract with the Royal Electric Co. of Montreal, The power will be taken from the Chandiere Falls.

At the London Health Exhibition the electric light has been successfully used to light a baker's oven. This is the first time it has ever been applied to such a purpose A great difficulty has always existed among bakers to get a light into their dark ovens, so that the progress of baking might be observed. This application, of placing two incandescent lamps driven by a Victoria Brush machine inside an oven, where the temperature ranges from 400° to 600° Fahrenheit, is therefore a notable advance. The oven door contains a sheet of plate-glass, through which the whole of the oven is distinctly visible. The baker now never need burn his bread or pastry.

Trouve's electric lamp for surgeons obviates the necessity of shifting the light with each movement of the patient. The entire apparatus is attached to a frontal plate, padded on the inside and secured to the forehead by an elastic band or by springs like those of a fencing mask, or by means of a spectacle frame resting on the nose, or it may be fastened to a cap or other head piece. The lighting portion is mounted on the frontal plate by a ball-and-socket joint, the ball being united to a plate, which may or may not be furnished with a reflector, and which forms the end of a cylindrical casing, upon which fits a tubular socket carrying the source of light. It can be used in mining, etc.

MISCELLANEOUS.

Domestic.

A bill was introduced in the Vermont Legislature, Oct. 17, by the opponents of capital punishment by hanging, providing for the execution of murderers by electricity.

Charts of the geographical distribution of the lightning strokes for 1882 and 1883, prepared from our fire records, says the *Insurance Chronicle*, show that they are chiefly confined to that part of the country situated north of the Ohio river and east of the Missouri river. In both years 85 per cent. of all the strokes occurred within this area. In the southern states lightning seems to be comparatively rare, and seldom occurs outside of three states—Texas, Louisiana and Georgia. There seem to be two principal centres of electrical disturbance, from the fire underwriters' standpoint, and these are in the New England and Northwestern states. Sixty-five per cent. of the strokes happen in the summer; the remaining thirty-five per cent. are divided between spring and autumn in about equal proportions.

A press despatch from Norwich, Conn., says: A single flash of lightning struck an entire potato field of several acres belonging to N. J. Wood, of North Sterling, in Windham County. The vines turned yellow and sprawled over the ground. When Mr. Wood went to dig them, a few days ago, he found not a potato in the whole piece. It is the first instance on record here in which a growing crop was destroyed by the electric fluid.

H. H. Veitch, of Quinapoxet, writes to the *Manufacturers' Gazette* as follows: When the belts in a mill generate too strong a current of electricity, a little free steam permitted to escape into the room will stop it immediately. Managers of mills are obliged to do this every day in winter, and particularly so about the vernal and autumnal equinox. A belt passing out of one room into another will generate a current of electricity in proportion to the difference between the temperature of the rooms. Thus a belt running out of an extremely cold room into one extremely hot produces an exceedingly strong current of electricity.

Foreign.

The Brussels mail carts are now provided with electrical alarms, which give immediate warning to the driver of any attempt to get at the contents.

Señor Cruzada Villaamil, the Director-General of the Spanish Postal and Telegraph Service, has resolved to stimulate the interest of the porcelain and wire manufacturers, in order that the wires and fittings required for the various lines may be constructed in Spain and of Spanish material, thus avoiding the premium at present paid to foreign manufacturers the to prejudice of the home industries.

SUBMARINE CABLES.

A company has been organized to lay a cable from Brazil to New Orleans, via St. Thomas, to cost $3,000,000, which will work in connection with the Mackay-Bennett cables.

There are now in operation about 70,000 miles of submarine cables, of which 30,000 are duplexed by the Muirhead system, which is also to be used on the Mackay-Bennett cables.

One of the new Commercial cables and one of the Gould cables are broken about 1,800 miles from Land's End. Tests are being made to locate the exact position of the trouble which will require perhaps three months to remedy.

A new cable steamer, named the Mackay-Bennett, has just been launched from the Fairfield Shipbuilding Yard, Scotland, for service in connection with the new cables of the Commercial company. She is 270 feet in length, with a gross tonnage of about 2000, built of steel, has twin screws, and a rudder at each end.

The Dominion government will place the sum of $140,000 in the estimate during the coming session of Parliament to defray the expense of laying a cable between Nova Scotia and Sable Island. Owing to the rocky nature of the bottom over which the cable will run it will be necessary to lay a shore cable the whole distance, which will cost three times as much as an ordinary ocean cable.

It is stated that the Mackay-Bennett cable people will not materially lower their rates beyond the present tariff. It is, however, understood that a vigorous attempt will be made to secure the patronage of large cable customers by offers of heavy rebates on their accounts. This method of obtaining custom and practically cutting charges will be resented by the members of the pool, who assert that they will fully meet every move of this kind by proportionately low rates, and thus make the battle sharp and, it is hoped, decisive.

ELECTIONS AND APPOINTMENTS.

At the annual meeting of stockholders of the Gold and Stock Telegraph Co., Sep. 30, the old board of directors was re-elected (with the exception of Charles A. Tinker in place of Augustus Schell) as follows: Norvin Green, John Van Horne, T. T. Eckert, Jay Gould, William M. Bliss, Russell Sage, Charles G. Landon, C. A. Tinker, William A. Wheelock and George J. Gould.

At the annual meeting of the Great Northwestern Telegraph Co., of Canada, the following directors were elected: Chas. Tinker and E. Wiman of New York; Hon. Wm. McDougall, of Ottawa, A. S. Irving, Jas. Hidley and Wm. Gooderham, of Toronto; Richard Fuller and Adam Brown, of Hamilton; O. S. Wood, of Montreal. Erastus Wiman, of New York, was re-elected president, and Wm. Gooderham, vice president.

At the regular meeting of the directors of the Postal Telegraph and Cable Co., Oct. 10, Henry Cummins tendered his resignation as director and general manager. F. M. Gillett was elected director in place of Mr. Cummins. Henry Rosener was elected second vice president and General manager. George S. Coe, first vice president, made a statement to the board setting forth the present favorable condition of the company.

The directors of the Western Union Telegraph Co. organized Oct. 9 by the election of the following officers: President, Dr. Norvin Green; vice president and general manager, Gen. Thomas T. Eckert; vice presidents, John Van Horn, Harrison Durkee, George J. Gould; secretary, A. R. Brewer; treasurer, R. H. Rochester; executive committee, Dr. Norvin Green, Thomas T. Eckert, John Van Horn, Harrison Durkee, John T. Terry, Jay Gould, Russell Sage, A. B. Cornell, Sidney Dillon, Cyrus W. Field, George J. Gould, and Samuel Sloan.

PERSONAL MENTION.

J. Slater Lewis, of England, inventor of Lewis's improved insulator for telegraph lines, is now in this country.

Dr. Cornelius Herz, who is an American by birth, has been made a commander in the Legion of Honor, for services in the cause of electrical science. He is one of the first foreign scientists invested with this distinction.

Dr. Edward Davy, who is now living in the wilds of Australia, at the age of eighty years, was one of the originators of the electric telegraph in England, but others stepped in and reaped the reward.

MANUFACTURING AND TRADE NOTES.

William Coutie & Son, of Troy, N. Y., have set up a pair of their compound engines for the Electric Light company of that city.

John Brady, manufacturer of electrical machinery at 242 Plymouth st., Brooklyn, suffered a loss of $50,000 by fire on Oct. 20th, which, however, is fully covered by insurance.

Alfred Swadkins, of Chicago, is building the iron work for an electric tower 140 feet in height, to be erected at Elgin, Ill. He is also busy on the iron work for towers at Winona, Minn., East Saginaw, Mich., and other points.

Twenty-five miles of aerial telephone cable, for use on a line between Philadelphia and New York, are being made by the Western Electric Co., at Chicago.

Durkee & Keffer, of Chicago, are building two Harrington rotary engines for the Van Depoele Electric Light Co., to be used for running locomotive headlights.

The stockholders of the Palmer Wire Co. voted to increase the capital stock of the corporation $50,000, making a total financial basis of $200,000. The change was essential to the welfare of the company, and will place it in a position to do its business with more economy and to extend it in certain directions. The gain in sales during the first six months of the year over the preceding six months, was 82½ per cent. in weight and 42½ in amount.

The Armington & Sims Engine Co., Providence, is running full time and all the men it can work; is building three 16½ x 24-inch engines, 150 h. p. each, for the new station of the Brush Electric Light Co., of Boston. Having fitted the steamers Pilgrim and Bristol, of the Fall River line, it is now building two engines, 12½ x 10 for the electric light plant of the steamer Providence, of the Fall River line, with a number of other orders from electric lighting companies now in hand.

The Boulton Carbon Co., of Cleveland, has recently purchased the whole carbon plant, stock and good will of the United States Electric Lighting Co., of New York, and will transfer the same to Cleveland. To accommodate this addition to its business the Boulton company is erecting new buildings which, when completed, will make this the largest carbon factory in the world. It is expected that the whole factory will be in full operation by the first of November. This gives a capacity of 100,000 carbons per day.

FINANCIAL.

NEW YORK, Oct. 22, 1884.

While the uncertainty prevails which hovers over the pending decision of Judge Wallace in the Drawbaugh suit, there has been more activity in telephone stocks, and the advance in the Bell company's shares indicates that the widespread interests of that corporation will not be disturbed. A little more animation is also perceptible in electric light stocks. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Bell	181 00	184 00	Mexican Central	—	1 75
Am. Speaking	102 50	110 00	Molecular	8 00	9 00
Currier-Tele. Bell	2 00	5 00	New England	25 00	28 50
Colombia & Pan.	24 00	25 00	New York & N. J.	52 00	60 00
Continental	5 00	—	N. Y. & Penn.	41 00	75 00
Dolbear	5 00	10 00	Peoples	7 00	8 50
Erie	18 00	19 00	Southern Bell	—	175 00
Globe	4 00	5 00	Tropical	1 00	1 50
Hudson Riv.	80 00	90 00	W. I. Tel. & Telph.	1 00	1 25
Inter-Cont.	50	1 50			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Cable	53 50	55 50	Manhattan Telegraph	10 00	85 00
American Rapid	—	25 00	Mexican	125 00	147 00
Bankers & Merchants	1 25	4 00	Mutual Union	13 50	17 00
Com'l Tel. Co., common	10 00	25 00	Postal	2 75	3 00
do. preferred	91 50	120 00	do. bonds	26 75	27 50
Harlem Dist. Tel. Co.	—	2 50	Western Union	59 50	59 624

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
Brush	50 00	90 00	Edison European	1 00	5 00
Brush Ill.	30 00	40 00	Swan	15 00	40 00
Edison	45 00	55 00	U. S.	60 00	90 00
Edison Ill.	30 00	05 00	do. Ill. Co.	15 00	60 00
Edison Isolated	40 00	55 00			

The following answers to inquirers are from the *Miscellaneous Security Report*:

"The Underground Electric Cable Co. is a company organized under the laws of New Hampshire; capital, $1,000,000; par value, $100. Company said to own patents of Wm. MacMahon & Son, of Rahway, N. J., but not supposed to have any conduits or real property. Stock is reported to have sold from $25 to $183 per share. It is now offered in the market without any bids at $10.

Long Distance Telephone Co., organized under New York laws; capital, $1,000,000; shares, $50 par; managed by prominent business men; owns patents of Webster Gillett; claimed can converse distance of thousand miles distinctly as few miles by ordinary line; Treasury stock offered at $20."

A sale at auction of 400 shares Commercial Telegram Co. preferred, was made at $60.75 per share 100 share.

An exchange is reported of 72 shares Commercial Telegram Co., for 3 second hand locomotives.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

United States Circuit Court—District of New Jersey.—*Schneider v. Pountney.* Nixon, J. (1.) Where a reissue had been held to be invalid because the specification did not contain the full, clear and exact description of the invention that the law requires, held that in the light thrown upon the subject-matter of the patent by the evidence introduced, and by the fuller specification of the last reissue, the true character of the invention had been fairly brought out and the reissue was sustained. (2.) Where one party manufactures one portion of the device covered by a combination claim, and another party manufactures the other part of the combination, and it does not appear that the two parts are capable of separate use, held that the parties are joint infringers, and that the defendants cannot protect themselves by invoking the well-settled rule. (3.) Where a patent is for a combination merely it is not infringed by one who uses one or more of the parts, but not all, to produce the same results, either by themselves or by the aid of other devices. (4.) Even if there is no proof that the defendant had made an actual prearrangement with any particular person to supply the other portion of the combination, it will be inferred from the circumstances of the case that it is the intent of the defendants that such other portion shall be added to their article of manufacture. Commissioner's Decisions.—*Ex parte Moodie.* Upon appeal from the Primary Examiner, Butterworth, C., held, (1.) That Congress intended to devolve upon the Commissioner of Patents the duty of determining the character of the subject-matter offered for registration under the label and trade mark law; (2.) That the proper construction of the statute is that the subject-matter of an application for a label shall be that which may be properly claimed as a label and not be merely subject-matter for a trade-mark; (3.) But that the statute does not mean to imply that if certain subject-matter is found to be incapable of registration as a trade-mark it can nevertheless be registered as a label, for it may not be descriptive of the quality or nature of the goods and therefore fail to constitute a label; and (4.) That the Examiner properly refused to register as a label matter which, gauged by the established rules, constitutes only subject-matter for a trade-mark.

Board of Examiners-in-Chief—*Voelker v. Gray, et al.* Interference. This case has been pending since March, 1878, and involves the invention of the speaking telephone. Of the 14 original parties there remain now only 6, namely, William L. Voelker (2 applications); Thomas A. Edison (5 applications); Elisha Gray (4 applications); John H. Irwin, James W. McDonough (1 application each), and Alexander Graham Bell (2 patents). The Examiner of Interferences had awarded priority of invention to Bell in cases A, B, C, E, F, I, J and L; in cases D and "No. 1" to Edison, and in case G to McDonough. Case G is generally regarded as a principal point at issue and practically covers the telephonic invention, for it is an application for "a telephonic receiver, consisting of the combination in an electric circuit of a magnet and a diaphragm, supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality." Bell is the only one of the contestants having patents. Before taking up the issues in detail the Examiners say: "The courts have held that those seeking to overthrow patents should be held to strict proof of actual and successful prior embodiment, and the office has applied the same rule to those asking a patent for that which has already been patented to another. In this case the rule of the office is to be applied with strictness, for Bell's patent has not only not been declared invalid by any court, but it has actually been sustained, and upon a record which is a part of the record here. It follows, therefore, that although satisfied from the evidence that Bell had made the invention before the filing of his application it will not be necessary for the general purposes of this case to review those portions of it which have led to this conclusion. It will be sufficient to determine whether or not the other parties have overcome his record dates." The issues are then taken up separately and decided. Issue A is "the art of transmitting and reproducing at a distance sonorous waves or vibrations of any description by increasing and decreasing the strength of an electric current," etc. Edison, Bell and Voelker were the principal contestants, and the decision is that "it must be concluded that Edison, like Voelker, has not overcome Bell's record dates." Issue B is "the improvement in the art of transmitting vocal sounds and words telegraphically by throwing upon the line, through the medium of a varying resistance, electric impulses corresponding to the vibrations of a diaphragm," etc. The decision of the Examiner in favor of Bell is sustained on this point, and also on issue C, which relates to the transmitter, consisting of the combination of a diaphragm and a liquid or equivalent substance of high resistance. Issue E is for an armature plate, the electro-magnet for the same and a closed circuit passing from the helix to the source of undulatory electric energy, and is also awarded to Bell. Issue F, concerning the transmitter, was not appealed and stands to Bell's credit. Issue G, "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm, supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality," was awarded by the Examiner to McDonough. The parties were Bell, McDonough, Gray and Edison. After an exhaustive review of the great mass of evidence adduced upon this point and stating at length the reasons leading to the conclusion, the Examiners say: "Upon the whole, McDonough's proofs cannot be held to be sufficient to overcome Bell's record dates. We have seen that a party contesting the right of a patentee must show completed and perfected apparatus. That McDonough did not have this is clear. Had a patent been granted to him for it as described in his application, or as experimented with in June, 1875, the public would have been no wiser than before. It still would have been ignorant of the method and apparatus for speech transmission, for no instrument working upon its principle of making and breaking contact can accomplish that result. In this respect McDonough gave no more to the world than Reiss. As was said of Reiss by Mr. Justice Lowell, in *American Bell Telephone Company v. Spencer*, a century of McDonough would never have produced a speaking telephone." Issue J, for the combination with an electro-magnet of an iron or steel diaphragm, secured to a resonant case for rendering audible acoustic vibrations, is confirmed to Bell, as is issue L, which concerns the polarized armature in the receiver. Edison's claim is supported in issue No. 1, for a spring carrying one electrode of the circuit of a telephone and constantly pressing against the other electrode and diaphragm.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From September 23 to October 14, 1884 (inclusive).

Alarms and Signals:—*Telethermometer*, W. H. H. Barton, Sept. 23, 305,499. *Shut-off for Water and Gas*, T. P. Hughes, 305,595. *Signaling Apparatus*, J. K. D. Mackenzie, 305,611. *Fire Alarm and Call Bell System*, P. Gugerty, 305,688. *Alarm Signal*, I. H. Farnham, Sept. 30, 305,747. *Alarm and Call-bell Hotel System*, W. T. Kellogg, Oct. 7, 306,084. *Alarm for Automatic Fire Extinguishers*, C. C. Worthington, Oct. 7, 306,201, 306,-302. *Apparatus for Working Bells*, W. P. Horn, 306,255.

Clocks:—*Secondary Tower Clock*, C. H. Pond and A. S. Munger, Sept. 23, 305,632.

Commutators:—*Switch-board*, C. W. McDaniel, Oct. 14, 306,414. *Telegraph and Telephone Switch*, G. L. Anders and E. B. Welch, 306,467.

Conductors, Insulators, Supports and Systems:—*Conductors*, T. S. Reed, Sept. 23, 305,475; W. Jamieson, Oct. 7, 306,256; P. G. Gardner, Oct. 14, 306,478; W. R. Patterson, 306,513. *Joint for Conductors*, R. W. Kear, Sept. 23, 305,601. *Cable*, W. A. Shaw, Sept. 30, 305,854; T. G. Turner, 306,037. *Conduit for Conductors*, D. H. Dorsett, 305,904. *Device for Stringing Wires*, S. McAuliffe, 305,946. *Underground Line*, H. A. Chase, Oct. 7, 306,-057. *Press for Moulding Glass Insulators*, L. B. Gray, 306,146, 306,147. *Skeleton Tower*, J. S. Adams, Oct. 14, 306,374.

Dynamo Machines and Motors:—*Dynamo*, W. S. Horry, Oct. 14, 306,687. *Mechanism for Driving Same*, J. R. Markle, Sept. 30, 305,948.

Galvanic Batteries:—G. F. Green, Oct. 14, 306,684.

Ignition:—*Igniting Device for Gas Engines*, S. Marcus, Oct. 7, 305,339. *Lighting Gas Burner*, A. L. Bogart, 306,128. *Gas Lighter*, H. N. Williams, Sept. 23, 305,726.

Lamps and Appurtenances:—*Arc Lamp*, R. H. Mather, Sept. 23, 305,617; T. L. Dennis, Sept. 30, 306,005; E. Thomson and E. W. Rice, Oct. 7, 306,118, 306,119; E. Pickering, Oct. 14, 306,547. *Combined Gas and Electric Light Fixture*, S. B. H. Vance, Sept. 30, 305,984; Oct. 14, 306,557, 306,558. *Incandescent Lamp*, Sept. 30, 305,817.

Measurement:—*Galvanometer*, W. G. David, Sept. 23, 305,481.

Miscellaneous:—*Electro-therapeutic Apparatus*, C. L. Clarke, Sept. 30, 305,-894. *Machine for Winding Wire on Bobbin*, John Leigh and C. L. Clarke, 305,930. *Lock*, H. L. Roosevelt, Oct. 7, 306,179. *Means for Diminishing Battery Consumption in Normally Closed Circuits*, C. Cummings, 306,225. *Sewing Machine*, W. C. Shaffer and J. L. Poalk, 306,288.

Protectors:—*Lightning Arrester*, M. J. O'Sullivan and T. J. Houck, Oct. 14, 306,697.

Railways and Appliances:—*Railway*, W. H. Knight, Sept. 23, 305,604; E. M. Bentley, 305,729; B. Bidwell, 305,730; W. H. Knight, 305,731; E. M. Bentley, Oct. 7, 306,315. *Car-brake*, Oct. 14, 306,452.

Storage Batteries:—*Electrolytic Fluid for*, W. E. Case, Sept. 30, 305,737. *Accumulating Battery*, N. Basset, Oct. 7, 306,051. *Construction of Secondary Batteries*, W. Lachlan, Oct. 14, 306,405.

Telephone Systems and Apparatus:—*Mechanical Telephones*, J. V. Hyder, Sept. 23, 305,453; A. G. Holcombe, Oct. 14, 306,616. *Switch*, H. E. Waite, Sept. 23, 305,552; S. H. Bartlett, Oct. 7, 306,050. *Transmitter*, W. Hale, Sept. 30, 305,812; W. S. David, 305,901; C. W. Long, 306,026. *Apparatus for Communicating Telephonically*, W. N. Marcus, 305,820. *Telephone Receiver*, G. M. Hopkins, 305,927, 305,928; T. F. Taylor, 305,980. *Telephone*, C. E. Allen, Oct. 7, 306,044. *Telephone Circuit and Apparatus*, E. T. Gilliland, 306,236. *Telephone Circuit*, same, 306,239. *Metallic Circuit System*, same, 306,240. *Multiple Circuit Changer*, same, 306,241. *Telephone Support*, T. N. Vail, 306,290. *Central Office Instrument*, 306,360. *Individual Call Instrument*, J. P. Stabler, 306,361. *Time Indicator for Exchanges*, C. H. Haskins, Oct. 14, 306,395. *Telephone Conducting Cord*, M. G. Kellogg, 306,495. *Telephonic Apparatus*, 306,514. *Signal and Test Circuit for Telephone Exchanges*, C. H. Wilson, 306,663. *Combined Telegraphic and Telephonic Apparatus*, F. Van Rysselberche, 306,665.

Telegraphs:—*Local Circuit for*, B. E. J. Ellis, Sept. 30, 305,906. *Quadruplex*, same, 305,907, 305,909. *Art of Diplex Telegraphic Transmission*, 305,908. *Printing Telegraphs*, C. G. Burke, Oct. 7, 306,055, 306,056; H. Van Hoevenbergh, 306,297. *Relay for*, J. E. Smith, 306,187.

The following electrical patents were omitted from previous lists: *Mould for Making Glass Insulators*, S. Oakman, Sept. 9, 304,748. *Substitute for Hard Rubber, etc.*, S. Barbier and C. H. Coiffier, 304,775. *Manufacture of Carbonizable Material for the Conductors of Incandescent Lamps*, E. Weston, 304,880. *Manufacture of Carbon Filaments for Incandescent Lamps*, G. Bowron and W. Hibbert, 304,901. *Engraving Machines*, G. M. Guerrant, Sept. 16, 305,177; G. M. and J. C. Guerrant, 305,178. *Imitation Ivory*, C. S. Lockwood and J. W. Hyatt, 305,205. *Electric Brush*, M. McMullin, 305,321.

THE ELECTRICIAN

AND

ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY

THE ELECTRICAL PUBLISHING CO.,

115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	4.00
Single Copies,		.25

[Entered at the Post Office at New York, N. Y., as second class mail matter.]

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NEW YORK, DECEMBER, 1884.

TO OUR READERS.

WITH the present issue, the third volume of THE ELECTRICIAN, and the first of the new series under the name of THE ELECTRICIAN AND ELECTRICAL ENGINEER is completed.

Since this journal has been under the charge of its present conductors, every effort has been made to render it even more than before, a worthy exponent of electrical progress, both scientific and industrial, in the United States. Believing that the true mission of a monthly journal is not so much to give in full detail, the current professional news and gossip of the day, as to furnish a medium for the publication, in a form convenient for reference and preservation of discussions, papers and other information of permanent value, we have sought to occupy a field somewhat different from that which has been cultivated with diligence and apparently with success by the weekly journals devoted to the same general subject. In saying this, we by no means intend to underrate the value of the large amount of excellent work which has been done by our contemporaries, but merely to point out what we conceive to be the general scope of the enterprise in which we are personally interested.

It has ever been the policy of the management of this journal to aim at the highest attainable standard of excellence, not only in the character of the subject matter presented, but in the manner and form of its presentation as well. While the commendation, encouragement and support which we have received from the profession, especially during the past few months, has been most gratifying, yet the limitations of expenditure to which we have been subject by reason of the low price of subscription, have been such that we have found ourselves unable to afford the amount of space which has become absolutely essential for the publication of original contributions and other matter of value relating to the different departments of electrical science. We have therefore determined to signalize the commencement of the new volume by increasing the amount of reading matter in each number to at least 40 pages. This enlargement will enable us to give each month a much greater amount of valuable and interesting scientific and professional matter than has before been possible, as well as to improve our publication in many other respects. In order to carry out these plans, we are compelled to make a material advance in the price of subscription, but we think we may safely promise all who are interested in the progress of electrical science, that they will find the ELECTRICIAN AND ELECTRICAL ENGINEER in its improved form well worth its increased price.

THE TELEGRAPH AND THE ELECTION RETURNS.

THE intimate relations which exist between the press, the telegraph and the public have been brought vividly to mind during the past month. Owing to the unusual closeness and uncertainty of the result of the Presidential election in New York state, the wildest accusations and denunciations were made against the management of both the Western Union Telegraph Company and the Associated Press, based upon the conjecture that these organizations had been tampering with or delaying the returns. The large total vote of the State, the complications of the ballots, and the remote location of many districts, were all forgotten by the impatient public in its feverish anxiety to obtain accurate information. The partisan newspapers of the city were bristling with claims and counter-claims, but at the same time they were by no means slow to avail themselves of the unusual market afforded for disposing of their regular editions, supplemented by an abundance of "postscripts" and "extras," which were eagerly sought for by the adherents of both parties. Instead of expressing honest doubts, the daily press of this city sedulously fanned the growing flame of excitement, and in a short time brought about a state of popular feeling which, under the merest accident of provocation, might instantly have developed into a furious riot.

Now, what were the facts upon which all these senseless accusations were based? In the first place, the weather was bad, the telegraph lines were working with difficulty, and every "way" office was in circuit. Hundreds of rural operators were called upon to perform unusual service of a character to which they were not accustomed, while their surroundings were by no means calculated to facilitate their work. As time wore on, the result bade fair to be so close that mere estimates were utterly useless. Neither telegraph company nor press agency could count votes, but merely transmit and record the results. It appears, however, from the published statements of members of the Associated Press, that a new system was adopted on this occasion, that of figuring up the gains and losses. The bulletins issued upon its authority ex

hibited to the eye of the expert internal evidence of wooden-headed stupidity rather than intentional fraud. It is upon an occasion of this kind that the Associated Press should be of the greatest possible value to its clients. There are no sensational incidents calling for the services of the facile pen of the special correspondent. The facts in the case are of the simplest possible character, the names of the parties and of their candidates, and the number of votes cast. If any deductions are to be drawn from these figures, each newspaper is well known to possess the necessary data from which to make its calculations. In this purely functional undertaking the Associated Press failed most deplorably, according to the testimony of its own members. These were compelled to depend wholly upon their individual resources in order to ascertain facts, which they were utterly unable to get through the operation of the vaunted machinery of which we have heard so much. Upon the character of the telegraph service, which is so essential at such a time, little praise can be bestowed. The public may be impressed by the spectacle of 11,000 telegraph offices kept open for the benefit of the community, but the futile wrangling of 5,000 "plugs" by no means constitutes a sublime feature of the scene. The various officers and employés of both the telegraph and press service are pretty fairly distributed between the several political parties, and our experience in both during many political campaigns has taught us that in the telegraph service, at least, party bias is entirely subordinate to public obligation. There is little doubt, however, that while both services which have apparently been unequal to the public demand during this period, the time has not yet arrived when it is either desirable or safe to place the telegraph system under government control. For the first time since an attempt has been made to reform the civil service, a change in the political complexion of the administration is to occur. If a conservative course is pursued by the incoming administration and it should eventually prove that the minor government offices have permanently ceased to be considered as the legitimate spoils of a victorious party, one of the most potent of the existing arguments against a government telegraph will have been removed. Whether or not such a change will be brought about at an early day depends principally upon the policy of the present owners of telegraph property. When they are prepared to sell at a fair price, we anticipate little opposition from Congress.

ELECTRICAL IMPROVEMENTS AT THE EXHIBITION.

WHILE awaiting the reports from the various examining committees as to the respective merits of the various exhibits brought to their notice, opportunity is afforded to review some of the impressions created by the exhibition. Although its title indicated that it was designed to be "International" in character, there was a general feeling of disappointment that there was so little claim to such a designation. This was not, however, in any respect the fault of the management, but rather the natural result of the protective policy which prevails in this country, the avowed object of which is to discourage and prevent foreign competition. It is the hope of deriving a profit from an increased sale of their wares, that leads manufacturers to incur the expense of making a display. The only foreign electrical goods which may be said to find a market in this country are instruments of measurement, and philosophical apparatus, and these constitute all the foreign exhibits of importance that were displayed. The great feature of the exhibition was the electric light display, and to those who have been familiar with but one or two systems, the number of complete plants of arcs, incandescents and dynamos presented for competition must have been a surprise. Practically the electric lighting business appears to be as open to competition as the manufacture of steam engines. Certain appliances are, of course, covered by patents, but there is little promise of fabulous wealth to be derived from the introduction of plants, excepting when a monopoly may be secured through some municipal franchise, such as is frequently obtained by gas and water companies. It is the utilization of dynamic currents which has led to the recent development in electric machinery, but it is generally believed that still greater strides will be made in the future. This, however, is not necessarily the case. The steam engine, the Morse telegraph and the speaking telephone were practically complete inventions, and their improvement has been principally in the perfection of their manufacture, the skill with which they are handled, and their more economical application, rather than in any radical improvement in their construction. The Morse operator of to-day could obtain as good results with the instruments used 40 years ago, as he can from the modern key and sounder. The Davenport motor of 1837, a model of which was in the Patent Office collection, has not been greatly improved upon. It successfully drove a printing press 25 years ago, and is unquestionably superior to many which have followed it, and which have absorbed thousands of dollars from the coffers of enthusiastic investors who have expected to see electricity supersede steam. The popular ignorance upon this subject was demonstrated by the inquiry of a visitor from Ohio, an apparently intelligent manufacturer, who desired to obtain a dynamo of sufficient power to drive a 15 h. p. steam engine. Further inquiry brought out the fact that he supposed the function of a dynamo was to generate power within itself, sufficient to drive an engine, thus dispensing with the steam boiler and the consequent consumption of coal. If the exhibition with its concurrent circulation of electrical primers has corrected any of these false impressions of the wonders of electricity, it has certainly proved its usefulness. Being the pioneer exhibition of its class in this country, the managers have every reason to be congratulated upon its financial success.

COMPETITION IN TELEGRAPHY.

THERE is a considerable portion of the community which has little faith in the permanency of opposition telegraph companies, and it is very certain that past experience has greatly fostered this belief. Heretofore these lines have usually been absorbed by the Western Union Telegraph Co. before actually reaching so low a stage in bankruptcy as to have their property seized by the sheriff. The recent unfortunate experience of the Bankers and Merchants' Telegraph Co. is a new

spectacle to the present generation of telegraph exploiters. Its career has brought great hardship to many investors and contractors, and it is to be hoped that no further extension of telegraph facilities will be placed upon so flimsy a financial foundation. So far as the actual transmission of messages is concerned, its record has been good, but with the ambition to cover a vast amount of territory, without a substantial treasury, it has been irretrievably crippled, and there seems to be little hope of the property being preserved intact. One of the most significant features of telegraphic competition is the slight effect it has upon the market value of Western Union stock. A war of rates between the trunk railways not only depresses the whole line of those securities, but even appears to have a sympathetic influence upon Western Union shares greater than that produced by the cutting of rates in its own field. No other system of lines has yet been established embracing that multitude of minor offices which may be depended upon for a net revenue of from one to five hundred dollars per month. It is possible that capitalists may eventually be found who will have sufficient faith in the richness of the field to encourage them in advancing money until every point is covered, but it does not appear possible that they will be fully conversant with the exact situation of affairs, or else that they organize such companies for some other purpose than the earning of dividends. The men who are selected to manage such enterprises are usually aware of the difficulties to be encountered and of the uncertainty of their future prosperity. They have learned by their own experience, or that of others, to guard against personal misfortune by entering into contracts. We doubt if any of them would invest their own money in the stock. If the establishment of opposition lines has influenced the reduction of rates, the result has been beneficial to the stockholders as well as the public, for it is now acknowledged that the greatest returns may be derived from a moderate tariff. Possibly the same result would have been arrived at eventually, without compulsion, but corporate officials are prone to be governed in this respect by their idea of charging "what the traffic will bear," not always the wisest plan, as experience has frequently shown.

COPPER LINE WIRE.

Now that many of the leading telegraph and telephone companies have actually begun the use of hard-drawn copper wire for overhead lines, to a considerable extent, the question of its fitness for such work will soon be fully determined. Its superior conductivity will improve the working capacity of long circuits, and as progress in this direction has long been a desideratum, it is certainly encouraging to know that there is a prospect of a permanent advance. Electric light companies would no doubt be pleased to have an opportunity to utilize a metal superior in conductivity even to copper if such were to be found, as their lines are now built of wire that is exceedingly heavy and unwieldy, requiring very substantial fixtures. The comparatively low price of copper has had considerable influence in hastening its substitution for iron, but after being fairly introduced no doubt quite a decided advance in price would be required to drive consumers back to the old practice. It is scarcely wise to attempt to make a prediction as to the future price of copper, but many suggestions are being made as to its substitution for tin and sheet iron, which will doubtless result eventually in increased consumption. Its value as a roofing material has been recognized for centuries, and the *Mining Gazette* has recently demonstrated that it is the most economical material for stove pipes. The price exacted for converting it into sheets is now 7 cents per pound, but the possibility of materially extending its usefulness may lead to a reduction in the cost of rolling, which will tend to increase the demand and consequently stiffen the price of ingot copper. The fact that the Calumet and Hecla company has recently passed a dividend, appears to indicate that the production of copper at present prices is not attended by exorbitant profits, so it is fair to presume that they have reached their lowest limit unless new processes are introduced which may lessen the cost of mining and smelting. The use of copper wire for overhead lines, has passed the experimental stage in Europe, having been used in Italy for ten years, and is now used, as we are informed, exclusively by the British government for its post-office telegraph lines. There is some doubt expressed, however, as to its behavior under the effects of the extreme variations in temperature which it will be subjected to in our climate, and it is doubtless this alone which gives rise to any hesitation on the part of telegraphic constructors to adopt it for all new lines.

TELEGRAPHING AS AN ITEM OF BUSINESS EXPENSE.

WE have heretofore called attention to the fact that the cost of telegraphing, was by no means such an onerous burden upon the public, as certain agitators would have us believe, and that, considering its importance the service is really cheap. These deductions were made partly from general observation and practical experience in the telegraph service, and partly from our personal use of the telegraph for social and business purposes.

As an example of its relation as a factor in the cost of goods, an elaborate calculation of the cost of a ton of stoves compiled by Mr. Perry is of interest.

This statement was read before a convention of stove founders and was no doubt carefully prepared. The various items were given, which produced the following amounts. Foundry cost per ton $39.00; labor, $45.00; selling expenses, $23.00. From the latter amount we extract the following two items: Postage stamps and telegrams, $1.00; *bad debts*, $2.00. That is to say the entire expense of postage and telegraphing was less than 1 per cent of the cost of production, while bad debts were double that amount. There are of course various lines of business whose percentage of telegraph expenses are greater, yet there are many others who use the wires still less, but few are exempt from the burden of bad debts. This leads us to say that in most branches of trade that portion of the community which pays for its goods, is saddled with a share of the indebtedness of others.

The telegraph business is certainly exempt from this evil, for it is conducted on a strictly cash basis, and it would be better for the community at large if a similar practice prevailed more generally in mercantile circles.

ARTICLES.

THE WARING SYSTEM OF UNDERGROUND CABLES.

BY F. L. POPE.

It has been remarked by electricians that the display of so-called systems of underground conduits and electrical conductors at the recent electrical exhibition in Philadelphia, although sufficiently extensive, was as a whole not altogether satisfactory as an indication of the actual progress which has been made in this direction in the United States. The exhibits of real merit were comparatively few in number, and were obscured and thrown into the background by a much larger number of contrivances, of which it can only be said that they were utterly beneath criticism, being in fact alike destitute of originality and of utility.

Upon a somewhat careful examination of the comparatively small number of inventions of this class which have been intelligently and carefully designed and reduced to a practical form, and whose original defects have been discovered and eliminated by the only safe criterion, that of actual use upon a commercial scale for a considerable period of time, the observer is at once impressed by the fact that the systems which have apparently proved the most successful in practice have certain features in common. The insulation is effected by the application of petroleum products to a textile wrapping enveloping the conductors, and the conductors thus insulated are protected from external destructive agencies, both mechanical and chemical, by metallic tubing. There are many indications that the successful underground telegraph of the future, at least in this country, is likely to be of this type. In general terms, this may be said to be the method of manufacturing insulated electrical conductors for underground telegraphs and various other purposes which is employed by the Standard Underground Cable Company of Pittsburg, Pa.

The details of the system, which have been very thoroughly and successfully worked out, mainly by Mr. R. S. Waring of Pittsburg, will be found to present many points of novelty and interest. The conductors and cables are now manufactured in many forms to suit a variety of uses, and contain any required number of conductors from 1 to 7 or more, but whatever the form, the general principle of construction is substantially the same in all. The conductor is first enveloped in a wrapping of fibrous or textile material, which is then saturated and coated with the insulating substance, a compound to which the name ozite has been given, and the whole is afterwards enclosed in a continuous sheathing of lead, which is pressed closely around the insulated conductors. Each conductor is separately surrounded by the metal on all sides, an in-

FIG. 1.

genious provision being made which will be hereinafter described, by which a branch or loop may be attached to or led out of any particular conductor in a multiple cable without possibility of interference with the remaining conductors.

Figure 1 represents the simplest and perhaps the most generally useful style of insulated conductor manufactured by the company; it is shown of full size in the cross-section within the coil. The conductor is formed of the best quality of copper wire of high conductivity, and for ordinary purposes is usually of number 18 gauge, although any other size may be employed with equal convenience. This is covered with a double wrapping of textile material, usually cotton, and is then wound on a reel in readiness for the application of the insulating material.

In the process of distilling petroleum or other mineral oils, the distillates of low specific gravity, such as naptha and the various grades of illuminating oil are the first which pass over, leaving in the still the heavier compounds, which are themselves capable of being segregated into numerous other distinct products by continuing the process of distillation. Among these latter products some become solid when cool, while others remain in a liquid condition. By compounding certain of these liquid and solid products, in proper proportions, a plastic or semi-liquid material is obtained, of high insulating properties, and low specific inductive capacity, which is at the same time repellent of moisture. This compound forms the principal base of the substance which is employed for insulating the conductors. The wire having been coated with textile material as described, is drawn through the liquid compound, which is kept at a high temperature in a suitable vessel, in such a manner as to expel all the moisture from the covering, and to thoroughly saturate it, as well as to form a substantial body of the composition upon the exterior surface. The coated wire is then drawn through dies and gauges in order to smooth the surface and bring it to a uniform size, after which it is passed through a press of special design, operating somewhat upon the principle of the well-known lead-pipe machine, by means of which a heavy body of lead is closely compressed upon the wires.

The single covered wire shown in figure 1 is extensively used for hotel-annunciators, burglar alarms, electric call-bells, clock wires, and the like, for which it is admirably adapted. It may be embedded in the plastered walls of a building at the time of its erection, so as to be entirely out of sight. The lead covering is absolutely impervious to moisture and cannot be injured in any way by the wet plaster. The metallic envelope of each conductor forms a convenient return wire or ground, thus avoiding in most instances the necessity of providing a special return wire.

A multiple cable containing 6 conductors, and designed especially for an underground line, is shown in cross-section (full size) in figure 2.

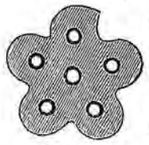


FIG. 2.

It will be observed that one of the exterior ridges of this cable is somewhat different in section from the others being provided with a sharp edge or corner which serves to designate the position of one particular conductor throughout the entire length of the cable. The position of one conductor being known enables the position of any one of the others to be readily determined. The principal object of this arrangement is to enable a branch or loop to be inserted into any one of the conductors of the main cable, without disturbing the others. The way in which the loop is inserted into the cable will be understood by referring to figure 3. The branch or loop itself is usually made with a two-wire cable, shown in elevation and cross-section in figure 4. It is divided at the end for a short distance as shown, and its conductors spread apart and attached to the severed ends of one of the conductors of the main cable, which has been previously opened for the purpose, after which the lead coating is made continuous by a soldered joint, similar to that employed in fitting up water pipes.

The cables are made in continuous lengths in the factory, and are divided into suitable lengths for convenient handling in transportation and laying. The six-wire cable, such as shown in figure 2, is usually shipped in half-mile

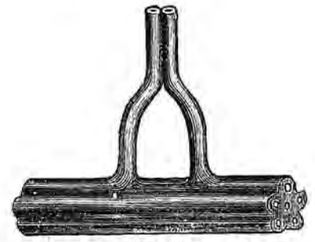


FIG. 3.

lengths. The ends of the lengths are united when laid, by a joint or splice as shown in figure 5. The lead is removed from the end of the cable for a distance of 1½ inches, the insulation is also removed from the ends of the wires, and

FIG. 4.

these are then united by a double twist joint, carefully soldered. This joint is then covered with insulation, and wrapped with silk, after which a strip of sheet lead is applied to preserve the continuity of the metallic division between the conductors. A sleeve formed of a piece of

FIG. 5.

lead pipe of the proper size, which has previously been slipped over one of the cable ends, is then brought over the joint and dressed in close to the cable at both ends, after which a soldered joint is "wiped" at each end of the sleeve. A perforation is then made in the sleeve, and a quantity of the melted insulating material is introduced into the pipe so as to fill it up and expel the air and moisture from the interior of the pipe. The perforation is then closed, which completes the operation of making the joint.

A number of different styles of cables adapted to various purposes are shown in figure 6, which require no particular explanation. The flat or ribbon cables may be laid along or upon the wood-work within a building, and when painted and varnished to correspond with the interior decoration, are not distinguishable from an ornamental moulding.

For trunk lines, and general street service, from 1,000 to 1,500 wires may be laid in a box 1 foot square. The flat cables are well adapted for this service, as they are very flexible, and will pack in a small compass.

The operation of laying an underground cable is illustrated in figure 7. A trench of convenient depth is first opened, and the reel mounted on a pair of wheels like a hose carriage, is drawn along by horses, paying out the cable, which is laid in the bottom of the trench and immediately covered. The operation is performed with great expedition and a mile or more of cable may be laid in a day without difficulty.

Figures 8 and 9 show two different samples of Waring cables containing stranded conductors of No. 4 and No. 6 gauge, which are made either single or double for electric lighting conductors, a service for which their high insulation and non-liability to injury from heating, render them peculiarly well adapted. The Standard company manu-

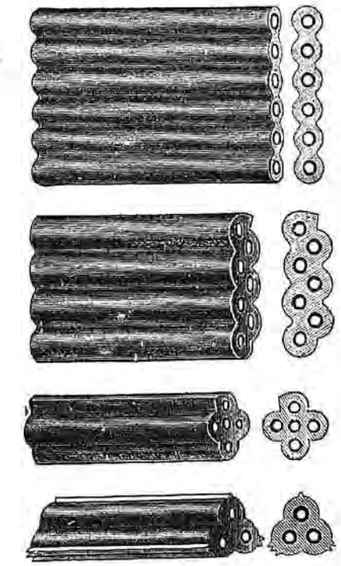


FIG. 6.

factures cables of a number of different styles and sizes, both for arc and incandescent electric lighting.

It is hardly necessary to speak at length of the peculiar advantage which this cable possesses for use in electric

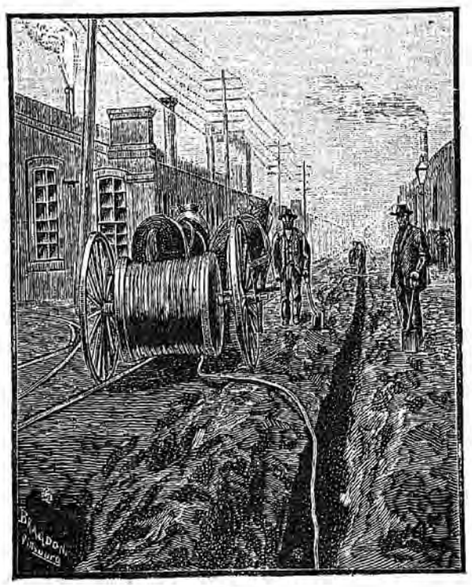


FIG. 7.

lighting systems on board vessels, or in mining operations. The impossibility of protecting the conductor from the effects of dampness has hitherto prevented the use of incandescent light for mining purposes, for which it is in

every respect admirably adapted not only by reason of its brilliancy and convenience, but on account of its absolute safety.

The Waring system of cables has already undergone quite extended practical tests with the most satisfactory results. In the spring of 1882, a cable of 5 wires similar to that shown in figure 2, but without the central wire,

FIG. 8.

FIG. 9.

was laid from the Chamber of Commerce in Pittsburg, Pa., to the Vesta oil works on the Alleghany river, a distance of a little less than 9 miles. This cable was laid in a trench in the earth without protection of any kind. It contains telegraph and telephone wires both of which are operated with complete success. The writer has repeatedly conversed over this line with a Bell telephone and was unable to detect any interference or disturbance whatever, either from the adjacent Morse wire or from any other cause. A considerable length of cable has also been laid in the city of Washington by the company for the United States government. The capitol, executive mansion, state, war and navy departments have been connected together by cables, the conductors being used for both telegraph and telephone purposes. A line of cables has also been laid for the fire-alarm and police telephone service of the District government. All the Washington cables are of the pattern shown in figure 2. A report made to the Senate by the Secretary of War, in reply to a resolution of inquiry as to the practical working of the Waring cable, was accompanied by a report from Col. A. F. Rockwell, Superintendent of Public Buildings and Grounds, who expresses the opinion that the cables of the Standard Underground Cable Company fulfil all the requirements of the service, as an efficient and practical substitute for the overland system, and recommends its adoption for the departmental telegraph lines, and the removal of all aerial lines and poles from the public buildings and grounds.

Tests which were made of the insulation of the Pittsburg line soon after it was laid down are reported to have shown that its insulation was above 200 megohms per mile, and more recent tests show that the insulation has not fallen off. The writer hopes to be able, within a short time, to present a complete series of tests of the insulation and electro-static capacity of this cable, which will be of much interest. The inductive action from wire to wire is, of course, effectually cut off by the intervening shield of metal, a feature which renders the cable peculiarly well adapted for the telephone service.

The workmanship of all these cables is of a high standard of excellence. Every piece of cable, before leaving the factory, is carefully tested, inspected and approved by the electricians in charge. The successful working of all the lines which have been laid by this company is a sufficient evidence of the watchful care which has been exercised over their construction, and a sure indication of an extensive and profitable business in the future.

THE ELEMENTARY PRINCIPLES OF ELECTRICAL MEASUREMENT.

BY F L. POPE.

(Continued from page 212.)

ERRATUM.

[A valued correspondent has called the attention of the writer to an error in the definition of the *Ampère*, as given on p. 211 of the present volume, in this series of articles. The reader is requested to substitute the following definition for that which is there given, in which the element of *time* was erroneously introduced.]

THE *Ampère* is the unit of current, or as it is often expressed, of "effective strength of current," and represents the strength (or intensity, as it is termed by French writers) of the current which traverses a circuit having a resistance of 1 ohm, when the electromotive force is 1 volt. It was formerly called by British and American electricians a *Weber*, and sometimes an *Œrsted*, but the designation of ampère, having been established by the Paris congress, may now be considered authoritative.

GEOMETRICAL REPRESENTATION OF THE PHENOMENA OF THE ELECTRIC CIRCUIT.

The mathematical relations which have been shown to exist between electromotive force, potential, resistance and current, in an electric circuit, and which are expressed by Ohm's law, may also be graphically represented to the eye by geometrical projection,—a process which often materially assists the student in forming a correct conception of a subject.

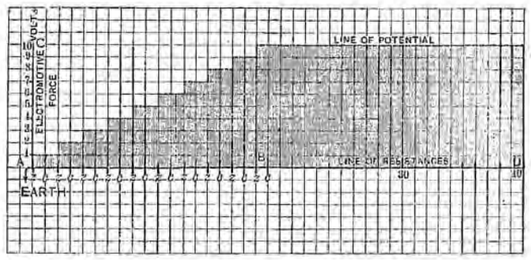


FIG. 5.

Let the resistance in any given circuit be laid off along a horizontal line, A B, figure 5, on a scale of equal parts in which each division represents 1 ohm. In the same manner let the electromotive forces be laid off along the vertical line A C, drawn perpendicularly to A B, and let the line A B also indicate the zero of potential. A battery of 10 Daniell cells is represented in figure 5, the zinc and copper plates *z* and *c* being represented at such a distance apart as to correspond to an internal resistance of 2 ohms per cell. Let the total resistance of the entire circuit be 40 ohms, which will be represented by the length of the line between A and D. The total resistance within the battery is shown by the length of the line A B, and the resistance exterior to the battery by the length of B D.

Each of the 10 divisions of the line A C represents an electromotive force of 1 volt, which, in this case, we will assume to be exactly equal to that of 1 cell. The total electromotive force included in the circuit will therefore be 10 volts.

We have then in figure 5 a battery of 10 cells, each cell having a resistance of 2 ohms and an electromotive force of 1 volt, and the copper pole of this battery is connected to an insulated conductor B D, having a resistance of 20 ohms.

Now, let us assume that the zinc or negative pole of the battery is connected to the earth at A, and that the remote end of the conductor at D is insulated, or, in telegraphic parlance, "left open." In order to represent the difference

of potential at every point of an open circuit, such as that under consideration, we must construct a line which may be termed the *line of potential*. The perpendicular height of such a line above the zero line A B, at any point, will indicate a corresponding difference of potential between that point and zero. In the present case this will be a positive potential.

As the first zinc plate at A is connected directly by a conductor of inappreciable resistance with the earth, which is assumed to be the zero of potential, as we have already explained, its potential must likewise be zero. But the first cell contains an electromotive force equal to 1 volt, which electromotive force we will, for convenience, assume to be situated at the junction between the zinc plate and the solution in which it is immersed. As will be seen by the dotted line in the figure, at each junction of the zinc with the liquid the potential rises 1 volt, attaining in the tenth cell a potential of 10 volts. But the whole of a perfectly insulated conductor, whatever may be its length, acquires the same potential as the pole of the battery to which it is attached, and, therefore, the potential along the line B D is the same throughout.

Next, let us take the same battery and conductor, and connect the end of the conductor D to the earth also, the latter, of course, having no appreciable resistance. The distribution of potentials throughout the whole system is now changed and becomes as shown in figure 6.

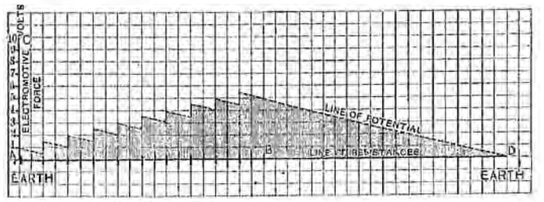


FIG. 6.

Both ends of the circuit being connected with the earth, have now a potential of zero, and the potential decreases regularly from the last cell of battery at B to the earth connection at D. It will be seen that the potential line falls and the potential diminishes within the cells of the battery just as it does on the line. The steepness of this line represents what Ohm termed the *electric fall*. If the units of resistance in A B D, and of electromotive force in A C, are laid off to the same scale, as is the case in the above diagrams, the degree of steepness or tangent of the angle of inclination represents accurately the strength of current in the circuit. A current of 1 ampère therefore would be represented by a line of potential having an inclination of 45° of which the tangent is 1. The line in the diagram has an inclination corresponding to one-fourth of the tangent of 45°, or $14\frac{1}{4}$°, showing that the current in such a circuit would be 0.25 ampères, which we find by Ohm's law to be the case, for

$$E = 10 \text{ (volts.)}$$
$$R = 40 \text{ (ohms.)}$$

and—
$$\frac{E}{R} = \frac{10}{40} = 0.25 \text{ ampères.}$$

Figure 7 shows the same battery placed on short circuit—its poles being connected together by the earth, a conductor assumed to be of infinitely small resistance. In this case the potential rises 1 volt in each cell, as in the two previous examples, and the maximum potential is found at each junction of a zinc plate and the solution. The line of potentials, however, is very much steeper, indicating that a much stronger current flows through the circuit. The angle of inclination is in fact 26½°, corresponding to a tangent twice as great as before, and representing a current of 0.5 ampères. As before, we find by applying Ohm's

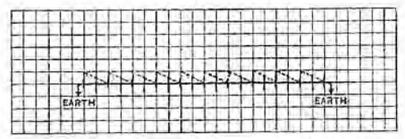


FIG. 7.

law that this is precisely what should be the case, for, we now have

$$E = 10 \text{ (volts.)}$$
$$R = 20 \text{ (ohms.)}$$

and—
$$\frac{E}{R} = \frac{10}{20} = 0.5 \text{ ampères.}$$

In the diagram figure 8, is shown the distribution of potentials on a closed metallic circuit having no connection with the earth. B A B' represents the line of resistances. Ten cells of battery are shown as in the former case, each having an electromotive force of 1 volt and an internal resistance of 2 ohms. The line B A B' is to be regarded as a continuous or endless line, the diagram being supposed to be the developed surface of a cylinder; the points B and B' of the line are in fact coincident, as shown in figure 9. In this, as in all closed circuits which are not connected at any point to the earth, there are 2

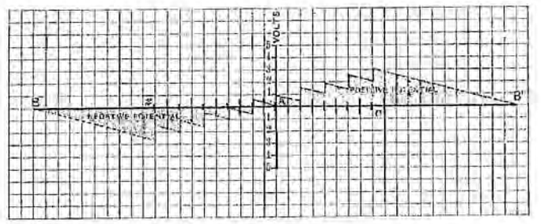


FIG. 8.

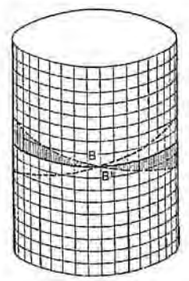


FIG. 9.

points of zero potential, one at A in the middle of the battery, and the other at D or B' at the middle point of resistance of the line conductor. Thus one-half of the battery and one-half of the circuit has a positive potential and the other half of the battery and of the circuit a negative potential. In this case, as in figure 6, the difference of potential at the opposite terminals or poles of the battery is necessarily less than the sum of the electromotive forces of the several cells of which it is composed,

a circumstance which is due to the internal resistance of the battery, as the diagram plainly shows. If the internal resistance of the battery were null, then the difference of potential at the terminals would be equal to the sum of the electromotive forces within the battery.

It is proper to state that many authorities now consider that the change of potential in a voltaic cell which accompanies the existence of an electromotive force, does not actually occur at the junction of the zinc plate with the exciting solution, as formerly supposed, but at the point of junction of the dissimilar metals, *between* two adjacent cells of the battery. This view is in accordance with what is called the contact theory of galvanism, and its correctness appears to have been verified by experiments of the most convincing character.[1]

Place a metal disc, B, figure 10, under a light suspended flat strip of metal or needle, A, maintained at a high positive potential by connection with a highly charged Leyden jar, D. When the disc is of uniform metal, the needle A is not deflected to right or left by the presence of B. A charge accumulates on A and B when they are brought close to each other, but the charges are symmetrically distributed relatively to A, so that A is simply attracted to B, and does not tend to turn round on the axis or suspending wire E. But if the disc B be made of two metals, such as

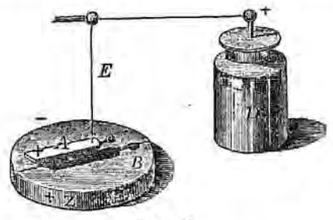


FIG. 10.

zinc and copper, with their junction placed under the needle A, this needle no longer remains in equilibrium, but deflects towards the side on which the copper is placed, showing that now the charge on B is not symmetrically distributed, but that there is a greater induced charge on the copper than on the zinc. This can only be due to the fact that there is a greater difference of potential between the needle and the copper than between the needle and the zinc; in other words, there is a difference of potential due to contact between the zinc and copper, the zinc being positive relatively to the copper. If the potential of A be negative instead of positive, the deflection will be in the opposite direction. The two half discs may be separated from one another by a narrow opening, as in figure 11. The needle will not deflect if the two halves are of the same metal. It will deflect to a definite amount if the discs are of different metals but in metallic connection by a wire, and the deflection D will, when A is positive, be as before from the zinc to the copper, if these are the metals employed for B and B1. In making this experiment care must be taken to ensure that the half discs are symmetrically placed on the two sides of A, otherwise deflections occur due to charges induced on the two sides of A, even when B and B1 are at one potential. If when the potential of A is reversed, being made alternately + and — to equal amounts, we obtain equal deflections in opposite directions, we may be certain that this symmetry is attained.

Let two such half discs of copper be carefully adjusted under A; when these are joined by metallic contact there should be no deflection, however high the potential of A may be. Then connect the side B with the copper pole of a galvanic cell, and the side B with the zinc pole (figure 11); the needle A will deflect towards the side B1, which is in connection with the zinc pole, and the amount of the deflection will correspond to the same difference of potential as that already observed as due to the simple contact of zinc and copper. Remark that, whereas in figure 10 A was attracted to the copper half disc, it is in figure 11 attracted to the half disc in connection with the zinc. We

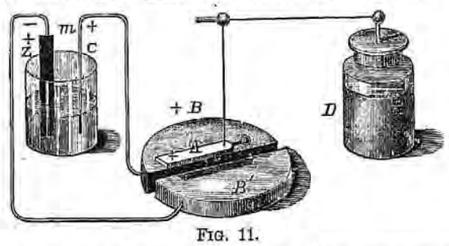


FIG. 11.

know from the first experiment that the junction M has made the zinc in the water positive, and the copper above M, with the half disc B1, negative. We find that the copper C and the half disc B are positive to just the same extent as X must be, and therefore conclude that the water has simply brought the copper strip and disc B to the potential of the zinc. The experiment is a delicate one, and does not prove that the difference of potentials between B and B1 is exactly equal to that produced by the simply metallic contact of zinc and copper; there is a slight difference due to the liquid, and different liquids will certainly augment or decrease this small difference.

The diagram (figure 8) will also serve to represent the distribution of potentials in the closed circuit of a dynamo-electric machine. Let the portion of the line of resistance, B A B1, included between c z, correspond to the internal resistance of the wire of the armature between the points of contact of the positive and negative commutator brushes. Let each cell of the battery be replaced by one convolution of wire upon the armature, and let these 10 convolutions be assumed to move through the magnetic field at the same time. The total electromotive force generated by the revolution of the armature and the consequent movement of the 10 convolutions of wire through the magnetic field will be represented by the vertical line, but the potential at the commutator brushes c z, will be somewhat less than this; how much less will depend upon the proportion of the resistance of the armature to the resistance of the external circuit. In the best dynamo-electric machines the armature resistance is very small in proportion to the external resistance, sometimes less than 5 per cent. of it. The principle of the action of the dynamo-electric machine will be explained in another place; it is only referred to here to call attention to the fact that the law of distribution of potentials in a closed circuit containing an electric generator is the same, irrespective of the character of the particular generator employed, whether chemical or mechanical.

(To be Continued.)

ELECTRICAL PATENTS.

OUT of 300,000 patents issued by the government, 104,217 have been for various branches of mechanical industry which are thus classified by Commissioner Butterworth.

Applications of electricity	5,872	Metaling	3,814
Artesian wells	500	Metal Working machines	10,203
Beds	2,150	Methods of tanning hides	1,219
Boots and shoes	5,060	Mills and thrashing	6,740
Bread & cracker machinery	440	Nut and bolt locks	734
Chairs	1,580	Plows	6,889
Corset patterns	969	Pumps	3,156
Dairy utensils	2,429	Railways	3,508
Fences	2,888	Railway cars	3,505
Fire engines	567	Seeders and planters	3,568
Fire escapes	884	Steam engines	5,111
Harvesters	6,606	Stoves and furnaces	8,238
Lamps and gas fixtures	5,254	Vegetable cutters	450
Laundry utensils	4,998	Water distributers	3,710
Machines for knitting	754	Wearing apparel	2,417

1. Fleeming Jenkin's *Elect. and Mag.*, p. 40.

EXPERIMENTS WITH THE TOEPLER ELECTRIC MACHINE.

BY P. ATKINSON, A. M., PH. D.

(Continued from page 105.)

EXPERIMENT V.

The Spark.—Its Direction, Subdivision and Color.

THE spark from a Toepler machine is a very interesting study, and presents phenomena which demand careful investigation.

As the electricity is generated it is stored up in the two Leyden jars, C and D, shown in the cut. Connected with their inside coatings are the sliding electrodes, P and R, which may be brought together in the centre, or drawn apart. The outside coatings are also connected by a metal conductor, consisting of copper wires under the base, connected with the terminals of the switch, S. By opening this switch, as shown in the cut, the induced current which passes between the outside coatings may be interrupted.

Thus it will be seen that the metallic connection between the inside coatings may be interrupted by separating the sliding electrodes, and that between the outside coatings by opening the switch.

The operation of the machine is such that the inside potential of one jar is raised, while that of the other is lowered; the outside coatings being similarly affected, but in reverse order; the jar D, as a rule, having the higher potential. Now when the switch is closed and the sliding electrodes separated, since the electricity cannot escape from the inside of D to that of C, it must accumulate and become condensed; and the effect of this is to repel a corresponding amount from the outside coating, which finds its way through the switch and connections to the outside of C, raising its potential and repelling a corresponding amount from the inside coating.

When the tension becomes so great as to overcome the resistance of the air, a discharge, known as the spark, accompanied by a sharp report, takes place between the separated electrodes, P and R, and the equilibrium is restored.

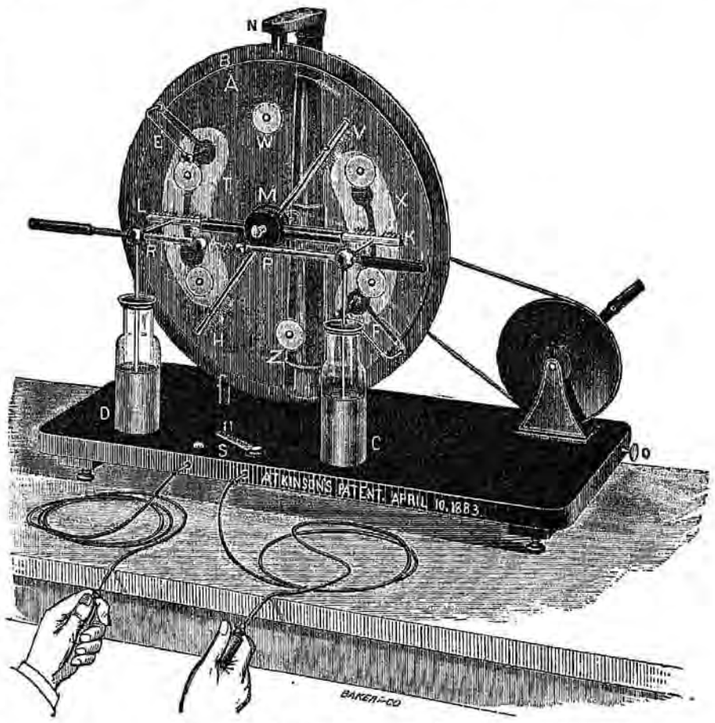
This relieves the tension on the outside coatings, so that a discharge, in reverse order, takes place between them at the same instant, silently, through the switch and its connections.

Now, as proved by Experiment I, page 104, the apparent time of the discharge is an optical illusion, time being practically annihilated; so that it is impossible, from observation, to tell in what direction it takes place; whether from higher to lower potential, or the reverse, or partly in both directions. A brilliant streak of white light, extending from one electrode to the other, suddenly appears and disappears, leaving us in ignorance as to the direction in which it moves. The natural inference would be that its direction is from the higher to the lower potential, but the following experiment brings us to a different conclusion.

Put the machine in operation in a darkened room at night, with the switch open, and the sliding electrodes separated three or four inches. From the electrode of higher potential, usually R, a brush of violet colored light, diverging from a small circular space, extends about three-fourths of an inch towards the opposite electrode, accompanied by a hissing sound.

The opposite electrode remains comparatively quiescent at first, showing only a glow of light; but, as the electricity accumulates, there is a sudden outburst from it, accompanied by phenomena of the most interesting and varied character.

A brush of light, of a faint white, or violet color, darts across the intervening space, diverging towards the centre, and converging as it meets the brush from the opposite electrode; forming an elliptical figure, 2 or 3 inches in diameter, extending from one electrode to the other. Through the centre of this brush shoot out long tongues of violet and rose colored light, curving and branching in a variety of fantastic forms. Sometimes 5 or 6 of these appear at once, like fiery serpents, hissing, spitting, and darting out their red forked tongues. Sometimes the appearance is that of a miniature tree, its main trunk branching off at various angles and curves. Then, again, the brush disappears, and we have a single, straight, violet colored stem, about three-fourths of an inch long, which divides into a great number of bright rays, radiating in straight lines from the end of the stem, and forming a globe of white light, about 3 inches in diameter; the whole resembling a little bush of remarkably regular appearance, in marked contrast with the curved and contorted phenomena just described. Between this, and the short brush on the opposite electrode, a dark space intervenes.



THE TOEPLER ELECTRIC MACHINE.

Now, if the discharge were from the higher to the lower potential, the phenomena here described could not occur. Instead of the short brush from the electrode of higher potential, we should have one extending across the entire space, and concentrating on the opposite electrode. But the experiment shows that there is a discharge from each electrode, with a dark space between, into which the

rays pass and intermingle; the brush from the lower potential being largely in excess of the other, and showing far greater energy; but more fitful, coming at first in jets, with a spitting sound, while the other is more constant, with a steady, hissing sound. Now, as already shown, the jar of higher potential, usually D, receives and stores up electricity on its inside coating, and repels it by induction from its outside coating, through the switch, when closed, to the outside coating of the jar C, causing electricity to be repelled from its inside coating. The electricity thus repelled, is attracted by the electrode R, of higher potential, and attracts electricity from it. Hence the discharge from P is influenced by two forces, repulsion from within and attraction from without, while that from R has only the force of attraction from the lower potential of P; the inside charge of D being bound by the lower potential of its outside charge; which sufficiently accounts for the difference of energy shown in the last experiment. But as this experiment was performed with the switch open, the effect was to substitute for the switch, which is brass, and has comparatively no resistance, a portion of the base, which is of kiln-dried wood, and offers high resistance. This retards the current, producing the difference of phenomena between the bright, instantaneous spark of white light, with its sharp report, and the slow moving brushes of violet light, with their hissing, spitting sounds; and from this slow movement we are able to determine the direction of the discharge, as already shown.

The subdivision of the spark when the switch is open next claims attention. It has been shown that the discharge between the inside coatings through the electrodes, P and R, and the intervening air space, is dependent on the counter discharge between the outside coatings, through the switch, when closed, or, through the kiln-dried wood of the base, when the switch is open. This discharge may be seen by opening the switch, half an inch or more, so that the resistance of the air is less than that of the wood: we then have a bright spark below, simultaneous with the spark above. But when the switch is opened so that the resistance of the air is greater than that of the wood, the discharge below takes place silently through the wood, and we have above, the subdivided, colored discharge already described.

With the switch closed, reducing the resistance below to zero, the discharge through the air is instantaneous; and there is seldom any subdivision, except that a long spark from a heavy charge sometimes divides into two, slightly separated during a part of their course. But, with the switch open, the high resistance retards the lower discharge, which is compelled to force its way slowly through the kiln-dried wood, making the change of potential between the outside coatings slow and gradual, and producing a similar effect on the inside coatings. Now, as the spark is caused by the electricity forcing its way through the air, whose electrified molecules are at the same potential near each electrode, and hence self-repellant, while the surrounding air is at a lower potential and attractive, these forces, acting at right angles to the original impulse, during the comparatively slow progress of the discharge, produce the brushes of diverging rays already described. Various influences, such as currents of air, particles of dust, and the induction of electricity generated on adjacent parts of the machine, curve and contort the spark, producing the peculiar phenomena already described in connection with the brushes, and also affecting the long bright sparks in a similar manner.

We next notice the color of the spark. Light is a mode of motion, and its color is influenced by the intensity of the motion. A bar of iron, drawn from the furnace, ready for rolling or welding, is said to be at a white heat; as it cools it changes to a red heat. Here the color of the light depends on heat, which is also a mode of motion; and as the intensity of the heat motion decreases, the light changes from white to red of various shades, till the bar resumes its original color.

The brilliancy of the arc in the electric lamp is due to the intensity of the motion, while the softer light of the incandescent lamp results from a motion less intense. When an electric lamp is being lighted or extinguished, the change of color from white to the various shades of red is evidently dependent on decrease of motion. Must we not conclude then that the white light of the electric spark, when the switch is closed, is due to intensity of motion, and the colored light with the open switch, to decrease of intensity, as in the iron bar or the carbon of the electric lamp? Or, if light and heat are modes of motion, is not the evidence equally strong that electricity is a mode of motion? Or may we not go still farther, and say that light, heat and electricity are only different manifestations of that energy which is a universal property of all matter, of which the experiments here given are an additional proof? For in the electric spark we have light, heat and electricity combined.

Having stated that D is usually the jar of higher potential, it should be explained that there is frequently a temporary reversal of potential; and, when this occurs, all the phenomena here described are reversed also. The cause of this reversal will be explained in connection with the following experiment.

EXPERIMENT VI.

Direct and Reversed Rotation.—Reversal of Potential.

A Toepler machine can be charged only by revolving the smaller plate in a given direction; which, in the machine represented by the cut, is shown by the arrow.

The reason is this: In order to store up electricity in the Leyden jars, each carrier must pass from an insulated brush, where it is charged, directly to a comb connecting with a Leyden jar, before it passes to an uninsulated brush, where it is discharged. Thus the carrier W, charged by the friction of the insulated brush E, must pass to the comb L, connecting with the jar D, and give up its principal charge, before passing to the uninsulated brush and comb H, where its residual is discharged through the brass rod H V, which puts it in electric connection with the carrier Z, of opposite potential. Reverse the rotation, and the carrier W, starting from E, would give up its principal charge to the uninsulated brush and comb at V, before reaching the comb K, connecting with the Leyden jar C, where only the residual would remain. It must also be noticed that the charge is greatly increased, both on the carrier and adjacent portion of the plate, by passing the inductor T, attached to the stationary plate B; whereas, when the rotation is reversed, the carrier leaves the inductor and passes the space between T and X, where the induction is almost zero. Thus it is evident that no storage of electricity in the Leyden jars, and hence no permanent charge can be obtained from a reversed rotation.

It has been shown in a former article, that from the higher position, and hence better insulation of the brush E, and upper half of the revolving plate A, as compared with the lower position, and consequent inferior insulation of the brush F, and lower half of A, the potential of the jar D, receiving its charge from the former, must be higher, as a rule, than that of C, which receives its charge from the latter. Repeated experiments, which I have made with more than 100 different machines of this kind, fully confirm this position. The higher potential is shown by the frequent partial discharges between the inside and outside coatings of this jar; and, in case of fracture, which sometimes occurs from an overcharge, it is always this jar which is broken, and the fracture always occurs on the side nearest the opposite jar, showing that the charge is attracted to that side, and electricity repelled from the outside coating, creating a sufficient difference of potential between the two coatings to overcome the resistance of the glass and perforate it.

It has been already stated that there is frequently a temporary reversal of potential. Such a reversal can be

produced, if desired, by joining the electrodes P and R, reversing the rotation of the plate, then separating P and R, and resuming the direct rotation, when a complete reversal of potential will be found to have occurred, which will continue till again reversed by a similar experiment. The explanation is as follows:—

When P and R are joined, equilibrium is restored between C and D; then, when separated, and the rotation reversed, the same causes which operated to raise the potential of D above that of C, now operate to raise the potential of C above that of D, but in a very limited degree. For, as already shown, any carrier, as W, charged by the brush E, would now give up its principal charge to the brush and comb at V; but the residual, slightly increased by the inductor X, would be given up, through the comb K, to the jar C; while the opposite carrier Z, would give up its principal charge at H, and carry its residual to the comb L, and the jar D, after a slight increase by the inductor T. But the difference of insulation between the upper and lower parts affect these residual discharges in the same manner as the principal discharges, and hence operate to make the potential of C, receiving its charge from above, higher than that of D, receiving its charge from below. This residual is not sufficient of itself to bring the machine into action, but it creates a slight difference in favor of C, sufficient to sustain a reversal of potential when the direct rotation is resumed.

EXPERIMENT VII.

The Faradic Current.

The faradic current consists of a series of electric impulses following each other with great rapidity. It is obtained from the battery and coil by a spring vibrator, which opens and closes the circuit; and from the magneto-electric machine by a revolving electro-magnet and commutator.

Both these instruments have, for many years, been extensively used in medical practice; but the use of a static machine for this purpose is quite recent, and the switch, on the machine here represented, affords special facilities for producing and utilizing this current. In the cut are shown two sockets, on the front edge of the base, connecting with the terminals of the switch, into which are inserted the tips of conducting cords, to the outer extremities of which may be attached metal handles, as shown in the cut, or other electrodes suitable for the use of this current, for medical or scientific purposes.

As already shown, when the machine is in operation there is a constant discharge of electricity through the switch and its connections, simultaneous with the discharge between the electrodes P and R. When the switch is open and the cords attached, as in the cut, this discharge must either force its way through the kiln-dried wood, or pass out through the cords and any object connected with their outer terminals, according to the degree of resistance offered by each path respectively. If a person, or a number of persons with hands joined, grasp the handles, as shown in the cut, the resistance will be less than through the wood, and they will feel the effects of the discharge. This discharge is regulated by the distance to which P and R are separated. With a separation of $\frac{1}{16}$ of an inch, on a large machine, the discharge is so rapid that the distinction between the impulses can scarcely be perceived; producing a faradic current smoother than can be obtained from the best batteries, while a separation of half an inch produces effects which the strongest nerves cannot endure.

This current, in its milder form, cannot be distinguished from that obtained from the battery, or magneto-electric machine; but, in its more powerful effects, it is more impulsive, coming in jets, with cumulative force, like the rapid blows of a planishing hammer, while with the battery, the stronger effects show increased intensity, and a greater tendency to muscular contraction. The reason of this is evident, when we consider that the strength of the battery current is increased by an increase of magneto-electric force, the motion of the vibrator remaining the same; while increase of strength in the static current is due to the slower impulses giving more time for the accumulation of electric energy.

EXPERIMENT VIII.

The Electric Bath and Electric Wind.

Charging a person on an insulated stool is one of the most common experiments in static electricity, but it has only recently come into use in medical practice; and, instead of the stool, an insulated platform, on which one or more persons can be comfortably seated, has been substituted; the treatment being known as the "Electric Bath."

When the patient is seated, as above, the electrodes P and R, drawn out beyond sparking distance, and the switch closed, a connection is made between the patient and the machine by a conducting cord; one end being attached to the ball surmounting one of the Leyden jars, and the other end to the chair. A similar connection is made between the opposite jar and the floor near the platform, to create a certain degree of induction, and so facilitate the process of charging, which is now done by putting the machine in operation. Very little sensation is experienced from this charge, but its effect in certain nervous diseases, which cannot be treated with the battery, such as St. Vitus's dance, is said by medical men to be very soothing. In other cases sparks are drawn from the patient with the hand or a suitable electrode, as a ball, roller, or sponge, attached to the cord from the opposite jar, and held by an insulating handle.

The electric wind is given by a point electrode, attached as above, either with or without the insulated platform. A gentle current of electrified air from the point fans the patient, producing a delightfully soothing sensation.

Electric treatment of this kind can be given only by static electricity, and its value must be determined by the medical profession, among whom it is coming into favor, both in this country and in Europe; being used and recommended by physicians of eminence.

EXPERIMENT IX.

Gas Lighting.

Lighting the gas in churches and public halls by electricity is commonly done by a battery and coil, but the Toepler machine can also be used for this purpose. With either method there must be wires connecting the generator with the chandeliers, wires connecting the chandeliers together, and also the separate burners; all arranged in one circuit and properly insulated. At each burner there is a break in the circuit, so arranged that a short spark will pass through the gas; the ends of the wire being attached to a porcelain insulator fitted to the burner.

With the battery there is a ground wire, and connection with the gaspipe to complete the circuit; but, with the machine, the circuit is made by two separate wires, connecting the chandeliers with the balls surmounting the Leyden jars. On account of the greater intensity of static electricity, these wires must be thoroughly insulated with thick rubber tubing, wherever they are liable to come in contact with the walls or gas fixtures. With these arrangements properly made, it is only necessary to close the switch, separate P and R to the full extent, turn on the gas, and put the machine in operation. The resistance of the air between P and R being greater than the resistance of the wires and the short breaks between their terminals at the burners, the sparks take place at the burners, and the gas is lit. This system has been in successful use for the last two years, in one of the large churches of Chicago, with a small two-plate machine of the style represented in the cut.

As to its expense, convenience, and efficiency, as com-

pared with the battery system, only general statements can as yet be made. The first cost would probably be about the same; after which there would be no further expense with the machine, which, with proper care, should remain in good working order, for this purpose, for an indefinite term of years, while the battery requires frequent renewal of the fluid, and occasional renewal of the zinc, besides cleansing and amalgamating.

As to efficiency, the greater intensity of the spark from the machine will be evident, when we consider that a machine of very moderate size will easily produce sparks three to five inches in length, while a very large battery and coil would be required to produce the same result. But this should be taken merely as an indication of the comparative intensity, as, practically, only very short sparks are required; so that a battery and coil of medium size is generally sufficient.

A damp atmosphere does not affect the battery, while it lessens the energy of the machine, and, in unskillful hands, may interfere with its practical efficiency. But, with either system, the person in charge should have a thorough knowledge of its care and management, in which case the machine can always be kept in practical working order.

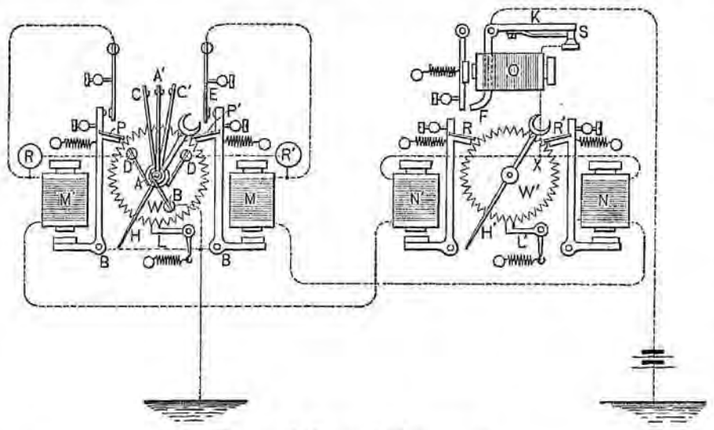
CHICAGO, Nov. 1, 1884.

TELEMETRY.

BY D. W. EDGECOMB.

THIS very appropriate term has been lately applied to that branch of electrical science which has to do with the indication and recording of variable physical forces, such as temperature and pressure, at any distant point.

Mr. Robert Hewitt, Jr., of New York, must be fairly considered as the originator of the first practical commercial system of telemetry, while to the inventive genius of Mr. Charles L. Clarke, the well known electrician, is due the perfected series of apparatus for transmitting and recording, instantly and continuously, the indications of temperature, steam and barometric pressure, the height of water, etc., now regularly constructed and installed by the Telemeter Company of New York, and which was exhibited in practical operation by that company at the late International Electrical Exhibition in Philadelphia.



HEWITT & CLARKE'S TELEMETER.

It is scarcely necessary to enumerate the numerous branches of modern industry that stand ready to accept the aid offered them by a reliable system of this kind. In breweries, oil, sugar and other refineries, storage warehouses, refrigerators, the holds of vessels, drying and seasoning rooms, wherever heat or its absence is to be maintained for the preservation of valuable property, or where security of life is involved, as in the pressure of steam and the heating of public buildings, the variations and condition of the element which involves danger if unwatched and uncontrolled, may be indicated at any desired point, and neglect exposed.

A system securing these results involves, first, the transmitter, or the instrument which indicates the variable force at the place where it exists, whether the thermometer in the dry house or at the mountain top, the steam gauge at the boiler, or the water indicator at the reservoir, in combination with suitable electrical devices; and second, a receiver or counterpart instrument at the point where the variations are desired to be known. To maintain these in perfect unison or synchronism automatically, so as to afford a reliable system, has proved one of the most difficult of electrical problems. The instruments of Messrs. Hewitt and Clarke are operated upon the open circuit principle, thereby involving but slight expenditure of battery power, while the devices for securing unison and correct indication of the distant changes are not only most ingenious and elegant from a mechanical and electrical point of view, but appear to be entirely successful, having proved themselves to be trustworthy and reliable through months of practical use.

These devices will be readily understood by means of the drawing, which shows diagrammatically the two instruments, and the arrangement of the electric circuits.

The transmitting device is at the left hand, and the receiver at the right hand. The shaft A carries the contact arm A1, and it is moved by the initial physical instrument—that is, the shaft A is the same which carries the index hand of a metallic thermometer, pressure gauge, or any other instrument indicating the varying force to be watched. Thus, in the instruments furnished by the company, the thermometer used is a fine instrument of the Breguet form, with delicate adjustments, its central shaft being the same as A; their barometer is of the siphon form, the open arm being of large diameter, to prevent capillarity, and carrying a float actuating a wheel upon the shaft A. These instruments are called respectively the Telethermometer and the Telebarometer; and the nomenclature is similarly applied to all the various instruments used to indicate variations in the physical forces. As the simple mechanical devices whereby these forces may be made to give motion to a shaft in its bearings are well known, this part needs no further explanation. A in the drawing, then, may be considered as this shaft, or its extension, in any one of the several instruments. It is electrically connected, as will be seen, through B, with the ground and with the armatures of the two electro-magnets M and M1; C and C1 are two contact points carried on arms each side of A1, and which are carried on an insulated sleeve, and are also insulated from each other. This sleeve is carried on a shaft (which also carries the V-toothed wheel W) and which itself is a sleeve over the shaft A. As the wheel W revolves with C and C1, the continuity of the circuit is preserved by two insulated posts, D and D1, which carry two wires resting each in a groove in the insulated sleeve. By this means the circuit of D is maintained with C, and D1 with C1 respectively. The shaft which carries the wheel W, and the arms C and C1, also carries the index hand H. P and P1 are the pawls which propel the wheel, W, and which are normally out of the path of its teeth, the wheel being held by the locking-pawl L.

It will be seen that the diagram shows a similar arrangement of devices and circuits on each side of the wheel W. The pawls P and P1 are carried upon the right-angled armature levers of the magnets M and M1. They serve to turn the wheel W, in either direction as M or M1 is vitalized. The shape and position of the pawls L, P and P1, with reference to the teeth of W, are such that the latter is always securely locked, and no matter what excess of battery power may drive P or P1, the wheel W can never be carried more than one tooth by a single impulse. The wheel and pawls of the receiver are precisely similar to those of the transmitter, hence it is only necessary that the two instruments receive similar impulses to have the two wheels move in unison, as neither can move more than one tooth for a single impulse.

Let us suppose now that the shaft A, is moved by some force acting upon the initial instrument, as has been explained, and that A1 is made to touch C, then the series of magnets M, N, and O are put in circuit, as also the small resistance coil R1. The coils of the magnet M, are so adjusted that it attracts its armature first in the series, and the first movement of its armature causes a contact at the point E, where a shunt is formed around the resistance R1, and the contacts A, C. This is a most important thing in this class of instrument and is a great factor in their reliable operation. The subsequent action of the circuit is independent of the delicate points A and C. The continued motion of the armature of M causes the pawl P1, to engage a tooth of W, and to turn the latter until the pawl fits in the space between the teeth. This movement of the wheel separates the contacts A1 and C, by moving C away from A1, so that the latter stands as before, midway between C and C1. The locking pawl L, also slips over the point of its next tooth. The circuit, of course, has not been broken by the movement of the wheel, because the shunt was formed, as has been explained, around the contacts A1, C, before they were separated. The separation also takes place without a spark, as the shunt is without resistance to the electric current.

Almost simultaneously with the engagement of P1 with the wheel W, the pawl R1 in the receiver engages its wheel W1, and the same operation just described is repeated. The coils of the magnet O, are adjusted so that it is the last in the series to respond to the impulse, and its armature lever strikes the arm F, freely turning upon its pivotal support, and the horizontal arm K, is thrown up, breaking the circuit at the point S. The instant this takes place, the springs draw the armature levers of all the vitalized magnets back to their normal position, separating the points at F and E, and withdrawing R1 and P1; and since the contacts A1, C are already open, it follows that when S falls back again the circuit is open and remains so until A1 makes another contact. It will readily be seen from the above that the indexes H and H1, have moved one division on their respective dials, and as the wheels W and W1 must move together, and in the same direction, it is impossible for the indexes to move except in unison. If the original force had turned the shaft A in the other direction, and had thus brought A1 in contact with C1, then the magnets M1, N1 and O would have been vitalized in series, and have operated in the same order, moving W and W1 one tooth in the opposite direction from that described.

To prevent the circuit from opening at the point S at the wrong time (which it might do from a sharp jar or shock, for instance, at the instant after the armature of M had moved and before that of N had moved, thus throwing the indexes H and H1, out of unison), the contact point at S, carried by the arm K is supported on a long spring which is so adjusted that when the arm K is raised, its contact point is held a short distance away from K, but when K is down, the contact point is pressed against it. This device prevents any jar which might otherwise open the circuit at S, from having that effect.

The system, it is evident, is equally applicable to those instruments in which the index hand moves completely around the dial, as in clocks, as to those where the movement is confined to a portion of the dial, as generally in temperature or pressure indicators.

The instruments of the company are made self-recording, the paper being moved by clock-work. Maxima and minima hands are also provided, which may be set to ring an electric alarm bell at any desired limits.

EVOLUTION OF THE ELECTRIC RAILWAY: [1]

ITS COMMERCIAL AND SCIENTIFIC ASPECT.

BY DR. WELLINGTON ADAMS.

SINCE Denys Papin, in 1687, proposed the transmission of power over long distances pneumatically, human genius in every age and clime has been struggling to solve the problem of power transmission in accordance with the principles of economy.

It is primarily the more desirable to effect this, that advantage may be taken of the various forces of nature, such as the ebb and flow of the tide, swift-running streams and waterfalls, for the performance of work at points located awkwardly or at some distance from the source of power.

Furthermore, since the advent of the steam engine, the economy attending the centralization of power and its distribution to isolated consumers, even when thus artificially developed, has been fully recognized by all engineers. Various methods have been proposed for accomplishing this; such, for instance, as pneumatic, hydraulic, cable, and steam transmission. But all have thus far failed to practically meet the requirements, until now electricity has entered the field as a contestant, and seemingly put an end to competition; since it has been both *theoretically* and *practically* demonstrated beyond question by a host of noted scientists, some of whom have the honor of being recognized as among the greatest living engineers—such, for instance, as Sir William Armstrong, Sir Frederick Bromwell, Dr. Werner Siemens, Sir William Thomson, Prof. John Perry, and W. E. Ayrton, M. Marcell Deprez, Count du Moncel, and many others of like scientific celebrity—that electricity may be used as a medium of power transmission with greater facility and economy, all things considered, than any of the other known methods.

It is the invention of the dynamo-electric machine that has rendered possible this method of power transmission. Such a machine yields electricity as the result of rotation imparted to it by the expenditure of mechanical power derived from some natural or artificial source. A portion of this power may be reclaimed by causing the electric current generated in one dynamo-machine to circulate through a second similar machine. Hence, all dynamo-electric machines—the name signifying from mechanical motion to electricity—become electro-dynamic machines when the condition of affairs is reversed, and an already existing current of electricity is caused to circulate through them. The second or reclaiming machine, or translating device, as some call it, will, when a "series wound" machine, rotate in an opposite direction and deliver up a certain proportion of the mechanical power expended upon the pulley of the first. This constitutes the basis of the electrical transmission of power. These facts are generally admitted to have been first pointed out and demonstrated by Messrs. Fontaine and Gramme, at the Vienna Exhibition of 1873; although Pacinotti had, in 1861, constructed a motor identical in principle with the modern dynamo-electric machine, and clearly pointed out

1 Read by the author before the Engineer's Club, of St. Louis, April 23, 1883, and published in the *Journal of the Association of Engineering Societies.*

its reversibility. Considering this question of electric transmission of power from its two principal standpoints —first, as regards the electric current developed from the mechanical power (the steam engine, for instance); and second, as regards the amount of mechanical power reclaimed from this current at the distant point through the instrumentality of an electro-dynamic motor, the efficiency of the system is 70 per cent., allowing 7 per cent. for loss by leakage in and resistance of the connecting conductor. The amount of energy lost by the two conversions from mechanical motion into electrical energy, and from electrical energy back again into mechanical motion, is a fixed quantity, and practice has demonstrated this to be 13 per cent. from the first, and 10 per cent. from the second process, when the most efficient types of electric generator and electric motor are used.[2]

The other element of loss—that by leakage in and resistance of the connecting conductor—will naturally vary with the conditions in each individual case, and will depend entirely upon the size and insulation of the connecting conductor. In general it will, in my opinion, be best to base a calculation upon a 7 per cent. loss in the conductor, allowing 5 per cent. for resistance and 2 per cent. for leakage. This, however, will be governed entirely by the peculiar conditions attendant upon each individual case. The rule given by Sir William Thomson is to the effect that the most economical diameter is secured when the two losses (that is, the loss from heating and the interest upon the price of the conductor) are equal. Knowing the cost of 1 h. p. of electrical energy in any particular locality, which depends upon the price of coal and the efficiency of the machinery used, and the cost of copper per ton, and remembering the formula $H = \frac{C^2 R}{746}$, the calculation for that locality may be readily made. Assuming, however, the loss in the conductor to be 7 per cent., and the loss in each of the translating devices to be 10 and 13 per cent. respectively, the total loss by transmission becomes 30 per cent.; or, in other words, 70 per cent. of the power expended at the point from which the distribution is to take place, may be recovered in the reclaiming machines or electric motors. That is to say, we may deliver within reasonable distances just $\frac{7}{10}$ of the power expended in the first instance. For example: a steam engine of 500 h. p. operated at a central station in the centre of a 10-mile circuit, could by the aid of an electric current traversing a suitable conductor, lay down $\frac{7}{10}$ of its power, or 350 h. p. distributed among as many different points within that circuit. The fact must here be borne in mind that, aside from all considerations of nuisance and cost of service of engineers, this 500 h. p. may be generated in a single engine for one-fourth the cost, in the way of fuel alone, of generating the power in small engines. Consequently, while we lose 30 per cent. of the power by this two-fold conversion and transmission, we more than make up for such loss by this one item—the gain in point of economy of fuel from the saving effected by the generation of our power in one or two large engines as compared with the cost of developing the same power in a number of small engines. Other than this, however, there are very many more important sources of economy and advantages attendant upon the centralization of our forces. Such an amount of reclaimed power is far in advance of that obtained under similar conditions with compressed air, pulleys and shafting, cables and steam, and approaches the theoretical efficiency of hydraulic transmission as advocated by Sir William Thomson, with the fact in favor of electricity that it possesses the unparalleled advantage of being almost entirely untrammeled with the obstacles presented by distance, while it is at the same time remarkably portable and capable of having its direction and intensity changed at the will of a child. No force can be detected in the connecting portions, that is, in the conductor, such as appears during mechanical transmission with shafting and cables or in pipes with compressed air, steam or water. The conductor is clean, cold, and does not move, appears inert and can be shifted, bent or moved in any manner with the greatest facility while transmitting many h. p. The primary source of power and the point of reclamation may be relatively situated most awkwardly, for the electric conductor, which is simply a copper wire, may be brought round the sharpest corner or carried through the most elegantly appointed private room conveniently and without any manner of annoyance or danger. A conductor carrying many h. p. through a room may be rendered imperceptible. There is no noise, no smell, no dirt, no heat, nothing to burst or give way; and the same circuit which may be tapped to provide many h. p., can be as conveniently drawn from to work a sewing or a washing machine, a small ventilator, a table or desk fan, a domestic flour sifter, an egg-beater, a dentist's drill, a jeweler's or dentist's lathe. So convenient a source of light power will give rise to the invention of many new devices for the mechanical performance of much of the light domestic work which now proves a bugbear in every household.

In mining and excavating operations electric transmission will prove of great value, since it involves no danger and may be carried to points inaccessible to any other form of power. For plowing by power, trials made in France show that electricity can replace steam with advantage and economy.

In Scotland, power obtained from a waterfall has been electrically transmitted one mile and a half with an electrical return of 85 per cent. In Prussia, France, Austria, Ireland and England, many miles of electric railway in successful *commercial* operation demonstrates the feasibility of, and the many advantages attendant upon, electric transmission; for, as we shall see further on, this very principle of electric transmission of power to a distance constitutes the foundation of the modern electric railway, and it is here that this principle finds its pre-eminently important application.

From these, and very many other things not here mentioned for want of time, which have already been accomplished, calculations have been based, and these show conclusively that it is possible to render available at every door any desired proportion, within reasonable limits, of the stored-up energy of our continent, in a form at once universally applicable, cheap, noiseless, cleanly, safe and manageable by unskilled hands.

All this is not only theoretically possible, but economically practicable. It is not of necessity simply a dream of a future Utopia. It may be made a realization of the present—a grand every-day commercial experience.

It only requires that engineers generally and capitalists shall become conversant with these facts, to bring about a transition from the stage of practical *demonstration* to that of practical *application*. It seems strange, perhaps, to some of us, when we consider that these things have been demonstrated facts since the beginning of the present decade, that capital has not been directed in this channel ere this. Great scientific truths, however, become popularized very slowly. They require a long time to become a part of the current knowledge of mankind. Without doubt we all recall to mind how it was fully a century after Copernicus died before the Copernican theory was generally accepted by even the *learned*. And again, how from the time of Hero, who clearly set forth the principle of the modern steam engine, we find no historical evidence of its application to practical purposes for many centuries. Although John Fitch, in 1785 demonstrated beyond peradventure the feasibility of steam navigation, and worked

2 The lecturer here demonstrated the electrical transmission of power, by means of two dynamo machines of about 1½ h. p. each; and also by means of two Holtz machines—one acting as generator, the other as a motor. The electric motor used upon this occasion had been continuously and successfully running the machine shop connected with Dr. Adams' laboratory for over a year.

indefatigably up to the time of his death, in 1798, for its introduction as a commercial feature of our country, it was not until 1807 that capitalists, appreciating the field open to them, came to the rescue, and assisted Fulton to make steam navigation an every-day commercial success; and even so worthy a scientist as he, frequently endeavored in vain to secure pecuniary countenance from the possessors of wealth and influence. With what force the frequently reiterated assertions of John Fitch come home to us now: "The day will surely come when some more powerful man will get fame and riches from my invention, but no one will believe that poor John Fitch can do anything worthy of attention."

Let us hope the day for reproaches similar to those Fitch indulged in are past, and that capital, with its frequent similar experiences, backed by greater enlightenment and enterprise, will never again be wanting to prosecute schemes based upon scientific facts which bespeak untold wealth for their projectors and promise to confer manifold blessings upon mankind.

(To be continued.)

THE CONSTRUCTION OF LINES FOR ELECTRIC CIRCUITS.

BY THOMAS D. LOCKWOOD.

(Continued from page 242.)

TURNING now to the subject of insulation, it is to be noted that in addition to the well-known insulating materials, such as india rubber, gutta percha and kerite, a variety of new substances have recently been introduced: these are ozokerite, various forms of petroleum residuum, and bitite, which is practically vulcanized bitumen. There is really very little to say about any of these. We do not advocate the universal use of gutta percha, although there seems to be nothing so satisfactory for subaqueous cables. Its strong affinity for oxygen renders it almost useless for open air work as it cracks very soon and the insulation is then ruined; gutta percha whenever used in the air should be covered with tape soaked with Stockholm tar.

India rubber is a first-class insulator—and has a lower inductive capacity than gutta percha, and as compared with gutta percha it is for aerial cables a great improvement. Its defects are that it can absorb water, and so

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The following Tables, which accompany Dr. Adams's paper, show the relative cost of different systems of power transmission:

TABLE I.

Cost of 1 h. p. hour in shillings if transmitted by electricity (potential 1,500 volts.)

H. P. transmitted.	Distance in Metres. 100	500	1,000	5,000	10,000	20,000	Prime Mover.
5	0.188	0.194	0.201	0.230	0.274	0.433	Steam.
10	0.167	0.173	0.178	0.211	0.258	0.403	
50	0.155	0.161	0.166	0.190	0.227	0.253	
100	0.149	0.154	0.159	0.182	0.219	0.340	
5	0.029	0.030	0.031	0.037	0.043	0.070	Water.
10	0.022	0.023	0.024	0.030	0.030	0.059	
50	0.019	0.020	0.022	0.024	0.026	0.046	
100	0.017	0.018	0.019	0.022	0.024	0.042	

TABLE II.

Cost of 1 h. p. hour in shillings, with hydraulic transmission.

H. P. transmitted.	Distance in Metres. 100	500	1,000	5,000	10,000	20,000	Prime Mover.
5	0.209	0.236	0.263	0.544	0.873	1.053	Steam.
10	0.198	0.213	0.232	0.423	0.641	1.100	
50	0.136	0.142	0.150	0.242	0.351	0.651	
100	0.135	0.141	0.148	0.239	0.345	0.570	
5	0.024	0.032	0.040	0.115	0.208	0.320	Water.
10	0.021	0.025	0.031	0.079	0.138	0.264	
50	0.013	0.015	0.018	0.038	0.063	0.110	
100	0.013	0.014	0.016	0.036	0.060	0.095	

TABLE III.

Cost of 1 h. p. hour in shillings, with pneumatic transmission.

H. P. transmitted.	Distance in Metres. 100	500	1,000	5,000	10,000	20,000	Prime Mover.
5	0.225	0.247	0.275	0.483	0.704	1.396	Steam.
10	0.212	0.234	0.259	0.373	0.521	0.863	
50	0.168	0.176	0.182	0.239	0.295	0.441	
100	0.167	0.170	0.174	0.218	0.258	0.375	
5	0.038	0.039	0.048	0.106	0.200	0.371	Water.
10	0.029	0.032	0.037	0.073	0.118	0.231	
50	0.018	0.021	0.023	0.037	0.054	0.090	
100	0.018	0.019	0.020	0.030	0.042	0.069	

TABLE IV.

Cost of 1 h. p. hour in shillings with wire rope transmission.

H. P. transmitted.	Distance in Metres. 100	500	1,000	5,000	10,000	20,000	Prime Mover.
5	0.094	0.122	0.157	0.455	0.808	1.899	Steam.
10	0.093	0.115	0.142	0.375	0.709	1.593	
50	0.090	0.098	0.108	0.212	0.376	0.925	
100	0.019	0.095	0.102	0.184	0.319	0.813	
5	0.009	0.010	0.025	0.104	0.207	0.406	Water.
10	0.008	0.014	0.021	0.080	0.159	0.333	
50	0.008	0.009	0.010	0.032	0.060	0.121	
100	0.007	0.008	0.009	0.023	0.042	0.090	

From these tables the author, whose name escapes my memory, concludes that in all cases where these four systems are equally applicable, wire rope transmission is best for distances under one kilometer (1,100 yards), and electrical transmission for longer distances.

The following curves, which have been platted from these tables, represent geometrically the relationship existing between these several methods of power transmission. (See Figures 1 and 2.)

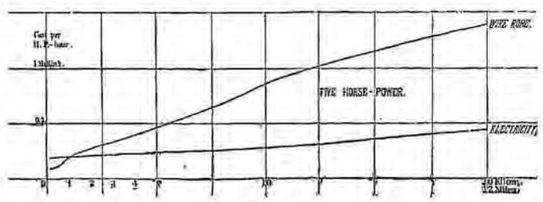

FIGURE 1.

Shillings.

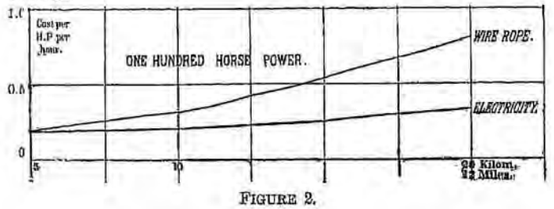

FIGURE 2.

tends in some degree to lower its insulation after it has been used some time, and also that when placed close to copper wire it decomposes, forming a viscid, tarlike substance. If conductors can be secured, in which the wire is exactly in the centre of the rubber insulation—the group of wires being well insulated and protected from injury and the weather by some external and reliable envelope—and if the precaution is taken of covering each copper wire with a layer of cotton before the rubber is put on, which proceeding prevents the chemical change referred to, there seems to be no reason why rubber should not prove to be a very satisfactory insulator.

Kerite is a vulcanized compound of asphaltum or tar mixed with certain vegetable oils. It is a good insulator, has a reasonably low inductive capacity, and if properly protected is very durable. Electrically it is first-class, and wherever kerite cables are used they are appreciated.

The new insulating compounds which have been referred to, are highly commended by their proprietors, are well spoken of by experts, and to the knowledge of the writer are very high insulators. The one element of durability is with them still uncertain, at least so far as our personal knowledge is concerned. We have not proved them.

There remains still one cable to be noticed, viz., the paraffin cable. Paraffin melts at from 113° F. to 140° F., and when solid is one of the best insulators known. Its resistance, however, depreciates very rapidly with warmth. It is obtained from coal tar, bituminous shale, peat, and mineral oil. One of the best telephonic cables now made consists of a group of copper wires each covered with two or more windings of cotton saturated with paraffin, and encased in a lead pipe. The space between the wires and the pipe is filled with paraffin, and the entire filling is heavily charged with gas which is scattered in globules throughout the mass. The electrostatic capacity of this cable is very low, and experience has demonstrated that it is a serviceable cable.

It is then evident from the foregoing considerations, that in ordering cables for ærial work, paraffin, rubber, and kerite are the materials which have proved themselves to be adapted for the purpose of maintaining insulation, and if either are chosen, they will probably prove satisfactory if well put together mechanically. For protection, the paraffin cables as made by the Western Electric Co., are, as already indicated, enclosed in lead piping; while the kerite cables are wrapped with kerite tape, and the rubber cables have been enclosed in painted canvass. There is, however, much still to be desired in this respect, and a protective envelope for ærial cables that is light, strong, durable, and capable of successfully withstanding for a long time the action of wind and storm would be very acceptable.

We now approach the different means which have been adopted to counteract or neutralize induction between wire and wire.

Until the advent of telephony, this obtrusive element in the electric transmission of intelligence was not often troublesome in the case of overhead lines. In telephonic transmission, however, it is very annoying indeed. Whether in bare wires supported as usual on insulators and poles, or in cables as we have described, this evil appears. Many of the disturbing currents known to the average telephonic employé or to the general public as induction, are really due to other causes. These are briefly: earth currents, atmospheric electricity, thermo electric currents arising from the ever varying thermal conditions of the earth and air, and magneto electric currents due to the swing of long wires, when stretching in an east and west direction, across the magnetic meridian of the earth. With disturbing currents due to these influences we have at present nothing to do. With all this, there are yet a multitude of disturbing effects produced by actual induction between wire and wire, resulting, if some of the wires are used for telegraphs and some for telephones, in the fact that the telegraphic signals are heard in the telephones, sometimes so loudly as to drown the legitimate sounds of articulate speech which are desired. If all the wires are used in connection with telephones, the message sent on one wire may be heard in the telephones connected with the others. What shall we do to prevent this? It is a fact worth knowing that in a cable of any given number of wires, say 50, if we speak on any one wire, the words can be heard nearly as well in a receiver connected with another wire, provided the remainder of the wires in the cable are left disconnected or open; but if we connect all the others to ground, the effect is greatly reduced, and practically dissipated. This leads to the conclusion that if we have a cable of more wires than are necessary for our business, by grounding or by looping the spares together at the ends, we may dispense with any other anti-induction devices.

For cables which are less than 500 feet no preventive of induction seems to be absolutely necessary, and half a dozen extra wires, grounded at both ends, have sufficed.

For longer cables it has for some years been customary to adopt the expedient patented by Dr. Foucault, and to surround each insulated conductor with a metallic coating (usually tinfoil) in connection by wires at suitable points with the earth. This remedy certainly subdues not only the induced currents, but also the extraneous currents due to other causes which have been referred to, and enables reasonable work to be got out of the cables. It is true that it also subdues the articulate speech, or rather the currents which reproduce the same, but not in so great a degree; and it has thus proved to be a great assistance to cable construction. It is thought that it would be still more efficient if a thicker metallic coating could economically be employed, or if iron could be commonly used for the outside coating, as, in the first case, the conductivity of the metal sheath would be greatly improved as a circulating medium for the induced currents, and in the second place, the induced electricity is transformed into magnetism in the iron coating. It has also been proposed to insulate the outside metallic coating of each wire, and then to loop them together in pairs at each end; but it is obvious that this is substantially the same expedient which was at first mentioned. In the paraffin cables which we have described, the only remedy against induction is a large central wire which at the ends may be connected either with the ground or with the enclosing tube, each wire apparently performing the function of an induction screen for the others. The most effectual arrangement for neutralizing induction is, however, to dispense with the use of the ground as a return circuit altogether, and to provide a metallic return wire in lieu thereof, the two wires being so placed as to be equidistant from the disturbing wires. This is best accomplished by twisting the two wires of each circuit together. This arrangement has not greatly found favor in the eyes of exchange managers, since it involves the use of a double wire not only for each conductor in the cable itself, which would be a small matter, but also throughout, in the remainder of each line, and in the switch apparatus also. The necessity for employing anti-induction devices limits the length of cable which may profitably be employed, because the devices which have proved to be most generally useful—*i. e.*, those which bring the earth into close proximity to the outside of the insulated conductor by means of a grounded metallic envelope, unfortunately increase the electrostatic capacity of each line materially, and thus cause a very pronounced degree of electrical retardation if the cable exceeds in length a maximum of two miles.

(*To be continued.*)

DEATH OF ROBERT SABINE.

We learn with profound regret of the death of this well-known English electrician, which took place on Saturday, October 25. Mr. Sabine was born at Dorchester, November 6th, 1837. At the age of 17 he secured a position as assistant electrician with the late Sir William Siemens, who at that date was in business as an electrical engineer in London. In 1867 he embarked in business on his own account, and subsequently became a director of the factory of the late Sir Charles Wheatstone. It was under his management that some of the first Gramme machines were constructed.

His literary ability was generally recognized as of a high character, and his electrical works are regarded as of standard authority. He was thoroughly versed in both land and submarine electrical engineering. Like most men of his class, he was of a retiring disposition and simple manners. He was eminently conscientious in all his undertakings. He married a daughter of Sir Charles Wheatstone, who survives him with a son nine years of age.

ABSTRACTS AND EXTRACTS.

CONDUCTIVITY OF METALS AND ALLOYS.

M. Lazare Weiller has conducted a new and independent investigation into the electrical conductivity of certain metals and alloys, the results of which he lately presented to the Society Internationale des Electriciens. For the purposes of his experiments he caused small bars of metal to be cast of a diameter of about 13 mm. (0·51 in.). These were divided in such a way as to show the grain of the fracture, and one part was drawn into wire to be used in the trials. Those alloys which can neither be drawn nor rolled easily such as silicides and phosphides, were tested directly on the cast bars after the method of Sir William Thomson. In the trials the bars, fitted with binding screws at each end, rested upon knife edges at an invariable distance apart. These knife edges were respectively in communication with two resistances composed of two parts, of which the one was a thousandth part of the other. The extremity of one was connected to the fixed terminal of a Wheatstone bridge with a sliding contact, and the other to the slider itself.

The two points which separated the resistances communicated with the galvanometer. Finally the extremities of the bridge were connected to the binding screws by means of a circuit, which included a battery of four elements and a contact key.

The resistance sought was then equal to the resistance measured upon the wire of the bridge, divided by 1,000. The measurements, which were very carefully and accurately conducted, and were effected on a great number of specimens, were made in part by M. Weiller himself, and in part by M. Duflon, in the laboratory of MM. Breguet. The results are given in the following table:

1. Pure silver	100
2. Pure copper	100
3. Refined and crystallized copper	99·9
4. Telegraphic silicious bronze	98
5. Alloy of copper and silver (50 per cent)	86·65
6. Pure gold	78
7. Silicide of copper with 4 per cent of silicium	75
8. Silicide of copper with 12 per cent of silicium	54·7
9. Pure aluminum	54·2
10. Tin with 12 per cent of sodium	46·9
11. Telephonic silicious bronze	35
12. Copper with 10 per cent of lead	30
13. Pure zinc	29·9
14. Telephonic phosphor-bronze	29
15. Silicious brass with 25 per cent of zinc	26·49
16. Brass with 35 per cent of zinc	21·5
17. Phosphor tin	17·7
18. Alloy of gold and silver (50 per cent)	16·12
19. Swedish iron	16
20. Pure Banca tin	15·45
21. Antimonial copper	12·7
22. Aluminum bronze (10 per cent)	12·6
23. Siemens steel	12
24. Pure platinum	10·6
25. Copper with 10 per cent of nickel	10·6
26. Cadmium amalgam (15 per cent)	10·2
27. Dronier mercurial bronze	10·14
28. Arsenical copper (10 per cent)	9·1
29. Pure lead	8·88
30. Bronze with 20 per cent of tin	8·4
31. Pure nickel	7·89
32. Phosphor-bronze with 10 per cent of tin	6·5
33. Phosphor-copper with 9 per cent of phosphorus	4·9
34. Antimony	3·88

The resistances are not given in ohms, but as proportions to a given body. They may be reduced to the conventional standard on the assumption that a wire of pure silver, one millimeter in diameter, has, at a temperature of zero Cent., a resistance of 19·37 ohms per kilometer.—*Scientific American.*

A CHINESE TELEGRAPH OFFICE.

I had some curiosity to see how the Chinese managed a telegraph office, and through the influence of a Danish friend was admitted yesterday to that of the Imperial Chinese Company. It is in a handsome building in the usually massive style of banks and business houses in Shanghai, which often have an arched balcony running around each story. When space becomes valuable these balconies are closed in, which darkens the inner rooms. The general result is a structure which is a cross between the Alhambra and the residence of a Southern planter.

In the first room I entered there were a number of Chinese clerks whose duty it was to receive messages and send them by elevator to the operating room. Directly behind was the room of the bare-legged coolie messengers. Other rooms on this floor were occupied for various subordinate purposes. On the second floor were the business manager, assistant manager, chief clerk, electricians, operating room and reception room. The reception room had Chinese furniture about the sides, there being a table between every two chairs for tea, without which no business can be transacted in China. On one side was a raised divan large enough to accommodate two Mandarins; also with it a little elevated table for tea. The walls were ornamented with marble slabs, the veins of which were supposed to represent trees and mountains. There was hardly a room in the building, not excepting that occupied by the messengers, in which there was not a tea table.

The operating room bore little resemblance to the large noisy rooms with their several hundred operators which one sees in America. In front of the windows on one side of it were some half dozen or more Siemens machines, and near them three or four brown, round faced Chinese boys of fifteen or sixteen years. These were operators. As there happened to be a lull in war news, they rose respectfully and listened to our conversation. One machine was for the business of the Woo Sung fort; another connected the settlement with Woo Sung village, and was chiefly patronized by Chinese merchants; others belonged severally to Foo Chow, Nan King, including other Yang Tse ports, and Pe King and intermediate points. Nan King is the capital of this province and the headquarters of the Viceroy Tseng, uncle of the Marquis Tseng. I had reason to believe he kept his line busy, for the boy in charge of the Tien Tsin and Pe King wire had little repose. The anxiety of Chinese officials to know what is going on is great, and as their telegraph connections are limited, they are obliged often to depend on foreigners for information. In commercial despatches less was doing.

The operators learn telegraphy and English in schools established for the purpose in Shanghai, Foo Chow and Tien Tsin. They do not speak English, but read it and understand it when spoken. The officers in talking to one another over the wire always use English. All despatches except those in Chinese are sent and received as handed into the office for sending. For the Chinese despatches a code of numerals is used, the figures running from 1 to

10,000, and each figure representing a Chinese word. The code book is voluminous. The same system has been employed for some time in Europe to avoid lingual difficulties which would otherwise seem insurmountable. Before this method was employed, Chinese despatches had to be translated into English before transmission. It will be a fortunate day for China when she is covered with a network of telegraphs and railways. Every intelligent Chinaman believes in railroads now, since the present war has shown their absolute necessity. This telegraph office is the only business enterprise of importance in which the Chinese have yet succeeded with the officers and nearly all the employés natives. The company has no cables except in crossing large rivers like the Yang Tse. The lines were constructed under the direction of Danish engineers, a few of whom are still employed in important positions in the main offices. A Danish company has a cable to Hong Kong and Vladivostock and St. Petersburg, touching at Japan. The Eastern Telegraph Company, owned by Englishmen, has also a cable to Hong Kong and Australia, and is building a land line to Foo Chow. These are all the telegraph accommodations so far possessed by China.—*Shanghai corr. N. Y. Tribune.*

ENGINES USED FOR ELECTRIC LIGHTING.

A TRAVELING correspondent of the *Manufacturers' Gazette* makes the following statements regarding the difference in electric lighting plants visited by him:

"The next peculiarity was one of those engines that we sometimes read about, one that coughed and sneezed, has had the asthma ever since it was located, snorts sometimes and throws water enough through the exhaust pipe to sprinkle two acres of vegetables amply. This engine was used for an electric light plant. We offered the owner $5 for the privilege of attaching an indicator, if he would allow us to print the diagram. The engineer wanted very much to have it done, but the old gentleman said she had been a good old machine, and so we left her working. The engineer's report to us on the amount of coal, after we saw a diagram taken by one of his friends, figures only about 8½ pounds per h. p. per hour.

"In another place was a gold-medal engine, with the due allowance for springs, indicator pipe stuck into the steam passage just above the valve under the cylinder, nice old machine she used to be, been running five years. We watched the exhaust pipe for a few moments, and had a laugh with the engineer when we asked him how much he had a barrel for pumping water. In this case boilers ten or twelve years old were used. The engineer knows his business first rate, but could no more influence his employer in selecting an engine which had some value beyond the builder's gold medal than he could have influenced him (the owner) in buying railroad stock for speculation. After having looked at these old traps, or museum of curiosities (for they were all grouped together), it was a pleasure to look at the Porter-Allen electric light plant in the basement of the Philadelphia Post-office, and to see machinery which ran like a sewing-machine, where everything was neat and clean, and where, although it was government property, some attention was paid to the amount of power required. We had a look through several electric light plants, but this one in particular gave us a great deal of pleasure, from the fact that everything ran as still, as quiet, and as smooth as could be."

SAVED HIS MONEY.

THE *Mechanical News* vouches for the following story of the result of an investigation by a well known expert, who was employed by a capitalist to make a report upon a new system of electric lighting recently on exhibition not far from New York city. On visiting the premises the expert found 36 large arc lights pouring forth enormous volumes of light, the power for the dynamos being apparently derived from quite a small steam engine hard by. The reply of the manager, when asked if all the dynamos were run by the small engine, was in the affirmative. The investigation of the expert could not be made entirely satisfactory to himself with the electrician hanging about him, and so he returned a day or two later with an assistant, who engaged this functionary in earnest conversation pending further search by the expert. The latter at length discovered a superfluous leaden pipe which appeared to him to have no necessary relation to the water supply. This he cut into with his knife and found certain electrical wires which were soon traced to another electrical plant somewhat more important than the first,—comprising a 100 h.p. engine and several large dynamos. The facts of course were reported to the capitalist and he wisely refused to have anything to do with the stock of the concern. If capitalists were more in the habit of employing competent and unpurchasable experts to examine the thousand and one "new inventions" of this class which are continually cropping up, they would save themselves much pecuniary loss, to say nothing of personal mortification.

LITERATURE.

REVIEWS.

The Electric Light: Its History, Production and Applications. By Em. ALGLAVE and J. BOULARD. *Translated from the French by T. O'Conor Sloane. Edited, with notes and additions, by* C. M. LUNGREN. New York: D. Appleton & Co., 1884.

We have already had occasion to remark that a decided change for the better was becoming apparent in the character of the electrical literature recently published, as compared with much of that with which we have been favored since the beginning of the electrical revival, which may be said to have commenced with the exhibition of the Jablochkoff electric light at Paris in 1878.

One of the earliest works on the general subject of electric lighting having any pretensions to completeness, was that of MM. Alglave and Boulard; but on account of its having been published in the French language, it has remained comparatively unknown to the majority of English readers. Messrs. Appleton & Co. have, however, been led to believe, and justly so, that this work possessed merits sufficiently distinctive to warrant its introduction to the English-reading public. The progress of discovery, invention and development in this branch of science has become, however, so extremely rapid, that even the most complete work is soon out of date. Hence the publishers have done well not to content themselves with a mere translation of the original work. They have employed Mr. C. M. Lungren, a well-known and accomplished American civil engineer, to make such changes and additions in the original work as were essential to an adequate presentation of the present advanced state of the art. In the performance of this task, Mr. Lungren has not only corrected a considerable number of errors, but has enlarged and amplified many statements which seemed to be insufficient. He has also made many exceedingly important additions, relating perhaps more particularly to the general aspect of the subject than to special forms of apparatus, although the latter, when of sufficient importance to warrant it, have received adequate notice.

This work, although not professing to be an exhaustive presentation of the general subject, nevertheless covers the field quite thoroughly, not merely from the historical and descriptive point of view, but from the scientific and practical direction as well.

It is a time-honored custom of the French author, whatever may be the subject of which he proposes to treat, to go back as nearly as possible to the beginning of the world. It therefore need occasion us no surprise to find that the first chapters are devoted to a compendious general history of artificial lighting. From the time when our barbarous ancestors illuminated their smoky caves by a piece of moss dipped in a dish of bear's grease, down to that wonderful improvement, the mutton tallow candle of the twelfth century, and from that to the argand and petroleum lamps of modern times, no essential improvement is omitted, but our authors, strange as it may seem, have been unable to trace the origin of the artificial electric light any farther back into the dim mists of antiquity than the time of Burgomaster Otto Von Guericke, of Magdeburg, who flourished in 1675, and who first produced light from electricity by rubbing a globe of sulphur with the hand. A brief description of the manner in which the modern electric arc is produced is followed by an excellent chapter on the electrical units by Mr. Lungren, wherein the whole subject is discussed and explained in a manner which, although brief, is exceedingly clear, and in every way satisfactory. A description of the various automatic arc lamps and so-called electric candles is next given. These are well described and illustrated, and accompanied in most cases with brief historical notes and sketches. The history of the incandescent system and its development is then taken up, and a very full and satisfactory account is given of the work of Edison, Swan, Maxim and Lane-Fox in this direction. The Weston incandescent lamp is probably of too recent commercial introduction to find a place among the others. In this connection Mr. Lungren has contributed a most excellent chapter on the subject of the measurement of incandescent lamps, in which he displays entire familiarity with the subject, although it is treated in less detail than would perhaps be desirable, were it not that the work is intended largely for popular reading. We fully concur with the editor in the opinion which he expresses, that "the incandescent lamp has unquestionably taken its final form, that of a strip of resisting material enclosed in an exhausted glass envelope—a form of such extreme simplicity that nothing more remains to be done in this respect. Attention must hereafter be concentrated upon the incandescing strip itself, as on its improvement depends whatever gain in economy is to be obtained. Methods of constructing this incandescent portion must be sought for which will give it increased ability to withstand the disintegrating effects of high temperatures, and the disrupting action of the current. The problem is, therefore, but partly electrical; it is mainly one concerned with a consideration of the structural characteristics of bodies upon which their power of withstanding strains of such character depends."

The fourth book treats of the production of electric currents. In this connection primary, secondary and thermo-batteries are briefly taken up, by way of introduction to a discussion of the various typical forms of dynamo-electric generators. Of the unimportant and obsolete constructions a large number have necessarily been omitted, while the forms described have wisely been confined mainly to machines either of historical or practical importance. The more recent and efficient forms of American machines have also found a place in the work. In continuation of this branch of the subject, Mr. Lungren has added two original chapters, one on the efficiency of the dynamo, and the other on the measurement of dynamos and arc lamps, in which are included the results of a number of actual tests. It cannot, of course, be expected that this part of the subject should be treated exhaustively in a work of this character, but the essential considerations upon which the whole matter depends are laid down in the clearest manner.

The fifth book treats of the distribution of electricity, and includes a discussion of the subject of conductors, regulators and other appliances. The ingenious three wire system of distributions which is employed in the recent installations of Mr. Edison is given, among others.

The sixth book is devoted to some of the miscellaneous industrial applications of the electric light.

From what has been said, it will be seen that the careful revisions and additions which have been made in the American edition by Mr. Lungren have very greatly increased the value of the work as a whole. Those who are already in possession of a fair degree of scientific knowledge and who desire to gain an intelligible idea of the general subject of electric lighting, both in its practical and historical aspects, will find this work admirably adapted to their purpose. The publishers for the most part have done their work well, although many of the process reproductions of the original engravings merit anything but commendation. They are presumably inserted for decorative purposes, as they have no particular relation to the text; but in our opinion the appearance of the book would have been considerably improved if many of them had been entirely omitted.

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CORRESPONDENCE.

NEW YORK AND VICINITY.

An Electric Torchlight Procession.—The Mutual Life Insurance Building Isolated Plant.—Electricity on the Elevated Railway.—The Commercial Cable Co.'s System.—The Callender Insulated Wire Factory.—The International Exhibition of Inventions.—Dr. Talmage's Proposed Telephone System.

THE recent political campaign has embodied the use of electricity and magnetism to an unusual extent. The incorporation of an incandescent electric light plant in a torchlight procession was a novel idea, and made a splendid display, although like other spectacular demonstrations, it is difficult to determine its exact effect upon the number of votes cast. The arrangements were under the auspices of the Edison Electric Lighting Co., which supplied a 200 ampère dynamo, mounted on the forward part of a truck, behind which was a 40 h. p engine from the New York Safety Steam Power Co. Attached to the truck was one of the largest Clapp & Jones steam fire engines, from which steam was supplied by a flexible tube. The necessary water tanks and coal carts followed with their supplies, the water being conveyed to the feed pump by lines of hose. Two wires were led from each side of the dynamo along a rope 1,200 feet long, extending along the procession, forming a hollow square, supported as it was by a double line of men, each of whom carried an incandescent lamp on his helmet, connected by two small wires leading under his coat through the sleeve to the main circuit. Altogether about 300 lamps were displayed. The effect was very beautiful, but the lights were at one time interrupted by an accumulation of mud in the hose.

One of the finest and most extensive isolated plants in the country for incandescent lighting is that of the Sawyer-Man system in the magnificent building of the Mutual Life Insurance Co. in this city, on the site of the old post-office. The building is wired throughout for 1,650 lamps, the work being done by the Electric Construction and Supply Co. of 145 Broadway. The current is derived from 8 dynamos, each having a generating capacity of 250 lamps, and belted direct to separate Westinghouse engines. The driving pulleys of the machinery are covered with paper to prevent the slipping of belts. In order to prevent vibration, one of these engines is being mounted on a bed of sand as an experiment. If successful, the other engines will be similarly arranged.

Renewed interest in electric railways has been awakened by the suggestion of President Cyrus W. Field of the Manhattan Elevated Railway, in his recent report to the directors of that company, in which he said:

> One step yet remains to be taken. Already in Europe short lines of railway are run by electricity; and we have the highest authority in the world—that of Sir William Thomson, the great electrician of England, who has recently made a visit to America—for saying that nothing could be better fitted for the application of electricity as a motive power than an iron track raised in air, whose "elevation" furnishes the best possible facility for "insulation." The use of electricity in place of steam, it is estimated, would effect a very great reduction in the expense of operating our roads; while the removal of the heavy engines, making the passage of the trains almost noiseless, would bring this system of rapid transit as near perfection as we are likely to attain in our day. These improvements will come in time, perhaps within the coming year.

The business arrangement, or pooling of issues on the part of various inventors, may perhaps stand in the way of any immediate result in this direction, but the above words coming from a man of such well-known energy as Mr. Field, evidently mean something.

The New York office of the Commercial Cable Co. will probably be ready for business before the cables are repaired. This will be the first office in this city in which a regular submarine cable system has been operated. The connection will be direct with Canso, N. S., a distance of 800 miles, which will be the repeating station for the western end of the transatlantic cables. From the eastern terminus of the cables at Waterville, Ireland, connection will be made by the company's own system to London, Liverpool, Paris, Havre and other important European cities. The Thomson siphon recorder will be used in this city, the instrument being mounted in such a manner as to neutralize the jar from heavy vehicles passing through the neighboring streets. A mirror galvanometer will be constantly in circuit also, to be used in case the recorder fails to work satisfactorily. About 10 cells of battery will be required for the service.

The use of cables for arial as well as subterranean work, is causing an increased demand for good insulated wire, and the Callender Insulating and Waterproofing Co. has been established at about the right time to take advantage of it. The new buildings of this company are located at East Newark, N. J., where the machinery is being driven night and day to keep pace with orders. The insulation of this wire is spoken very highly of by English authorities, and it is extensively used by the British government. Every coil of wire or cable sent out from the factory is soaked 24 hours or more in large tanks provided for the purpose, and electrically tested for faults before shipment.

Mr. J. Pierrepont Edwards, the British consul at this port, has

announced publicly that he will furnish, upon application, all necessary information to any person desiring to secure space at the international exhibition of inventions, which is to be held in London next year. No charge will be made, but applications must be filed before December 31st.

Preparations are being made with a view to effecting telephonic connections with the platform of Dr. Talmage's tabernacle in Brooklyn, so that subscribers in his parish may listen to his sermons in the seclusion of their homes. Dr. Talmage appears to view the project favorably, perhaps for the reason that it will have a tendency to bring him still more prominently before the public.

NEW YORK, Nov. 18, 1884.

PHILADELPHIA.

The City Ordinance Against Overhead Wires.—Extent of the Local Telegraph Systems.—Each Telegraph Company Wants its Own Conduit.—Representative Electricians Before the Council Committee.—Dangerous Explosions in the Sectional Conduits.

IT now seems certain that the ordinance of councils requiring all wires of telegraph and telephone companies now strung overhead to be put underground by January 1 next, will not be carried into effect. The ordinance will be for the present inoperative for several reasons. The most important is, that practically nothing has as yet been done towards burying the various lines of wires, which, under favorable circumstances, would take about a year. The companies excuse themselves for this inaction with the plea that they cannot make such a great expenditure of money without some surety of the practical value of the underground system adopted, and that they know of none that has been fully tested. Another reason is, that under the ordinances of the city no streets can be torn up between December 1 and March 1, and therefore as but a short time remains to the first date, there is very little chance of the 3,733 miles of wire being put underground in that time.

According to a statement carefully prepared by Superintendent Walker, of the city electrical department, there are 3,733 miles of wire overground, from which the city collects a tax of $9,550 a year. Of these the Western Union company has 769 miles and the Bell Telephone company over 1,300. There are altogether but 396 miles of wire underground, concentrated in a space of about 30,000 feet. Of this the Henry C. Gibson company, or Brooks system, has 23,457 feet of conduits, the Philadelphia Sectional Electric Underground Telegraph, 3,782, and the National Underground Electric Co., 5,670 feet. There are in the city 4,480 poles, of which 1,349 belong to the Western Union. For these the city gets $1 a year each In addition there are 12,272 attachments of wire to city poles, for which the city gets $6,136 yearly rental.

Among the propositions which have been before councils is one that the city build immense conduits through certain streets, and allow all the electric light, telegraph and telephone companies to lay their wires through it and be charged a regular rental. The companies do not take kindly to the idea, as they prefer conduits of their own. The companies themselves are so far apart on the merits of different systems that the more the matter is discussed the more difficult it seems of solution. The great objections urged by them to any underground system are the great expense, the uncertainty as to the durability and working value of the buried wires and the inconveniences that will result from having so many wires bunched in one pipe or cable.

As to the expense, the president of one of the telephone companies said yesterday: "There are about 200 wires in one of our 'legs,' or branches, extending to the northern part of the city only. I have just had one of the cable companies make an estimate of what it would cost for cables for this branch from Chestnut to Vine street. It would be $45,000. The branch extends to Kensington."

The two principal systems in operation in the city that meet with any favor from the companies are both the invention of Pennsylvanians. One is the system of David Brooks, the electrician, of this city, and the other that of R. S. Waring, of Pittsburg.

Up to the present time only three companies have filed the necessary bond indicating their intention of practically carrying out reform in putting the wires underground. The Baltimore and Ohio Telegraph Co. is one of these, and it is rapidly engaged in putting all of its wires underground in the central part of the city. Bonds have also been filed by the Baxter Telephone Co., and by the Henry C. Gibson-Brooks System Co.

At a meeting of Councils' Electrical Committee, a few days ago, President Bentley, of the Bell Telephone Co.; Wm. B. Gill, superintendent of the W. U. Co., this city; General Agent Latta, of the Pennsylvania Railroad Co., and Electrician Hamilton, of the Western Union, were among those who addressed the committee on the subject of underground telegraphy. President Bentley said:

"For nearly a year and a half I have been making tests with aerial cables, and as yet I can see no way by which electric wires can be successfully operated underground. It seems to me that this question is misconceived. A great deal of this cry for the burial of our wires has been raised upon the basis of the alleged success of the system in other large cities, notably London. I want to say that during the recent convention of scientists in this city I was visited by many of them who are regarded the world over as authorities upon the subject of electricity. Among them was Mr. Preece, the English electrician, who told me that, far from being successful, the problem of placing electric wires under ground was yet to be solved in Great Britain. Besides, there is no comparison between their system and ours, and I am accurate when I say that there are more wires within buildings alone in Philadelphia than underground, inside and over head in London put together. There is no system of cable that we have any knowledge of that will answer our purpose. In London the wires are simply placed in large cast-iron pipes, with man-holes at intervals, and wires with a rubber coating are easily hauled through, but these are only telegraph wires. The telephone wires are carried over head, as with us."

The Philadelphia Sectional Conduit Co. are having a little difficulty of rather a dangerous character. Within the past 2 months several explosions have occurred in the trench where their system is laid, owing to the accumulation of foul air, gas, etc. When the explosions occur, the heavy iron coverings of the manholes are lifted high in the air, and should they happen to strike anyone in their ascent or descent it would very likely prove fatal. It can readily be imagined how dangerous these explosions are when they generally take place on one of our most crowded and narrow thoroughfares—Chestnut street. It is to be hoped that the gentlemen connected with the system will soon find a remedy for this evil.

PHILADELPHIA, Nov. 21, 1884.

CHICAGO.

The City Authorities Again Threatening Existing Lines.—Hope of a Peaceful Solution of the Difficulty.—Reminiscences of Early Telegraphing.—The Original Story of the Clock which Fought Circuit.—The Haskins Time Indicator for Telephone Exchanges.—Pronunciamento of the Baxter Overland Telephone Management.

IN my last letter I inadvertently stated that Mr. Ward was manager of the Excelsior company here. Mr. W. J. Buckley is their manager, while Mr. Ward, as I intended saying, has his headquarters in the office with Mr. B.

The several electric light companies complain of dull business. There are several openings for central stations in the city, and these are only held in abeyance until the underground muddle can be straightened out. On the 6th of October the City Council passed this order: "That the Superintendent of Fire Alarm Telegraph and Commissioner of Public Works be directed to prohibit the further stringing of electric light wires across the streets and alleys of the city until further orders from this Council," which is interpreted by the city officials to mean both above and under the streets. On the 20th the City fathers ordered "That the City Electrician and Superintendent of Streets be instructed to cut all electric light wires crossing streets or alleys, above or below ground, that are there without authority from this Council."

Of course there was consternation in the camp of the enemy. Speculation was rife as to the cause, dread as to the result was freely expressed, and timid prophets saw in the near future darkness and desolation and blasted hopes. But for some reason or other, despite the fearful forebodings of several interested parties, peace still reigns, and there is now every prospect of a satisfactory solution of the Gordian knot without cutting. The clouds of unhappiness are fast drifting away. From what I am told by several of the agents, I judge that smooth water has already been reached, and all will progress as heretofore in a very short time. Out of the threatened chaos a new departure has developed which is eminently satisfactory in the matter of placing lights. The Inspector was instructed to prevent the further hanging of lights outside the line proper of any structure, and as a substitute for this, wires have been run from the building to lamp posts similar to those used for ordinary street gas lamps, and through these to lights on their tops. The result is eminently satisfactory, both as to utility and beauty, when compared with the former style of outside lamp installation. If there ever was an ungainly fixture that was worse than another upon the outside of a building, it is the slovenly looking wires that lead to the lamp, half the rays from which are lost, to all intents and purposes, by being thrown upon the wall behind it. But the street post utilizes all these by throwing them directly into the windows, and illuminates the surroundings even better than the original form.

Here and there we meet with some gray-haired-grandfatherly-visaged old gentleman who looks upon the present race of telegraphers as children, and himself as a patriarch in the art. The electrical exposition and its reminiscences has brought several of these "ancients" to the front. The *Journal of the Telegraph* lately published an item headed "The First Telegraph Instrument," which, read aloud to one of these "Moses of telegraphy," roused him from his lethargy and brought out some curious facts contrasting with the present methods of the science.

"Boys," said he—some of the boys were over forty years of age—"those lines, attached to that exhibit:

> 'The steed called Lightning, says the Fates,
> Was tamed in the United States;
> 'Twas Franklin's hand that caught the horse
> That was harnessed by Professor Morse.'

"We boys, who were plugs in 1846—Carter, Sam. Porter, A. J. Partridge, the two Haskins, W. D. Allen, the Gibbs brothers, Anson Stager, Dave Kissock, Don Mann, and a whole lot of us in western New York, recognize those lines—what there are left of us—as familiar poetry of our boyhood; but these were improved upon somewhat. When the struggle between the Speed and the O'Reilly systems, from Buffalo west, was at its height, two lines were added to the stanza:

> 'With Kendall's rein the steed worked shyly,
> Till curbed and broke by H. O Reilly.'

"Speaking of poetry reminds me of the message heading of the Dubuque manager in the early days. In addition to the usual heading, there were these lines:

> 'I fly with the lightning of heaven,
> I travel unseen and unread;
> A word and the impulse is given,
> A touch and the message is sped.'

"I ll never forget the first relay I ever saw. It weighed about eighteen pounds, and contained four double coils set in a candle box, the armature standing upright, moving in a horizontal arc, the local connection being made by one of the four cross arms. We might look at that wonderful machine, but to touch it was a grievous sin, and a positive assurance of condign punishment. Those were the days when offices closed at 9 o'clock, and the battery—Grove—was taken down, soaked and amalgamated, in some cases every day; and the operators had to do not only that, but all their own line repairing. 'Gone out on the line; back to-morrow,' was by no means uncommon as a poster on a telegraph office window, outside the larger towns. Business wasn't so brisk then as now, and to preserve the battery as much as possible, the line was only closed for short intervals, when not in actual use. Thus, if I received a 'communication,'—we didn't say message or telegram then—I said 'O K,' and was obliged to hold the circuit till some one else needed it, and this was done by striking a dot about once in two or three seconds. Any one who wanted circuit opened his key, and the next closing of the key relieved the operator who was keeping circuit.

"It sounds a little funny now, but when Livingston and Wells, those old timers in the express business, were building the first line from New York to Buffalo, they were obliged to build a line from Buffalo to Lockport, to show the people of western New York that the telegraph was reliable. This was tested by some of the most prominent business men of the two places, by sending duplicates by mail, to be compared on their arrival.

"At the Lockport end of this little line was a very fine old gentleman named Boughton, whom we all loved as a father. Never having been in any but a terminal office, of course he had never learned that a station could be operated without a ground wire, and when the line was continued on to Canada, through Queenston, the old gentleman was notified to take off his ground and complete the line. He took it off, but put it on the other side of his relay, told Queenston Buffalo wanted him, shifting it back again, to tell 'Bu.' that 'Q.' was all right. No argument could induce him to leave it off permanently, for he *knew* it wouldn't work, and in the end it became necessary to send a man from Buffalo to take off the ground at 'Lk.'

"Then the operator at Hamilton played it on us all one day. Being something of an inventor (he made a printing instrument afterward), and industrious withal, he counted as lost time the many hours devoted to keeping circuit, often half an hour at a time, and sought his remedy in pressing the pendulum of his office clock into service. It worked admirably. But one day while 'Perdix,' as Charley Wells called him, was thus utilizing his clock, a fire broke out in the neighborhood, and the clock held the circuit till the fire was out, despite the efforts of half a dozen who wanted to use the line. That afternoon, when the operator came back, the superintendent made some quite severe remarks, and the clock severed its connection with the company as circuit keeper."

When the old gentleman rose to go, a smile of incredulity overspread the faces of most of his hearers, but there was an old timer or two present who could vouch for the "ancient's" statements in every particular.

A new "Time Indicator for Telephone Exchanges," the invention of Prof. Haskins of Milwaukee, it would seem, is a very desirable adjunct to a central office system. By its use a certain time elapses after a watchman has given his accustomed signal; but on his failure to thus notify the office, the instrument announces the fact of his dereliction automatically by ringing a bell in a local circuit. This is accomplished by means of a magnet in the central office, the armature of which has a certain amount of lateral motion, and is carried by a screw on a revolving shaft, through the medium of a projection on the armature lever. When the watchman makes his signal by means of a magneto, battery, or push button, or inserting a key in a lock, the vitalization of this magnet lifts the point out of the screw threads, and a spring throws it back to zero, as in some forms of self starting registers, and like apparatus. The indicator is connected into the subscriber's line, and any number of these may be attached to the same common shaft. The local circuits from the several lines are run through annunciator drops, like burglar alarm circuits, so that it is readily shown not only when one of the numerous watchmen is at fault, but which particular one of these, and means can be taken at once to remedy the evil. It seems to be preferable to any system I have before seen, both on account of its simplicity and cheapness, and its thorough efficiency.

The Northwestern Overland Telephone and Telegraph Co. has at last publicly announced itself here. In its circular six distinct claims are advanced, showing the superiority of the Baxter telephone over any other form of instrument, and a list of ten cities in which exchanges are "now in operation or in process of construction"—Philadelphia, Pa.; Utica, Auburn, Syracuse and Rochester, N. Y.; Louisville and Lexington, Ky.; Omaha, Detroit and Cincinnati. Eight test lines are now in operation in the city, a list of which is given, and all interested are cordially invited to inspect these. In addition to telephone, district and burglar systems, will be operated by the new company, which, "it is confidently expected," will be in operation by January 1, "a valuable and efficient telephone exchange in the city of Chicago"—an indirect intimation that such a thing does not now exist here; and as if to clinch the proposition, after "promising prompt and satisfactory service at greatly reduced rates," the circular adds: "Thirty-three different classes of business are already largely represented on our subscription lists," and "For further information, etc., address Wm. S. Morse, 25 Borden Block." It may be of interest to know that Mr. Morse, until about one year ago, has been intimately connected with the present Chicago, and the former Bell Telephone Co. of this city, as solicitor, contract agent, etc., and is thoroughly acquainted with the majority of telephone users in Chicago, a fact which renders him peculiarly fit as an agent for a new company whenever they are ready to say "go!" In addition to this new organization, I am informed there will be, "in the sweet by and by," still more Richmonds in the telephone field.

CHICAGO, Nov. 12, 1884.

BOSTON.

Lively Telegraph Competition.—Western Union Poles Must Go.—The Boston Fire Alarm System Criticised.—Electric Light Stock Weakening.—The Departure of the Telephone Resonator.—Points in the Telephone Stock Market.—A Brilliant Telephone Entertainment.—The American Electrical Exhibition.

"WHO brought low rates?" is the heading of a 5x8 primer sheet distributed among the business offices of our town recently. The question reminds one of the old and justly celebrated query, "Who killed cock robin?" The answer on the circular is, "The Baltimore & Ohio Telegraph Co." We learn therefrom that their rate for ten words is 15 cents to New York and all New England points,—and night rates to Chicago, Cincinnati, St. Louis and all points West, fifteen cents for fifteen words. At the same time the Bankers & Merchants announce lower rates—as has also the Mutual Union. The "primer" referred to above, says "The Western Union is trying to stifle legitimate competition with their side show, the Mutual Union. Don't be deceived." As the public are reaping the results of sharp competition, they hope it will continue for some time.

In a recent communication I mentioned that testimony was being taken relative to the removal of Western Union poles in Friend street. The poles are of heroic size. The street being narrow, the casual observer might imagine a frigate was coming up the street. The committee on electric wires has decided the poles must go, and the wires will have to be accommodated on roofs. An order has been issued for the removal of the poles. Mr. Roche, Superintendent of the Western Union, has said if the consent of the aldermen could be obtained, the wires would be put under the pavement. It is the purpose to run two lines of iron pipe through the street at a depth of two or three feet, and near the gutter, each pipe to contain a cable of 28 wires.

The electric light conductors played a mischievous prank with the fire alarm wires at midnight, November 2d. A portion of the fire alarm bells in different sections of the city pealed out an alarm, striking only one round, the bell on the Old South striking 241, while no sounds whatever were heard on the tappers in the engine houses. At the fire alarm headquarters, the attendant noticed a peculiar sound upon the vibrator of Circuit No. 2, and went to the switch-board to test the circuit. Upon making the

ground connection fire burst from the switch-board, and the bells began to sound an alarm; he immediately took off the ground, when the bells stopped, and after some difficulty he extinguished the fire at the switch-board.

There is comment in the local papers about the slowness of the "best fire service in the world," to adopt new methods and new apparatus. Examples are given, for instance, that the hose wagons have only recently been substituted for the reel, reefers for the old style coat with the long tails, hats for winter wear in place of the old cap—the old titles of "Chief," etc., still retained. Complaint is also made that in outlying districts a call system of men is still maintained, instead of a small permanent force. The hours of street patrol are regulated by each Captain, and they are not the same with each one. Men are detailed to wind, supervise and repair the public clocks. The old subject of loud or still alarms comes to the front again. In fact, many of the Boston notions are regarded as "countrified," and the old town is charged with tardily following, instead of leading, in the race of improvement. However all this may be, the department has been successful as a fire extinguisher.

The American Electric and Illuminating Co. appear to have struck a ledge of distrust. Their common stock has been seeking buyers at 95c and $1, and the preferred at $5. Friends of the company claim there is no reason why holders should sacrifice their stock at present low figures, and declare that, while the company's assets are nearly $500,000, its liabilities of every character are less than $30,000. It is claimed that there is no reason why the preferred stock should sell to-day even less than its par value, and in the same proportion the common should bring at least $3 per share.

The telephone resonator business spoken of in my last letter, is working out its own condemnation in this section. The subscribers have found out that it is not an unalloyed bliss to use the resonator, and most of those who were so unfortunate as to expend their money for them have thrown them away. Although the annoyance has been great, yet the exchange managers have dealt gently with the matter, preferring the subscriber should discover his own mistake. I understand that there is no bottom to the patents on these resonators. One of Alex. G. Bell's original patents has a claim covering them all, so in case the resonator man should become turbulent, the "monopoly" has but to settle down on him. The Western States are now to encounter the subject—they having departed from New England.

Among the humors of the telephone we have to record the effect that the movements of Judge Wallace, of New York, in charge of the Bell vs. Drawbaugh interests have upon the stock market. One day we hear that the gentleman has given up all other business and is bending all his energies to the 10,000 pages of testimony and briefs—up flies the stock a few points. Next we hear the law is left behind and the judge has taken down his shot gun and gone for fall ducks—down drops the stock. Then it is whispered about as a good "pointer" that on a certain day the judge will be in New York, the stock goes up a point or two; then we learn from the underground intelligence that he will not be in the city until after Christmas—and the stock takes a tumble.

Saturday evening, November 15th, the management of the New England Telephone & Telegraph Co. gave a reception to the operators in their new building, which, by the way, they propose to occupy some time. The future operating room was used as the dancing hall, and the floor beneath as a supper room. The rooms were brilliantly lighted by electric lamps, and handsomely decorated. Each operator invited his or her companion for the evening, so that it was a very "select" entertainment. Every lady was presented with a handsome bouquet of choice flowers—while most of the gentlemen were decorated with *boutonniers*. Carter's orchestra furnished music, and the hall presented a very animated and jolly appearance. The floor was under the management of Prof. G. A. Gustin, G. B. Appleton and Arnot Quimby. An additional pleasure was afforded the participants of this entertainment by the thoughtfulness of the management, consisting of an interesting experiment in the way of transmitting music by telephone. Two of the ordinary Blake transmitters were placed in the Bijou Theatre, one on either side of the stage, and these were connected with the central office. Twenty receivers were here placed in circuit, and with these could be heard all the music of "Falka," and most of the dialogue was distinctly caught by those at the receivers. This has been tried in Paris, but it is said to be the first time that it has been done on so extensive a scale in this country, previous experiments having been confined to a single receiver. Much credit is due to the New England people for the kind consideration shown to their employés.

Before this letter reaches the readers of THE ELECTRICIAN, the Electrical Exhibition will have been opened in this city. While a very creditable exhibit will be made, yet it is to be regretted that there is some doubt as to whether the prominent exhibitors at Philadelphia will repeat here. The Edison people have but just decided to come, probably with a much reduced display; the American Bell Telephone Co. are not fully determined, but will probably make a small exhibit—and others in the same proportion. Many exhibits are already in position, and by the opening day a fair show will be made.

BOSTON, Nov. 18, 1884.

WASHINGTON.

Renewed Interest in the Government Telegraph.—Experimental Subterranean Electric Light Lines.—Annual Meeting of the United States Electric Light Co.—Capt. Greene's Report on Underground Systems.

INTEREST in the governmental system of telegraphs is revived by the near approach of Congress which meets on the first day of December, thereby securing all the days that are allowed for the closing session of a congress. At the close of the first session of the present congress Senator Hill and Messrs. Anderson and Sumner of the House declared themselves well satisfied with the progress made, and declared their intention to renew the war again this winter.

Since adjournment there has been much to encourage these gentlemen and their co-laborers. The failure to combine the opposition to the Western Union, and the collapse of two of the rivals, restores the odious features of monopoly, except so far as the Baltimore and Ohio R. R. Co.'s wires come in, and the public estimate of their extent is generally fixed by the length of the track of the B. & O Railroad. Accidentally and incidentally a stronger force than even the cry of monopoly has come to the aid of the friends of a government telegraph. The cry that was raised against the Western Union Telegraph, the Associated Press and Jay Gould, charging that they jointly, individually and in every other way combined, conspired and contrived to delay and doctor the election returns, no matter how groundless, how absurd or how impossible, has found a lodgment in many a mind, and no one knows better than the average politician how to take advantage of such popular prejudices. It is true that the final declaration of the election of Cleveland has made the outcry abortive for political ends, at least for the present, but it is only lying dormant. It is good stock in trade for the enemies of the Western Union and will be heard from before the final adjournment of the Forty-eighth Congress. With all the assistance that can be brought to its aid; with facts, fancies and prejudices I do not think they will be able to carry through a bill this season, but they may and probably will be able to secure—that congressional panacea for all perplexing troubles—a commission "to inquire and report, etc."—whose labors will be as fruitless and as valueless as all other commissions have been. It will no doubt make a good job for sombody or bodies, who can obtain probably all they will care to know from an inquiry made at the instance and under the direction of the late Post-master General Cresswell by Mr. R. B. Lines, and in the testimony before the committees of the two Houses of Congress last session.

Electricity for street lighting has been abandoned or suspended for the present. The Brush-Swan and the United States companies each declare their intention to comply with the requirements of the commissioners and lay a sufficient length of underground wires to test the practicability of maintaining street lamps by this method. The former has been given Pennsylvania avenue and the latter F street, but each are required to give others the right of way in their conduits at a reasonable rate. The inducement for laying cables is not great, as the city will pay no more for good electric light than they pay for poor gas light, and the work will not be very extended. For the present the United States company will confine its experiment to five squares on F street from 9th to 14th, where the merchants have agreed to assist in the expense of lighting the street, and many of them agreed to use the electric light for interior lighting. The stockholders of this company held their annual meeting on the 11th inst. The reports of the general manager and the treasurer were presented and proved very satisfactory. The latter announced the company free from debt with cash in the treasury for the regular semi-annual dividend on the first of January. The following officers were elected: Samuel Norment, president; Matthew G. Emery, vice-president; William Dickson, secretary; Seymour W. Tullock, treasurer; A. M. Renshaw, general manager; executive committee, Messrs. Boyd, Dickson and Tullock.

In his annual report upon the streets of this city, Capt. F. V. Greene, of the Corps of Engineers, U. S. A., pays much attention to the successful operation of underground electric wires in Washington. Substantial progress was made during the year, he says, 6.11 miles of line and 285 miles of wire being laid underground. The report says the Standard cables have been in constant use without a fault for telephone, telegraph and fire alarm purposes for nearly a year. The telephone wires using the Western Electric cables have also been in constant use for about six months, and are eminently successful. The Bankers and Merchants and Postal wires are also in daily and successful use.

"The Western Union company, which has one-half of all the mileage of overhead wire within the city limits," the report says, "is alone in refusing, or at least in neglecting, to take any steps toward burying its wires, although urged to do so by the Commissioners. All applications for new poles for the telegraph companies, or for removing their pole lines have been uniformly refused. Their wires are now much interfered with by the growing trees, and in order to get their wires out of the foliage they have resorted to the expedient of splicing the tops of their poles. But the trees will soon overtake them, and this and the rotting of their poles, will in a few years compel a settlement of the matter, even if legislation is not obtained requiring the removal of their main pole lines. . . . . The close of this year will see about 300 miles of underground wires for telephone, telegraph, and electric light purposes in full and successful operation in this city. It would seem, therefore, that the time had passed for discussing the feasibility of underground wires, and the time had come for compelling the removal of all overhead trunk lines within a reasonable period."

WASHINGTON, Nov. 18, 1884.

PROVIDENCE.

Change of Ownership in the Electric Lighting Interest.—Growth of the Incandescent System.—Preparations for Long Distance Telephony.—The Telephone Messenger System.—The Western Union 15 Cent "Side Show."—The Baltimore & Ohio System.—Election Returns Calculated to Please Everybody.

NEGOTIATIONS are in progress and may even now be completed involving the sale of the block of Narragansett electric lighting stock now held by Edward H. Goff, of Boston, to Lorin N. Downs the well-known telephone man. Mr. Goff was one of the prime movers in the enterprise and carried his project through very successfully, establishing the plant, placing the stock and afterwards securing the city contract for street lighting. His retirement from the directory and the admission of another energetic man like Mr. Downs will cause no diminution of the zeal displayed in prosecuting the business.

The Rhode Island Electric Lighting Co. is placing some excellent and satisfactory incandescent lights in business offices, and gradually the public is becoming educated to the advantages of this latest illuminant.

I hear of nothing new in the telephone business proper save that the Providence Telephone Co. will open a pay station in the room now occupied by the Southern New England. The last named company is getting its new place in readiness where the public can, if the elements favor, carry on a conversation with New York or Boston.

The new project of the Telephone Messenger Co. mentioned in my last letter has assumed definite shape. At the office named above a corporation under the name of the Telephone Manufacturing and Underground Co. has bought the right for the State of Rhode Island for the Time Telegraph business, and in addition thereto will carry on the messenger business using the telephone for a call bell. From the central office extends a wire connected to every operator's switch therein, so that when a customer wants a boy he will simply notify the central office. It remains to be seen whether in this respect the telephone can compete with the call-box. If it can, the extended facilities of the Providence Telephone Co. with its 3,000 or more subscribers will make it a formidable competitor to the District company and also to the Bankers and Merchants' company which is at present engaged in building an elaborate and substantial system throughout the city. Telegraph men, however, tell me that customers will bring or send their telegrams to the office when the call-box is out of order rather than wait the process of the telephone. This is something which can only be proven by actual experiment.

The telegraph war waxes hot. Rates are down to a minimum figure and to add interest to the fight the Western Union has opened, in the language of a circular issued by one of the other companies, a "side show" under the name of the Mutual Union with one operator, and started an opposition against itself. This has no palpable effect I am told upon the business of the other companies, as the public understand the gauzy pretext of opposition, and the success of the movement is lessened by the fact that the Western Union itself is carrying business at the low rate, provided the customer makes a protest against the regular one. As a Western Union man observed, "When we can't get 25 cents to New York, we take 15." It is obvious that this state of things cannot last long. Although the Western Union may at some time buy the Bankers & Merchants' Company it has met a gritty and determined opponent in the sturdy Baltimore & Ohio, backed by the immense capital of the B. & O. R. R., and engineered by the experienced hand of D. H. Bates, whose avowed purpose is to make the Western Union feel that it now faces the most formidable opponent which has appeared on the field. Its lines are being extended through New England, a 4-wire line being in process of construction from Providence to Woonsocket, and a similar line from Fall River to New Bedford. It has also opened on the wires of the New England Telegraph Co. at Gloucester, Mass., and at Lowell on a line which is being built by the Mayor of that city. The Mutual Union offices promptly reduced their rates to these points to 15 cents.

The recent election gave the telegraph companies an opportunity to show their enterprise. The Western Union furnished the much abused reports of the Associated Press over six special loops. The Bankers & Merchants gave the reports of the United Press over special wires in the rooms of the Republican State Committee, and also furnished the same reports by wire to the Providence Telephone Co., by whom they were sent all over the State, and the Baltimore & Ohio company supplied the public by messengers with the New York *Herald's* returns. The last two named were Democratic in tendency and borne out by subsequent returns, while those of the Associated Press held out false hopes to the Republicans, which were destined to be ruthlessly destroyed.

PROVIDENCE, Nov. 17, 1884.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, 115 *Nassau Street, New York city.*

THE DYNAMO AS A MOTOR.

[25]—Mr. Joseph V. Meigs, criticising the use of dynamos for railroad purposes, says that if a slow-running motor could be made we would not hear of successful trials without an immediate adoption of the same, and that the cost of transfer of power from a high speed to a low speed will prohibit the use of electricity as a motor, where cost is a consideration, until a slow-running electric power is discovered. This is just what I have always maintained, and I firmly believe that Mr. Meigs is correct. That this is true there can be no room for a doubt, and I may as well predict that the motor of the future, which is intended to compete with the steam engine, will be a comparatively slow running one. We all know that the electro-dynamic motor of to-day is as a rule, capable of generating an electric current. This however, ought *not* to be the case. An electric motor should be a motor and nothing else; that is to say, it should not be at all capable of acting as a generator, any more than a steam engine is of creating its own fuel.

The present method is about equal to substituting a bottle for a candle stick, or an old sock for a coffee strainer, through want of something better. In the electric horse to be, will certainly be found an entirely different kind of machine from the present apology for a motor. The mere fact that a dynamo is reversible does not necessarily open the road toward a solution of the problem. So far as the generator is concerned it will serve well for the purpose for which it was originally intended—as a powerful source of electricity, but as for attempting the use of an electro-dynamic motor, so-called, toward the economical development of any considerable power, I have good reason to believe that experimenters with such machines are entirely upon the wrong track. That there is a limit as to size in the construction of motor and generator within the boundaries of both economy and efficiency beyond which we cannot step, ought to be enough to convince us that the amount of energy which they are capable of exhibiting must also be limited. It is evident that quite a different principle should be applied, and I am perfectly satisfied that about all the "secret" there is in the entire affair lies in the construction of the motor alone.

This statement, however, should not be misconstrued, as I do not wish to infer that the sources of electricity are in any degree perfect. But one thing is certain, the principle of the machine must be altered, as, if the present method of construction be persisted in, little progress will be made towards the successful transfer of mechanical energy, and the reader is bound, sooner or later, to be convinced as to the truth of my assertions. The most powerful electro-dynamic engine, running under the most favorable conditions, is capable only of developing a force proportionally equal to that of the first steam motor. I have reference to the wheel carrying fans or blades fixed at right angles to the periphery, against which a jet of steam was brought to bear; the power of this apparatus amounted to almost nothing, and when we reflect that our electro-dynamic motor is in about the same condition to-day (considering the immense superiority of electricity in comparison with steam), it is simply outrageous. Is it not true that the same agent in even less quantity used to operate the little turbine was afterward made to exert its force one thousand fold, through the use of a properly constructed machine. Was this accomplished by altering the source of power—by substituting a volatile substance for the water used in the boiler? Was it done by altering the form and duplicating the number of blades, augmenting the number of jets or using such

a thing as a "reversible boiler"? Certainly not, and yet that is just about what is being done to-day as regards the dynamo. The quantity of electricity which we are now able to produce both by mechanical and chemical means is simply enormous—far more than sufficient to supply the most powerful electric engines capable of being devised. Electrical energy we have in plenty—let us turn our attention to the construction of machines which can properly utilize it. Under no conditions do we begin to realize the power of the electric current, or the immense quantity consumed to no useful purpose. A motor should be capable of transforming into useful work the amount of current necessary to drive it—no more. On the contrary, the dynamo, when it feels the electrical impulse, invariably "runs away," as if through fear of being "burnt up," which in some cases would happen if brought to a stand-still while the current is on. That the armature must revolve at a certain rate of speed before it can do any work at all, and also to prevent in some degree a dangerous overheating of the coils, is sufficient proof that the quantity of electricity supplied is altogether too great; from this it is evident that the sooner it escapes from the machine the better, although attended by a consequent loss of current. I have seen small electro-dynamic motors which required 6 or 8 battery elements to enable them to work a single domestic sewing machine; and again—pardon me—have I seen a motor of small dimensions capable of running 3 such machines with the aid of but *one* element. It is probably unnecessary to add that the latter was not a dynamo. I firmly believe that an ordinary battery having an E. M. F. of 8 or 10 volts is amply sufficient to propel a street car, instead of 100, as is generally required. Nature does not sanction the compatibility of such enormous waste of energy, and I repeat that in order to render the electrical transmission of power a universal success, the "dynamic" principle must be entirely discarded.

WM. A. J. KOHRN.

SAN FRANCISCO, CAL., Sept., 1884.

SPECIFICATION OF AN IMPROVED MOTOR.

[26]—Will you, or any of your readers assist me in the following: I wish to construct an electric motor on the following plan: The armature to be a Pacinotti ring with eight projections; outside diameter of ring, with projections to be 3½ inches; length of ring, 2½ inches; thickness, without projections, $\frac{3}{16}$ of an inch. The ring to be wound between the projections with 3 layers of No. 18 A. W. G. copper wire. Each projection will form $\frac{1}{8}$ part of the circumference of the ring. Field magnets to be in the form of a ring of the same kind as the Griscom motor. The field magnet ring to be 2½ inches long, 4½ inches outside diameter, $\frac{3}{16}$ inches thick. The two poles of field magnets to be inside, and each will embrace one-fifth of the circumference of the armature. The poles will project $\frac{3}{4}$ inch beyond the ends of field magnet ring and will carry plates of brass which will hold the bearings for the armature, and also carry the brushes. The field magnets will be wound with three layers of No. 16 A. W. G. wire. My object in designing this motor is to prevent the loss of energy which must be the case in the armature of the Griscom, Trouve or any motor using the Siemens armature, in consequence of the reversals of current twice every revolution, magnetizing and demagnetizing the armature continually. In this motor this does not occur, the armature being magnetized in successive sections. I wish to know whether the foregoing plan is a good one; if not, what modifications are required? I wish it to develop one-quarter h. p. What current and electromotive force will be required, and what will be its probable percentage of efficiency?

GEORGE LANGRIDGE.

PARKDALE, ONT., Nov. 17th, 1884.

[If any of our readers have had the necessary practical experience to enable them to advise our correspondent we shall be pleased to publish their opinions upon the points presented in the above communication.—EDITOR.]

GOING ABROAD FOR NEWS FROM HOME.

[27]—Your esteemed contemporary the *Scientific American*, might have saved itself time and embarrassment by copying direct from your September number, the article "How to Make Battery Carbons," instead of waiting until it was appropriated by the *English Mechanic*, and then erroneously giving that journal credit for it. This is not proper encouragement to home industry.

FAIR PLAY.

NEW YORK, Nov. 22, 1884.

[There have been other instances of a similar nature, in which our contemporaries have apparently awaited a foreign endorsement of information appearing in our columns, before considering it thoroughly trustworthy. We have no fault to find, believing it to be the true mission of a journal to inform, instruct and please its readers, rather than to devote space either to self-laudation, or abuse of its co-laborers in the scientific field.—EDITOR.]

ELECTRICAL NEWS AND NOTES.

OPENING OF THE AMERICAN ELECTRICAL EXHIBITION.

The date of the opening of this exhibition, at Boston, has been changed from Nov. 24 to Monday, December 1. This postponement was obligatory, as the Mechanics' Building was not cleared sufficiently early to admit of the proper arrangement of exhibits at the date originally fixed.

THE BELL TELEPHONE PATENTS IN CANADA.

The case of the Toronto Telephone Manufacturing Co. against the Bell Telephone Co., came up for hearing before the Minister of Agriculture on the 24th inst. The Toronto company has applied to the Dominion Government to set aside the Bell Telephone patent and declare it void for an alleged infraction of the Patent law. The defendants have endeavored to procure a writ preventing the Minister of Agriculture from hearing the case on the grounds that it was *ultra vires* of the Dominion Constitution. In this they were not successful. In opening, counsel for the prosecution brought documentary evidence to show that a larger number of telephones and essential component parts of the Bell telephone had been imported into Canada after the expiration of a year as prescribed by statute, and that after the expiration of two years the manufacturing of different parts of the instruments was carried on in the United States, these parts being imported and put together in Canada, in contravention of the Patent act, and that the Bell Telephone Co., had refused to sell their instruments at any price. It was found, however that several important witnesses were absent, and as the Minister of Agriculture desired to obtain all possible evidence he decided to adjourn the hearing until Tuesday, Dec. 2.

ELECTRICITY ON THE ELEVATED ROADS.

It is reported that the first experiment with electricity as a motive power on the elevated railroads will be made on the Second Avenue Line. A central rail weighing 80 lbs. per yard will be laid between the rails from Chatham square to the Harlem River terminus. Electricity will be conducted from the dynamos to the central rail by a large wire. The rail will be insulated, but the ordinary tracks will remain as at present. All the electric railway companies will be allowed equal facilities for experiments with the motors, and the expense of laying the third rail will be divided between them. A commission to be selected by the companies will decide on the relative merits of the inventions. After this decision a company will be formed to control all the patents of the several companies for this country, and for these rights each company will receive stock in the new company in proportion to the value of the property and patent rights conveyed by it. It is proposed that if the companies cannot agree upon the value of their interests the question shall be settled by arbitration.

TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.

The annual dinner and election of the Telegraphers' Mutual Benefit Association was held at D'Orville's restaurant, Washington Building, New York, Nov. 19. Jay Gould, Cyrus W. Field and Dr. Norvin Green were invited, but did not put in an appearance. Mr. Field and Dr. Green are members of the association.

A letter was read from Jay Gould, who said that an important engagement prevented him from being present, and Cyrus W. Field wrote that an out-of-town engagement compelled him to decline the invitation, but that the association had his best wishes. Among those present were Mr. J. D. Reid, who is called the father of the association, having founded it sixteen years ago. He sat at the head of the tables which were arranged in the form of a hollow square. Near him sat President A. R. Brewer, who is Secretary of the Western Union Telegraph Co.; Secretary Charles P. Bruch, Treasurer S. M. Taylor, G. G. Ward, Commercial Cable Co.; W. J. Dealy, W. D. Sargeant, of the New York and New Jersey Telephone Co.; William H. Baker, Clarence Cary, Charles A. Tinker, A. H. Watson, W. D. Schram, W. H. Young, delegate from Washington; Joseph L. Edwards, John McRobie, of Chicago; J. W. Tillinghast, Buffalo. About twenty delegates were present from Philadelphia. The speakers of the evening were A. R. Brewer, Clarence Carey, J. D. Reid, Thomas F. Clark, W. L. Ives, Editor Martin, of the *Electrical World*; Charles A. Tinker and others. Their remarks were confined to the growth and prosperity of the association. At intervals a quartet sang selections, which were loudly encored. The election of officers resulted as follows: President, A. R. Brewer; Vice-President, W. H. Young; Secretary, Charles P. Bruch; Treasurer, W. H. Baker, and A. R. Brewer, Samuel M. Taylor, J. Merrihew, W. B. Gill, Joseph Uhrig, W. H. Young, Joseph L. Edwards, and Charles P. Bruch, Executive Committee.

At a meeting held in the Western Union Building in the afternoon, the reports of the Secretary and Treasurer were received.

There are now 2,780 members. Since its organization the association has paid out $250,000. During the past year 30 death claims were paid, amounting to $28,375.30. An addition was made to the reserve fund, making the total amount $35,000. The year's expenses were $3,040.41, exclusive of the amount added to the reserve fund. The receipts for the year were $35,012 66. The officers of the association have served without salary.

THE TELEGRAPH.

The American Telegraph and Telephone Co. made application for a charter at Harrisburg, Nov. 12. The main office will be in Philadelphia. The contemplated line will run through every county in the state. The capital stock is $10,000. The Directors are all residents of Philadelphia except one.

The following press despatches indicate that the advance of the Baltimore and Ohio company in the south-west is being bitterly opposed:

Paris, Texas, Oct. 23,—The court to-day heard application for 11 injunctions against the Baltimore and Ohio Telegraph Co., brought in the name of farmers and land owners along the Texas and Pacific Railroad Co. through this county, to restrain the Baltimore and Ohio company from erecting its telegraph line along the right of way of that road. The land owners represented the interests of the Western Union Telegraph Co., which company, after having been defeated in their previous applications in their own name and that of the Texas and Pacific Railroad Co., are said to have bought up from the farmers their interest in the railroad right of way and applied to the court through this medium, claiming that the condemnation of their land for railroad purposes still left them entitled to damages, now that it was proposed to condemn the land for telegraph purposes. The court refused all these applications on the ground that, while the damage to the plaintiff, if any, was trifling, the damage to the telegraph company by stopping the work would be irreparable. The farmers are happy, having already received their money from the Western Union company.

Paris, Tex., Nov. 14.—Twenty-four Baltimore and Ohio Telegraph employés were arrested here several days ago at the instigation of, the Western Union, but in the name of the Texas and Pacific Railway Co., claiming that the Baltimore and Ohio Telegraph Co. was trespassing on their right of way, which, however, had been previously condemned under the general telegraph law of Texas. The men were released, the judge ruling that the railroad company should pay the costs. To-day the Baltimore and Ohio obtained an injunction from the United States Court restraining the Texas and Pacific company from any further interference with the Baltimore and Ohio's men or property in Fannin and Red River Counties.

Galveston, Nov. 14.—The Western Union obtained an injunction from the United States Court in this district in October, restraining the Baltimore and Ohio Telegraph Co. from building its new lines through Red River County on the right of way of the Texas and Pacific Railway, claiming that the proceedings of the State Court were not final, and that the Western Union company owned the exclusive interest in easement for telegraph lines along the railway. The United States Court to-day gave judgment in favor of the Baltimore and Ohio company, dissolving the injunction.

THE TELEPHONE.

Domestic.

Birmingham, Ala., is to have the Pan electric telephone. A strong company has been organized, and work of erection is to commence immediately.

The Court of Errors and Appeals has granted an imperative order on behalf of the Domestic Telephone and Telegraph Company restraining the New York and New Jersey, and Metropolitan Telegraph and Telephone Company from using the Bell telephone in Newark, Harrison and Kearney, N. J., and from interfering with the business of the Domestic company until the appeal from the Court of Chancery, now pending, can be heard and determined in the Court of Errors and Appeals, which will be about April 1, 1885.

Foreign.

The use of the telephone is generally on the increase in most parts of the Continent, the subscription in France being at the rate of 200f. per annum, reduced to 170f. when there are over 300 subscribers. The manufacturing towns of Lille, Roubaix and Turcoing are now in communication, the average number of messages per day between the two latter places being 657; and the system is in force also at St. Quentin and Troyes. Rheims is the best served town in France for its size, and contains 310 subscribers, or 23 out of every 10,000 inhabitants. This is the highest number comparatively in the whole country, Paris, Lyons and Bordeaux having but 14 to every 10,000, Calais and St. Pierre 22, Havre 18. The total number of French telephone subscribers is 5,535, while Germany has only 4,000 in 21 cities and towns. The proportion at Berlin is 9 to the 10,000 inhabitants, Vienna 4, and Brussels 11. Munich has 393 subscribers, Leipzig 285, and Chemnitz 101. A system has just been inaugurated at Mons, in Belgium, so that the inhabitants of the coal district of the Borinage can converse with Brussels, Antwerp, Charleroi, Liège and Verviers.—*Ironmonger.*

ELECTRIC LIGHT AND POWER.

Domestic.

The river steamer "Pargoud," recently built at Howard's yard, Louisville, Ky., has been fitted up with arc and incandescent lamps, having an ocean projector at her bow. The United States system is used, with two dynamos driven by a Buckeye automatic engine.

The Arnoux Electric Light Co. is putting 10 electric lamps in the workshops of the Harlan & Hollingsworth company at Wilmington, Del.

The Brush Electric Light Co., of Rochester, N. Y., has in use 1,100 h. p. from the Genesee Falls, which it owns, and is now putting in wheels for 700 more h. p. It proposes to rent the additional power for manufacturing purposes. The company is now running 500 Brush arc lights.

At a recent meeting of the trustees of the East River bridge, Mr. J. S. T. Stranahan explained the terms on which the settlement was effected with the United States Electric Illuminating Co. for the plant and lighting for the past year and a half. The amount paid for the plant was $15,500, and for the lighting about $21,000, the rate being 70 cents a light per night, and the cost of fuel and labor furnished by the trustees being deducted. The light was furnished free for 30 days, and after that time some 10 months were consumed in overcoming the obstacles caused by the vibration of the structure. Superintendent Martin said that the light was satisfactory now, but it cost about $40 a day for new carbons and the pay of employés. Over 300 carbons were used each night.

With regard to the cost of running his large printing establishment by electricity, Mr. Geo. S. Merrill, the proprietor of the Lawrence (Mass.) *American*, says: "We formerly used a Baxter 10 h. p. engine, necessitating the employment of an engineer, but the employment of the Edison company's power gives a saving in expense of more than 33 1-3 per cent. The speed is uniform, and the power satisfactory in every respect."

The Elgin (Ill.) Light Co.—object indoor and outdoor lighting by electricity—has been licensed to organize by the Illinois Secretary of State; capital stock, $50,000. Incorporators: Ald. D. E. Wood, Ald. I. C. Towner, and R. B. Chisholm.

There is something very strange about the cost of electric lighting. In Toronto the cost is 62 cents per light per night. In Winnipeg the cost is $1.25, which is said to be accounted for by the fact that coal is dear. In Rochester the cost is 40 cents a night. This is accounted for by the fact that the dynamos are run by water power. But that being so, how is it accounted for that in Ottawa, where water power is also used, the cost is only 23 cents a night?—*Toronto Globe.*

Foreign.

It appears by a despatch of the 4th of September last to the Department of State by Mr. Foote, the United States Minister to Corea, that Mr. Thomas A. Edison has been granted permission to place his system of electric lights within the palace grounds and buildings at Seoul.

According to a half-yearly circular just issued to the shareholders of the Maxim-Weston Electric Co., London, the directors estimate that the profits on their summer business will cover the whole year's expenses. We understand that 300 to 400 of the company's new incandescent lamps have been running for about 450 hours at Covent Garden Theatre without one renewal.

In an action raised by the Jablochkoff Electric Lighting Co. against the proprietors of the Edinburgh Lyceum Theatre for the cost of electric appliances, the Court of Session decided against the pursuers, with expenses, on the ground that the lighting of the theatre had been defective and unsatisfactory. The amount involved was over £1,700.

At a recent meeting of the Common Council, the subject of the electric lighting of the City of London was referred to. Mr. A. J. Altman stated that the Streets Committee had had several applications from the principal companies in regard to lighting the streets of the city with electricity, and they had now one before them which he had reason to believe with some modification the committee were likely to accept. He saw no reason why the greater portion of the city should not be lighted by electricity.

A second trial has been made at the Cornbrook telegraph works (Smith, Baker & Co.), Manchester, of an experimental line of electrical tramway. Mr. W. Holroyd Smith, Halifax, the pa-

tentee, explained to the members of the Blackpool Corporation Tramways Committee the working of the system, a thorough inspection of which was made. A car containing about twenty persons ran at various speeds up to twelve miles an hour. On the conclusion of the experiments the opinion was generally expressed that the system would prove excellent for street purposes.

ELECTIONS AND APPOINTMENTS.

The election of directors of the Edison Electric Light Co., October 26, was unexpectedly quiet, the combination ticket prepared by President S. B. Eaton having been chosen without opposition. This ticket is as follows: E. D. Adams, J. H. Banker, C. H. Coster, Eugene Crowell, R. L. Cutting, Jr., Thomas A. Edison, W. L. Garrison, E. H. Johnson, F. R. Upton, J. Hood Wright, Erastus Wiman, Spencer Trask and Charles Batchelor. Mr. Eaton said that a report of the finances of the company had been prepared, and would be sent to the stockholders during the week. Speaking of his own retirement from official connection with the company, he said: "Mr. Edison has been for some time past dissatisfied with the direction and executive management of the company. He wished to make use of money to push the enterprise, but some of the directors, including myself, were opposed to employing it upon the terms offered, deeming it unadvisable on account of the dullness in business everywhere. This was the occasion of his making an appeal to the stockholders for proxies. When it became apparent that there were differences I said I would retire, and this was also agreed to by others of the directors with whom Mr. Edison was not satisfied. We were met by concessions on Mr. Edison's part, and the combination ticket which I then prepared was made up and elected." It is understood that active measures will now be taken to push the enterprise and make some returns to the stockholders, no dividends having been paid since the company was formed.—*N. Y. Times.*

PERSONAL MENTION.

The late Ormsby Phillips, of *The Pittsburg Dispatch*, was head clerk of the first telegraph office ever established in that city, and among his assistants were Andrew Carnegie and Robert Pitcairn, now Superintendent of the Pennsylvania Railroad. He was Mayor of Alleghany City during the great railroad strikes and riots of 1877.

MANUFACTURING AND TRADE NOTES.

The Westinghouse Machine Co., of Pittsburg, has relinquished the direct sales of its products to customers. Contracts have been made with representative firms in various cities to whom all purchasers will be referred. The branch house in New York city has been transferred to the new firm of Westinghouse, Church, Kerr & Co., Contracting and Consulting Mechanical Engineers, No. 17 Cortlandt street.

The American Electric Construction and Supply Co., of Philadelphia, has been awarded the contract for wiring the new and extensive woolen mills of Folwell Brothers in that city, for a plant of 500 Brush-Swan incandescent lamps. A contract for installing 150 lamps of the same system has been completed at the Pequea Mills.

The Ogden Engine Co. has recently been incorporated in Illinois, with a capital of $10,000, for the manufacture of high-speed electric light engines. The works are located at 40 and 42 West Quincy street, Chicago.

A company is now being organized in Pittsburg for the manufacture of carbons by a new process, of which a well-known Ohio inventor is the patentee. The company starts out with a capital stock of $300,000. It is claimed that by the newly discovered process carbons can be manufactured at half the present cost of production.

The Westinghouse, Ball, Cummer, Ide, and Armington & Sims engines at the St. Louis Exposition have been tested as to their fuel and water economy while running the Edison lights. Each engine was given the load for a definite length of time, the work being done by Messrs. White and Jones of the St Louis Manual Training School, at the request of the managers of the exposition.

The employés of the Palmer Wire Mills at Palmer, Mass., have been notified that beginning Nov. 24th, the working time will be reduced to three days per week, with a slightly reduced force.

FINANCIAL.

NEW YORK, Nov. 20, 1884.

There is little change to record either in the tone of the market or the prices of electrical securities during the past month. There is a hopeful feeling of an improvement now that the excitement of election has passed away, but it apparently has no substantial foundation. Our quotations are from the New York Stock Exchange, and the Electric, Manufacturing and Miscellaneous Stock Exchange.

QUOTATIONS OF ELECTRIC STOCKS.

TELEPHONE.

	Bid	Asked		Bid	Asked
Am. Speaking	102 50	110 00	Molecular	3 00	7 00
Currier-Tele. Bell	2 00	5 00	New England	30 00	32 00
Colombia & Pan.	24 00	25 00	New York & N. J.	52 00	60 00
Continental	5 00	20 00	N. Y. & Penn.	41 00	75 00
Delbear	5 00	10 00	Peoples	7 00	—
Erie	17 50	—	Southern Bell	—	175 00
Globe	2 00	5 00	Tropical	1 00	1 50
Inter-Cont.	—	1 00	W. I. Tel. & Telph.	1 00	1 25
Mexican Central	—	1 00			

TELEGRAPH.

	Bid	Asked		Bid	Asked
American Cable	51 00	53 00	Mexican	115 00	125 00
Bankers & Merchants	2 50	5 00	Mutual Union	13 00	14 50
Com'l Tel. Co., common	10 00	25 00	Postal	2 75	3 25
do. preferred	91 50	120 00	do. bonds	28 50	29 00
Harlem Dist. Tel. Co.	50	2 50	Western Union	59 02½	59 75

ELECTRIC LIGHT, ETC.

	Bid	Asked		Bid	Asked
Brush	50 00	90 00	Edison European	2 00	4 00
Brush Ill.	30 00	40 00	Swan	15 00	40 00
Edison	45 00	60 00	U. S.	70 00	90 00
Edison Ill.	30 00	65 00	do. Ill. Co.	25 00	50 00
Edison Isolated	40 00	55 00			

The Southern Telegraph Company having earned the interest on its bonds, the Receiver of the Bankers & Merchants' Telegraph Co. has been authorized to pay the same. He will likely do so by issue of Receiver's certificates.

The following sales at auction have been made during the past month:

60 shares Manhattan Telegraph Company, $50 each, lot $2.

50 shares Electric Telegraph Company and 100 shares United States Disintegrating Ore Company, for $1.

The following is an extract from the annual report of the Baltimore & Ohio Railroad Co.:

For the improvement and extension of the Baltimore & Ohio Telegraph Line, $2,012,000 was spent during the year. The company now operates 47,417 miles of wires. President Bates reports both wires and service in good condition. The year's expenses included material, which was bought at a reduction of 15 per cent. below the construction cost of any other line in the country. Since the company began to do its own telegraphing the telegraphic expenses incident to railroad business have been reduced 43½ per cent., and the receipts from railroad business have increased 50 per cent. The telegraphic system is now twice as large as was that of the Atlantic & Pacific, which the Western Union bought in 1881 for $8,500,000, and one and one-fourth times as large as that of the American Union, which Western Union bought for $15,000,000, paying for both concerns in Western Union stock, then worth 85 in the market.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

United States Circuit Courts.—*McLaughlin* v. *The People's Railroad Co.* This was an action in the Eastern District of Missouri, charging infringement upon patent for street car gate. BREWER, J., held that where a patentee had acquiesced for 13 years in the infringement of his patent, and in his bill shown neither excuse for his delay, ignorance of the infringement, nor inability to assert his rights, his laches prevents a court of equity from interfering by injunction, whatever remedy he may properly have by action at law. *Hicks* v. *Otto.* Infringement was alleged upon certain claims of a reissued patent granted August 26th, 1882, upon an original issued December 9th, 1879. The defences relied upon, besides non infringement, were that patent was void, being for that which was abandoned on the application for the original patent, and also as enlarging the claim of the original. Anticipation by description in prior foreign publication and prior public use, were also set up. WALLACE, J., held that a reissue with claims more specifically describing the invention is valid, although applied for more than 2 years after the date of the original, and although the original claims in connection with the specification were capable of same construction as claims of reissued. Also, that the fact that a patented article, immediately on its introduction, was successful in the trade, is evidence of invention, while the fact that an alleged anticipating device made no impression on the trade indicates an abandoned experiment. *Milligan* v. *Lalance & Grosjean M'f'g Co.* This was an action in the Southern District of New York on a contract to recover royalties under a patent for an improvement in sheet-metal vessels. The defence contended that the patent was void, and it was shown that the invention, or at least an essential part of it, had been interpolated into the case by the solicitor while the patent was pending in the patent office, and without authority from the applicant. WHEELER, J., held, following *Eagleton* v. *West, Bradley & Cary*, 111 U. S. 400, that the patent was apparently invalid. The decision, however, did not turn on this point. *Lauther* v. *Hamilton, et. al.* Suit brought in Eastern District of Wisconsin to restrain alleged infringement of the patent for process of treating oleaginous seeds. DYER, J., held that it is doubtful whether a claim is valid which is so broad as to include every method known of effecting a particular result. It appearing that the crushing of seeds constituted one step in the process, and was effected by two mechanical appliances, and that dispensing with one of these was attended by a beneficial result, held, therefore, that the discovery or invention was not in a series of acts constituting the process, but only certain mechanical changes in carrying into effect the well-known old steps of the process. Bill dismissed. *New Process Fermentation Company* v. *Koch.* Bill in equity in Eastern District of Michigan for infringement of patent for process for making beer. BROWN, J., held that where a patent clearly shows and describes a machine whose use necessarily involves a certain process, no other person can afterward patent that process. The first patentee is entitled to his mechanism for every use of which it is capable, even though he did not foresee all of them. An imperfect prior description, coupled with an incomplete drawing, is insufficient to invalidate a patent. Business circulars which are sent only to persons engaged, or supposed to be engaged, in the trade, are not such publications as section 4,886 of the law contemplates, and in a contest of priority will not afford a basis for a claim of prior invention as against a patentee.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From October 21, to November 18, 1884 (inclusive).

Alarms and Signals:—*Bell*, E. W. Hazazer, Oct. 21, re-issue, 10,533. *Indicator*, T. A. Edison, 307,031; T. L. Dennis, 307,104, Oct. 28. *Call*, D. H. Rice, 307,494, Nov. 4. *Annunciator*, A. C. Palmer, 307,505, Nov. 11. *Signal-box*, H. McGonegal and S. D. Lake. *Thermoscope*, H. J. Haight, 307,543, Nov. 4. *Thermostat*, E. R. Wilder and J. P. Clark, 308,120, Nov. 18; A. W. Tubbs, 308,203.

Clocks:—*Time Controlling System*, W. F. Gardner, 307,287, Oct. 28.

Commutators:—*Apparatus for Breaking Circuits*, J. L. Huber, 308,261, Nov. 18. *Pole Changer*, J. E. Smith, 307,498, Nov. 4.

Conductors, Insulators, Supports and Systems:—*Insulators*, E. Clark, 306,718, 306,719, Oct. 21; J. S. Cleveland and G. F. Kent, 307,016, Nov. 11. *Machine for Insulating Conductors*, W. D. Grimshaw, 306, 744, Oct. 21. *Wire Supporter*, O. M. Draper, 307,025. *Composition for Covering Wire*, A. Derron, 307,184, Oct. 28. *Automatic Tension Line Holder*, M. Randolph, 307,588, Nov. 4. *Regulator for System of Distribution*, W. M. Thomas, 307,690. *Apparatus for Regulating and Distributing Currents*, J. J. Skinner, 307,810, Nov. 11. *Underground Conduit*, W. J. Ryckman, 307,872. *Communicating with Moving Vehicles*, L. J. Phelps, 307,984. *Rubber Composition*, J. J. C. Smith, 308,209, Nov. 18. *Cable Support*, A. S. Weaver, 308,220.

Dynamo Machines and Motors:—*Motor*, J. B. Atwater, 306,805, Oct. 21; W. W. Griscom, 307,387, Oct. 28. *Dynamo*, C. H. Benton, 307,261, Oct. 28; H. A. Gorn, 307,292; W. W. Griscom, 307,388; S. H. Short, 308,207, Nov. 18. *Regulator for Dynamo*, R. J. Sheehy, 307,084, Nov. 4. *Apparatus for Operating Tools*, C. J. Van Depoele, 307,884, Nov. 11.

Galvanic Batteries:—J. Zobel, 306,706, Oct. 21; W. S. Hogg, 307,945, Nov. 11.

Ignition:—*Electrophorous for Igniting Gas*, C. W. Weiss, 307,823, Nov. 11.

Lamps and Appurtenances:—*Multiplex Arc Lamp*, R. H. Mather, 306,764, 306,845, Oct. 21. *Air-tight Arc Lamp*, W. Baxter, Jr., 306,908. *Arc Lamp*, F. M. Newton, 307,062; J. M. Pendleton, 307,584, Nov. 4; R. J. Sheehy, 307,683; E. J. Houston, 307,709, Nov. 11; A. Serraillier, 307,808. *Filament for Incandescent*, T. A. Edison, 307,029. *Incandescent Lamp*, J. W. Benson, 307,166, Oct. 28; H. H. Grubbe, 307,389. *Holder for*, C. Dornfield, 307,970. *Automatic Cut-out*, E. Thomson, 307,818, 307,819, Nov. 11. *Combined Gas and Electric Light Fixture*, L. Stieringer, 307,879.

Measurement:—*Meter*, J. E. Ray, 306,957, Oct. 21; T. A Edison, 307,030.

Metallurgy:—*Magnetic Ore Separator*, R. A. Ripley and J. Bridgford, 306,778, Oct. 21.

Miscellaneous:—*Circuit Controlling Instrument*, F. Lane, 306,932, Oct. 21. *Machine for Controlling Elevators*, C. E. Ongley and E. W. Startevant, 307,064. *Pneumatic Dispatch Tube*, H. Clay, 307,137, Nov. 4. *Induction Coil*, J. Allen, 307,009. *Electric Bath*, J. B. Campbell, 307,745. *Cigar Lighter*, W. Glass, 307,759. *Magnet*, W. A. Legro, 307,777. *Apparatus for Maintaining Electrical Connections*, C. W. Williams, C. S. Barnum and E. B. Ives, 307,888. *Manufacture of Illuminating Gas by Electrolysis*, H. M. Paine, 308,276, Nov. 18. *Machine for Shaving Conductors for Electric Lamps*, J. J. Bradley, 308,301.

Protectors:—E. T. Gilliland, 307,030, Nov. 4.

Railways and Appliances:—*Railway Crossing Gate*, O. H. Clark, 307,005, 307,006, 307,007, Oct. 28. *Connector for Railway Train Signals*, F. P. Marshall, 307,314. *Railway Signal*, E. W. Applegate, 307,517, Nov. 4. *Brake*, H. Flad, 307,534, 307,535, 307,536. *Signal System*, W. Hadden and H. Van Hoevenbergh, 307,760. *Conductor for Railways*, A. M. Neeper, 307,791, Nov. 11. *Switch*, M. Marshall, 308,269, Nov. 18. *Signaling Apparatus*, B. K. Collenbusch, 308,316.

Telephone Systems and Apparatus:—*Switch*, H. E. Waite and S. H. Bartlett, 308,789, Oct. 21. *Exchange Appliance*, J. Feavey, 305,817. *Trunk Table*, same, 306,818. *Transmitter*, D. Drawbaugh, 307,020; T. J. Perrin, 307,728, Nov. 4. *Station Apparatus*, G. F. Durant, 307,106, Oct. 28. *Magneto for Signaling*, E. T. Gilliland, 307,290. *Mechanical Telephone*, M. Randolph, 307,800, Nov. 11. *Multiple Switch-board*, M. G. Kellogg, 308,315, Nov. 18. *Anti-Induction Device for Circuits*, H. Van Hoevenbergh, 308,010, Nov. 11. *Telephone Circuit*, same, 308,030. *Support for Telephones*, J. Tregurtha and C. T. Loring, 308,110, Nov. 18. *Telephone System*, C. A. Jackson, 308,165; *Combined Telephone and Time System*, R. W. Wilson, 308,225. *Exchange System*, J. P. Freeman, 308,248. *Telephone*, T. D. Lockwood, 307,478, Nov. 4; J. N. McIntire, 308,273.

Telegraphs:—*Telegraphy*, F. H. Van Der Weyde, 306,977, Oct. 21. *Printing Telegraph*, R. J. Sheehy, 307,281, 307,282, 307,333, 307,334, Oct. 28; A. & E. Wirsching, 307,606, Nov. 4; G. A. Cassagnes, 307,841, Nov. 11. *Telegraph Key*, C. Borchers, 307,836, Nov. 11

Expired Patents.—A list of the more important electrical patents, which have expired during the six months ending December 31, 1884 is subjoined:—W. G. Brownson, *Switch-Board*, 66,943, July 23; W. G. Brownson, *Battery Switch Board*, 66,944, July 23; Brownson & Shull, *Repeater*, 66,945, July 23;—W. G. Brownson, *Relay*, 67,160, July 30; S. G. Cabell, *Relay*, 67,410, August 6; J. Jonson, *Magnetic Ore Separator*, 68,205, August 27; J. B. Stearns, *Fire Telegraph*, 69,039, September 17; E. Gray, *Relay*, 69,424, October 1; J. H. Stevens, *Fire Telegraph*, 69,508, October 1; C. H. Pond, *Self Adjusting Relay*, 69,585, October 8; D. Brooks, *Insulator*, 69,622, October 8; W. Wickersham, *Electro-Magnetic Engine*, 69,880, October 15; W. M. Franz, *Self Closing Key*, 69,934, October 22; J. M. Fairchild, *Fire Telegraph*, 70,672, 70,673, November 5; S. Gardiner, Jr., *Electric Switch*, 71,158, November 19; W. E. Simonds, *Insulator*, 71,418, November 26; Edmunds & Hamblet, *Escapement for Electric Clocks, &c.*, 71,470, November 26; A. Foucault, *Marine Telegraph*, 71,476, November 26; M. L. Wood, *Insulator*, 71,504, November 26; S. C. Bishop, *Balata Insulation for Wires*, 71,588, December 2; C. T. Chester, *Electro Automatic Signal Buoys*, 71,701, December 9; M. G. Farmer, *Lighting and Extinguishing Gas*, 72,016, December 24; S. S. Laws, *Electrical Indicator*, 72, 742, December 31.

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THE ELECTRICIAN
AND
ELECTRICAL ENGINEER.

THE ELECTRICIAN
AND
ELECTRICAL ENGINEER.

Conducted by F. L. POPE. R. W. POPE, Associate Editor.

PUBLISHED MONTHLY BY
THE ELECTRICAL PUBLISHING CO.,
115 Nassau Street, New York city.

TERMS OF SUBSCRIPTION.

United States and Canada	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
One Copy, Four Months		1.00
Great Britain and other Foreign Countries within the Postal Union	"	4.00
Single Copies		.25

[Entered at the Post Office at New York, N. Y., as second class mail matter.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of the* ELECTRICAL PUBLISHING CO. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, *115 Nassau Street, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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NEW YORK, JANUARY, 1885.

NOTICE.

Subscribers who desire to avail themselves of the clubbing offer in our Prospectus, will please bear in mind that the ELECTRICAL REVIEW *mentioned, is published in New York, while the* LONDON TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW *is the title of a different periodical.*

ELECTRICAL PROGRESS IN 1884.

IF the year which has just closed has proved a disappointment to many sanguine investors in electrical enterprises, they may reflect that they are not alone in failing to realize their highest anticipations. So far as invention is concerned, however, every failure marks the general progress of the arts; therefore we may safely assume that whatever the record, there must be general advancement.

The year opened with a multiplicity of claimants to a share in the rich harvest which is being gathered by the American Bell Telephone Company. These various movements have had their thousands of sympathizers, their hundreds of supporters, and doubtless their scores of victims. Many were actuated by hope of legitimate gain, others by what they believed to be a sense of justice, while it is not unlikely that a few shrewd minds scented a field for possible plunder. Temporary encouragement was derived, on January 25, from the refusal of Judge McKennan in the United States Circuit Court at Philadelphia, to grant an injunction against the Overland Telephone Co., in view of the near approach of the Bell-Drawbaugh trial in New York city. The decision in the latter case just rendered by Judge Wallace will doubtless cause embarrassment in the procurement of the funds necessary to sustain further speculative enterprises of this character. It is a fair presumption that the removal of all uncertainty as to the future status of the Bell patents will develop renewed activity in the extension of telephone facilities.

The agitation of the question of underground wires has been felt in various parts of the country, and those of our readers who have watched our correspondence may consider themselves tolerably well informed in respect to the actual progress made toward placing electrical wires underground. We regret to be obliged to say that this question has not by any means been fairly treated by the public press, nor have the laws which have been passed evinced any particular disposition on the part of legislators to bring about the desired reform without seriously interfering with various branches of electrical business, which certainly cannot withstand the burden which is about to be forced upon them. Actual progress has been made in placing wires underground in New York, Brooklyn, Chicago, Philadelphia, Pittsburg, Boston and Washington, but it is highly improbable that the requirements of the statutes will be complied with in any of these cities upon the dates fixed by law.

Electric lighting is slowly emerging from the stage of sensational speculation which attended its earlier period of development, and those companies which have survived the ordeal of active competition are gradually building up a substantial legitimate business based upon the merits of their respective systems. The arc lamp has fairly established its reputation as an effective and comparatively cheap method of illumination for large areas, and its use in New York city is very extensive for street lighting, where over 3,700 gas lamps have been displaced by it. Its value for lighthouse purposes is being practically tested by its adoption for use at the recently completed tower on Hallett's Point, Hell Gate channel, the eastern entrance to New York harbor.

The superiority of the incandescent lamp for interior illumination is now admitted, even by those whose interests would naturally lead them to oppose it. For the safe, effective and healthful lighting of vessels, it supplies a want which had never been adequately met. As a competitor of gas on equal terms, for ordinary house-to-house lighting, it has thus far failed to achieve financial success. The most decisive improvement in electric lighting which has been made public during the year is unquestionably the mammoth incandescent lamp invented by Edward Weston, and first shown at the Philadelphia exhibition.

The electrical transmission of power has not as yet been very extensively applied, but its successful future is looked forward to with great confidence by those who are

best qualified to judge of its numerous advantages. Should it be substituted for steam on one of the lines of the elevated railways in New York city, there will be little question as to its prompt appearance in various other channels of usefulness.

Although numerous changes have taken place in the relative attitudes toward each other of the "opposition" telegraph companies, in the matter of pooling arrangements, and business partnerships, they now stand in this respect just where they did one year ago. The bankruptcy of the Bankers and Merchants' Telegraph Company has been the ostensible reason for the disruption of the working agreement between them, although the war in rates has doubtless caused a diminution in receipts which has been detrimental to the interests of all. The four rival companies are now being operated independently of each other, a state of affairs which is not likely to continue through another year.

The International Electrical Exhibition at Philadelphia, the first of its kind in America, afforded an opportunity for the convenient examination of the most interesting achievements in the field of electrical science. It was well patronized and proved a financial success, although two weeks' receipts were practically lost by reason of the exhibits not being wholly in readiness until that length of time had elapsed.

The American Electrical Exhibition is now in progress in Boston.

The World's Fair which is now open at New Orleans will also embrace some important electrical features, the starting of the machinery by an electrical impulse at the hand of President Arthur at Washington, 1,200 miles away, being an event which, perhaps, gives a popular idea of electrical power transmission. As a matter of record, however, we must state as a fact, that the steam was turned on by hand, in the ordinary manner, when the signal was received.

Among the deaths of the year was that of Th. Achille-Louis Du Moncel, more familiarly known in electrical circles as Comte Du Moncel. He had been for over 30 years an industrious experimenter and author, his literary work being of an especially popular character. At the date of his death he was the scientific editor of *La Lumière Electrique*, to which he contributed many interesting and important papers.

The eminent English electrician, Robert Sabine, died on the 25th of October. Although not a voluminous writer, his ability was recognized as of a practical and useful character, and he was among the earlier of the authors who have left a lasting impression upon the minds of our oldest American electrical students.

THE DECISION IN THE TELEPHONE CASE.

On the 1st of December Judge Wallace of the United States Circuit Court handed in a decision in the case of the American Bell Telephone Company against the People's Telephone Company in favor of the complainants, thus terminating, at least for the present, the legal proceedings which have been in progress for more than four years, and sustaining the preliminary injunction against the People's Telephone Company which was obtained some two years ago. The interest excited by this important case, especially in electrical circles, has been so great and so wide-spread that we have felt constrained to publish it elsewhere in full, notwithstanding its unusual length. The oral arguments before Judge Wallace occupied nine days. The following eminent counsel took part in the proceedings: J. J. Storrow and Chauncey Smith, of Boston; E. N. Dickerson and Roscoe Conkling, of New York, on behalf of the complainants, and Lysander Hill and Hon. George F. Edmunds on behalf of the defendants. The experts retained by the complainants were Charles R. Cross, of Boston, and Frank L. Pope, of New York, and by the defendants, Park Benjamin, of New York. The witnesses who testified for the complainants were 169 in number and their depositions occupied 2,493 printed octavo pages, besides 1,047 pages of exhibits, while 366 witnesses testified for the defendants, filling 2,476 pages of testimony and 160 pages of exhibits, making 6,456 pages in all, constituting eight large volumes.

Two months ago, after all the arguments on both sides had been closed, and the evidence had been placed in the hands of the Court, we published an article containing a careful review of the basis of the defence—the claim of Daniel Drawbaugh—in the light of the evidence which had been taken on both sides. In this article the opinion was expressed that the testimony, taken as a whole, failed utterly to prove the existence of any operative electrical telephone in the hands of Drawbaugh, prior to the date of the invention of Bell. We also editorially expressed the opinion that the claimant, Drawbaugh, and the multitude of witnesses who testified in his behalf, had failed to make out a case which could by any possibility be sufficient to overthrow the Bell patent, and furthermore that the case, taken as a whole, indicated the existence of one of the most extraordinary and widespread conspiracies for the purpose of destroying a patent which had ever occupied the attention of the court of justice. In making these remarks we simply expressed our views and opinions as to what the decision of the Court would necessarily be, in view of the law, of the evidence, and of previous decisions of the Federal Courts in similar cases. Our course in this matter has been severely criticised by a contemporary, who is apparently deeply interested in the success of the scheme of the People's Telephone Company, apparently upon the ground that it was an attempt made in behalf of the Bell "monopoly" to influence the decision of the Court. Since the opinion of Judge Wallace has been made public the same journal has reiterated the charge, and has more than intimated that a certain coincidence which it pretends to have discovered between the view of the evidence taken by us and that taken by Judge Wallace indicates that by corrupt means we were permitted to learn in advance what the opinion of the Court was to be. It is needless to remark that such a charge is utterly false, and a most unjustifiable attack upon the character of a Judge whose absolute integrity has never before been questioned.

In so far as our published views can be shown to agree with those subsequently put forth by the Court, it should rather be taken as a compliment to ourselves than as a ground for condemning the Court.

We said that the evidence indicated the existence of a conspiracy. It is not difficult to gather from the language of the decision, that the Judge is of much the same opinion. He says: "It is either true that Drawbaugh had long been treading his solitary path of investigation and experiment in poverty and obscurity, and had perfected his work when the inventions of other explorers were in embryo, *or his story is an ingenious fabrication*. And as will hereafter appear, if the defence is a fabrication, many disinterested witnesses have contributed innocently to give it color and strength, but Drawbaugh *has deliberately falsified the facts*."

"It is impossible, however, to believe that Drawbaugh can be mistaken in the substance of his testimony, and the conclusion cannot be ignored that *either his testimony is true in its essential parts, or his narrative has been manufactured to fit the exigencies of the case*."

Assuming the story of Drawbaugh to be true and that he had actually completed and publicly operated electric speaking telephones prior to March, 1876, it became absolutely essential to account for the fact that he omitted to apply for a patent and remained silent for years, while others were appropriating the fame and profits of the invention. The only possible explanation—that of extreme poverty—was set up in the defendants' answer and was attempted to be established by Drawbaugh's testimony. After summarizing his own evidence and that of others on this point, the Court reaches the conclusion, from a few plain facts, that "the theory of extreme poverty is unfounded, and *that Drawbaugh is dishonest in putting it forward*," and proceeds to sum up the whole matter as follows:

> Where a witness falsifies a fact in respect to which he cannot be presumed liable to mistake, courts are bound upon principles of law, morality, and justice to apply the maxim *falsus in uno, falsus in omnibus*. Drawbaugh could not be mistaken in asserting that it was his poverty which prevented him from caveating or patenting his invention. He was not led to the assertion inadvertently. Those with whom he is associated in the defence understood fully, and so did he, that the fact that a professional inventor and patentee did not go to the Patent Office to secure an invention like the telephone for ten years after it had been completed and demonstrated, was almost conclusive against the theory that he had made the invention, and that unless this presumption could be parried no Court would credit his story. The theory of constraining poverty was therefore formulated in the answer, elaborately fortified by witnesses, and testified to by Drawbaugh. It is overthrown by a few plain, indisputable facts, and Drawbaugh's veracity falls with it.

The Court seizes upon the autobiography of Drawbaugh, prepared by him for publication in the *History of Cumberland County*, as a graphic picture of the inventor and of the man. This is quoted in the opinion, but one or two extracts will suffice. He describes himself as follows: "One of the greatest inventive geniouses (*sic*) of this age (so prolific of great men), who has spent the greater portion of an active life conceiving and producing, as a result of the conceptions of an unusually fertile brain, a score of useful machines and devices." After giving a list of his achievements it concludes: "We are proud to own Mr. D. as a citizen of our township, and deem him worthy of a position at the head of the list of our prominent men, and are hapy (*sic*) to accord him that position."

The Court appropriately remarks that "this portrait, drawn by himself, depicts, without the aid of extrinsic evidence, the ignorance and vanity of the man, and the incongruous and fantastic assortment of his inventive projects. It suggests also the character of a charlatan."

We do not think we do the responsible authors of this scheme any injustice when we again characterize it as a gigantic conspiracy. The parties to it commenced operations by deliberately infringing a patent which had proved very profitable to its owners. An action being brought against them they cast about for a defense, and in some way, with the assistance of able, and it would seem not over-scrupulous attorneys, discovered a fitting tool for their purposes in Drawbaugh, and by working upon his vanity and cupidity, persuaded him, though not without manifest reluctance, to come into court and tell a carefully concocted story of his invention of the electric telephone. It is a significant fact that Mrs. Drawbaugh, who might naturally be expected to be the most earnest, persistent and enthusiastic supporter of her husband's claims, if they were just, has not appeared as a witness. We entertain no doubt that many of the witnesses, in fact the majority of them, were honestly mistaken in their testimony and in their dates, but there are others of whom this charitable view cannot be taken. They were all naturally more or less influenced by that local pride which is always so intense in isolated and comparatively unintelligent communities, to make out as good a case as their consciences would permit for one of their own number. This sentiment was evidently worked upon to the utmost by the attorneys for the defense, and their labors were attended with a degree of success not a little surprising.

It is not probable that the projectors of this fraud had the least idea at the beginning that it would ever have to undergo the searching ordeal of a trial in a Federal Court. They doubtless assumed that the owners of the Bell patent, rather than run the risk of having an invention of such enormous pecuniary value thrown open to the world, would be only too willing to compromise the case for a handsome sum. Many rumors have been published from time to time in reference to efforts said to have been made in that direction. It is almost needless to say that such a policy would have been simply suicidal. The moment Drawbaugh was disposed of a swarm of new claimants of the same character would have arisen. The complete overthrow of this precious scheme—for we think there is no possibility of the reversal of this decision by the Supreme Court—will probably leave the American Bell Telephone Company practically undisturbed in the enjoyment of its possessions at least until the expiration of its principal patents.

ELECTRICITY ON THE ELEVATED RAILROADS.

We remember a story of an occurrence which took place once upon a time upon a railroad which had been "reorganized." There was a new superintendent and a new engineer; there was also an old master-carpenter, but he was a relic of the departed administration. One day the new superintendent sent for the old master-carpenter, and said to him: "I have just received a despatch that the bridge at X—— has been burned; I have directed our engineer to complete the plans for a new bridge at the earliest possible moment. The plans ought to be in your hands

by to-morrow morning. Have your men ready to go to work the instant you get them, and do not lose a moment in getting the bridge ready for the passage of trains." The old master-carpenter gravely bowed, and withdrew from the presence. The next morning he presented himself at the superintendent's office, and was asked by that functionary whether the plans for the bridge had yet been delivered to him, to which he made answer: "The bridge is all done, sir, and the trains have been running over it since daylight. I haven't seen nothing of the pictur yet."

The condition of affairs in respect to the proposed employment of electricity to operate the elevated railroads in New York city reminds one of this story. We have been informed by the daily press at regularly recurring intervals of the proceedings which have taken place at a series of meetings lately held at the residence of an eminent engineer and patent attorney in this city, and attended by representatives of various inventions for operating railroads by electricity. We have also been informed that it is proposed to "institute a series of experiments" upon the Second Avenue railroad, in which the several competitors are to be allowed to participate, principally at their own expense, on the condition that their inventions are subsequently to be turned over to a "consolidated company," to be formed for the purpose of monopolizing all the electric railroad patents worth having. We are told that the proportion of stock which the competitors are to receive in this consolidated company in payment for their respective interests is to be determined by a "board of arbitrators," composed, as our esteemed contemporary the *Electrical World* expresses it, of "one very eminent non-resident expert, three absolutely inexpert officials, and one pre-eminent expert absent foreigner."

If this remarkably ingenious and original scheme is ever carried forward so far as the point where the board of arbitration decides "without appeal" upon the comparative value of the different inventions, the scientific world will witness an electrical row of unprecedented dimensions; but we hardly think it will ever get so far as that. Long before this board of eminent *savans* get their "pictur" completed, we shall probably have electric railroads in successful operation in nearly every country in the world. In fact, we already have the Portrush railroad in Ireland, which is as long as the Second Avenue line, and which has been in successful operation, carrying on a regular traffic the same as any other railroad, for a year or more, and moreover, as we are informed, earning a 12 per cent dividend. It is no doubt true that the mechanical and electrical arrangements of the Portrush railroad would be unsuitable, without material modification, for the elevated railroads of New York city, but the results which have been obtained by it prove conclusively the practicability of the system, and what is more important, the possibility of operating it continuously at a profit.

Apparently the only thing that really needs to be done is to place the elevated railroad problem in the hands of some electrical engineer of experience and ability for solution. There is no lack of this class of talent to be had in this country, although we do not find it represented on the "board of arbitration" above spoken of. In our opinion, the managers of the elevated railroads would find no difficulty in negotiating a contract with the United States Electric Lighting Co., the Edison Electric Light Co., or several other corporations or persons that might be mentioned, who are accustomed to deal with such problems, and would undertake to operate the elevated roads with much greater convenience, economy, and safety than is possible under the present system. We do not, in short, think that anything of importance is likely to be accomplished within a reasonable time in any other way.

ARTICLES.

THE CONSTRUCTION OF LINES FOR ELECTRIC CIRCUITS.

BY THOMAS D. LOCKWOOD.

(Continued from page 269, Vol. III.)

It is not therefore advisable with our present knowledge to use compound aerial cables of greater length than 2 miles for telephonic exchange purposes. When cables of any length between 500 feet and 2 miles are employed, if they are of the rubber or kerite insulation, the Foucaut arrangement should be applied in some form; and finally if cables are to be used for private lines, or for any purposes not connected with telephone exchanges, and where expense is not a factor, the use of the twisted or closely adjacent metallic return is here strenuously advocated, as a much greater length of cable can thus be employed; induction being practically eliminated; and retardation being by no means so pronounced as when the other remedies are employed.

JOINTS OR SPLICES.

The method of making joints or splices in gutta-percha covered conducting wires of aerial or sub-aqueous cables is so succintly described in many text-books that it is quite unnecessary to describe it here. For rubber or kerite cables, it is requisite only to strip off the insulation from the required conductor at the ends to be spliced, and to brighten and thoroughly clean the copper, then to make a long and close twist, after the style of an office wire splice, after which the joint should be soldered and made smooth, and finally covered with good kerite tape. There is a very objectionable kind of tape which is now being liberally bought by persons who know nothing of the demands of good construction (company purchasing agents *et al.*), simply because it is cheap; and which is sold with corresponding liberality, by dealers who do not care to possess the reputation of selling only good articles, because their customers ask for cheap grades. It will someday be found that in electrical construction only the best materials are cheap.

When a conductor in a paraffine cable is to be spliced, it is necessary to cut the lead covering completely back, until it is found that the core is quite free from moisture; this can easily be ascertained in the following manner: Melt paraffine in any suitable vessel, and heat it to a temperature of at least 260° F. If now the end of the cable when cut back be dipped in the heated paraffine, bubbles will arise, if the cable is damp. If dry, none will appear. Should bubbles appear, the core must be cut back still farther, until they appear no longer. Separate the conductors, and then splice them in the manner indicated in figure 1. By this kind of a splice we are enabled to join a large number of wires, and draw all equally tight. Joints in paraffine cable conductors should not be soldered, as some hot solder will almost certainly drop among the other conductors, and prove injurious to the insulation. Neither should kerite or rubber tape be placed round the joints. The best way of protecting such a splice in this kind of cable, is to draw over one of the divided ends, before the splice is made, a sleeve of braided cotton, which may then be drawn back over the naked wires after the

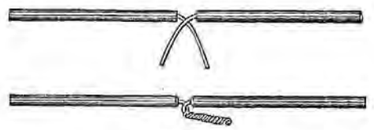

FIGURE 1.

joint is finished. After the conductors are all joined, they may be wrapped together with cotton yarn, twine, or hemp packing, after which paraffine should be heated as before, and poured over the combined splice, until bubbles no longer appear. At the end of a cable, the whole may now be wrapped again with twine. If the joint is made of the entire cable at some intermediate point, the cable must first be opened by carefully cutting round it with a knife or saw, taking care not to cut through. When the lead is nearly cut through, it will easily break.

A sleeve of pipe a little longer than the cable pipe, and long enough to cover the proposed splice, and lap 3 or 4 inches over at each end, should now be slipped over one end, and when the conductors are all joined, and paraffined as we have described, the sleeve can be drawn forward over the splice and joined to the cable pipe by a wipe joint using fine solder.

TERMINAL CONNECTIONS AND LIGHTNING ARRESTERS.

It is very necessary where aerial cables are used, to provide a suitable connection at the outward end for the attachment of the cable conductors to the line wires, and at both ends to attach lightning arresters. We show one very good style of pole box, into which the cable is led intact. The wires are then fanned out to each side and separately terminate at binding screws, which are placed on a bar in a row. The pole line wires enter at each side,

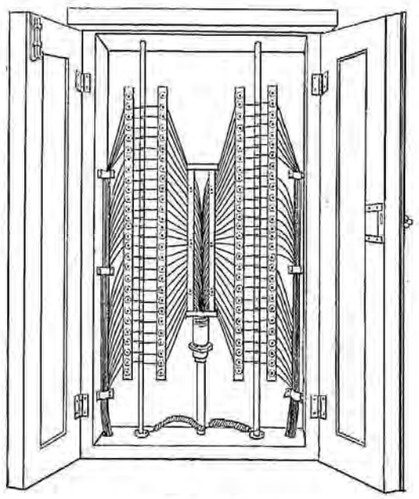

FIGURE 2.

and are terminated in the same way. A metal bar extends on each side between the pole line, and cable line screws, and each pair of terminals is connected by a little piece of comparatively fine wire, which is twisted once round the interposed metal bar. The metal bars being connected with the ground, serve as lightning arresters, and the short pieces are easily renewed.

Where aerial cables run near electric light wires, fusible links, such as narrow strips of tinfoil should, in addition to the lightning arresters, be placed in the line circuit, as electric light currents with a much lower electromotive force than lightning, have great heating power, and would soon destroy a telephone cable.

TESTING INSULATED CONDUCTORS IN CABLES BY MAGNETO BELL.

We have known many persons who were in the habit of testing cable conductors for insulation by ringing a magneto-bell into it, the conductor meanwhile being open at the distant end. As a matter of fact which should be well known, a magneto-generator sending alternating currents will ring its own bell as well on an open as on a closed wire, if the insulation is what it ought to be; and for this purpose a magneto-bell though almost too handy should not be used. If the insulation is good, the first pulsation sent by the generator may not be sufficient to move the armature, but the second being of opposite direction, having not only to charge the wire but first to neutralize the charge already there, may be strong enough, and the bell rings. On the contrary, if the insulation is not up to the mark, the first charge leaks out before the second comes in and the bell does not ring, except in case the insulation is very low indeed, and then it rings on the escape.

A 50-cell chloride of silver battery, and a magneto-telephone serve to test a cable very well, if the insulation is normally high. Grounding one pole of the battery, we connect the other pole to one of the telephone terminals, and a wire to the other telephone terminal. Now, if we touch the free wire to the end of the cable wire, if the said wire is perfectly insulated, we hear a click, the loudness of which depends on the length of the wire. This click arises from the rush of electricity through the telephone to charge the cable. Now, if the wire be touched a second time no click will be heard because the wire is charged. If the insulation is deteriorating the charge will leak out before the second touch, so that a very perceptible click will be heard the second time. This test, of course, only tells whether the insulation is or is not falling; but if that is once ascertained, the insulation resistance can then be measured. In testing for a break in the same manner, a little experience soon enables one to tell from the sound of the click, the approximate location of the break.

In addition to aerial cables, the constructor is frequently called upon to use office cables. These are usually cables consisting of any required number of wires insulated to a greater or less degree, and covered ordinarily with a cotton braid. If a more ornamental appearance is desired, a silk covering is added. The purpose of these cables is merely a concentration of conductors, so as to economize space, and no special mention of them at this time seems to be required. It will be necessary to refer again, hereafter, to aerial cables when the several methods of suspension will be described.

Before leaving the subject of line wire, it may be mentioned that a line of copper wire built November, 1877, was taken down in August, 1884, and was found to be scarcely diminished in size, and in no way oxidized. This wire was drawn to a degree of hardness which would admit of the regular telegraph twist joint. The line in question was built at Ansonia, Conn., and demonstrates beyond a doubt that hard copper wire (for short lines at all events) will "stand up," that it does not stretch unduly, and that it is not affected in an equal degree with iron, by atmospheric or gaseous agencies.

(To be continued.)

ELECTRICAL MOTORS AND THEIR CONSTRUCTION.[1]

BY JOHN E. CHASTER.

It is proposed in the present series of articles to give full working drawings and descriptions of an electrical motor, which has been designed with a special view to the production of a machine at once compact and well constructed, and having a high percentage of efficiency

The field magnets constitute the main portion of the machine. The accompanying drawings are made on a scale of half an inch to the inch, or exactly half size, the full size and dimensions being marked on the dimension lines.

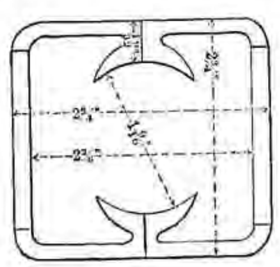

FIGURE 1.

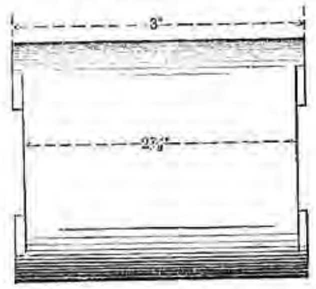

FIGURE 2.

Figure 1 is an end view of the two castings of the field magnets, placed side by side in their proper places, and figure 2 is a side elevation of the same. Figure 3 is an end, and figure 4 a side view of the armature. It is essential that these should be cast from the very best of iron, and thoroughly annealed, so that the character of the metal may approximate as nearly as possible that of wrought iron. Many failures and much loss of electrical energy have resulted from inattention to this important point.

The armature is of the well-known Siemens or **H** form, which is undoubtedly the best ever devised for small motors. Its efficiency is high, while it may be constructed with facility by an amateur of ordinary mechanical skill.

It is preferable to substitute gun metal for brass in the bearings and other non-magnetic portions of the machine, as the use of this material will well repay its slightly increased cost and small amount of additional labor required. The unsatisfactory results which have been attained by amateur constructors of dynamos and motors are largely due to the use of inferior metal.

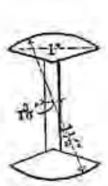

FIGURE 3.

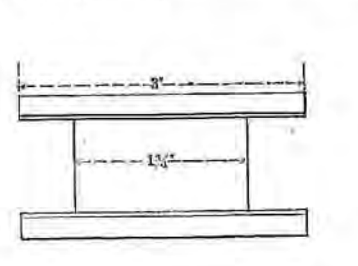

FIGURE 4.

Figure 5 is a front view of the gun metal bearing through which passes the armature shaft or spindle. This is made in two different sizes, which are marked full-size on the drawing. Side views of the same are given in figures 6 and 7. These bearings must be accurately fitted, and care must be taken that they are well trued up, as they must fit square on to the field magnets, as shown in figures 10 and 11. It is not essential that the exact design and shape shown in the drawings should be followed, as this may be varied to suit the fancy of the constructor, providing of course that the mechanical principles shown in the drawing are adhered to and faithfully carried out. Figures 8 and 9 show the gun metal caps which screw on to ends of the armature, into which are screwed the spindles by which the armature is carried. These spindles can be

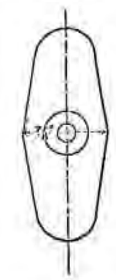

FIGURE 5.

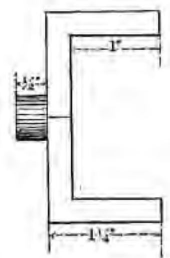

FIGURE 6.

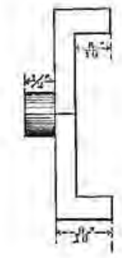

FIGURE 7.

soldered in their places, or secured by pins passing directly through them, to prevent them from unscrewing.

The remark above made, in respect to the precaution of getting everything true, must be borne in mind in every-

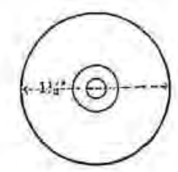

FIG. 8.

FIG. 9.

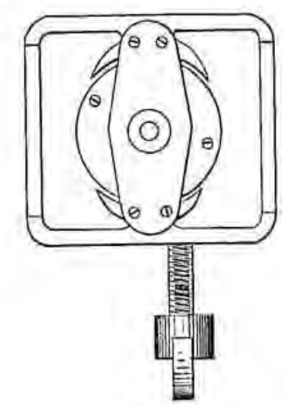

FIGURE 11.

thing relating to the construction of motors and dynamo-electric machines. Such machinery will not allow of any slovenly or slip-shod fitting.

Figure 10 is a cross-section taken through the centre of the armature but not precisely in the centre line of the field magnets, the object being to show in the section the

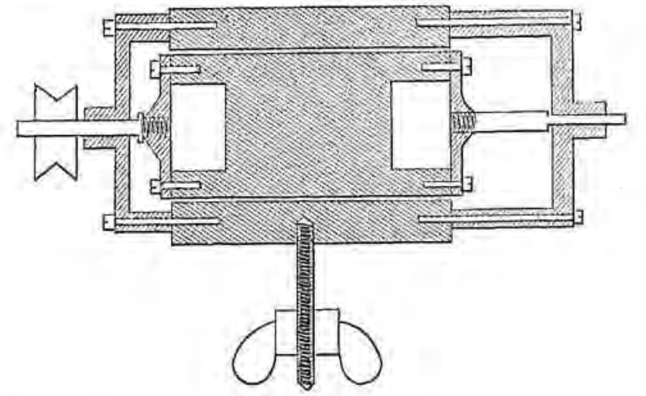

FIGURE 10.

screws by which the bearings are secured to the field magnets. Figure 11 is an end view, in which it will be noticed that the bearings shown in the previous figures 5, 6 and 7 also serve the purpose of binding the outer iron work or field magnets together. A bolt and thumb-nut is shown for securing the machine to a bench or other suitable bed, but if preferred it may be mounted on a polished wooden base.

(*To be continued.*)

1. *English Mechanic* (Abridged).

ELECTRO-CHEMICAL EQUIVALENTS.

BY GEORGE B. PRESCOTT, JR.

According to a recent determination by that careful investigator, Lord Rayleigh (B. A. Rep., 1882), the rate at which silver is deposited under the electrolytic action of a current is 1.118 milligrammes per coulomb of electricity, or, in C. G. S. measure, 1.118×10^{-2}. This value has been generally considered to be more reliable* than the old figures of the text-books,[1] and, since later independent experiments by Kohlrausch and Mascart have led to values almost identical, it is now commonly accepted, with confidence that it is at least more nearly correct than any of the figures previously taken.

On the basis of Rayleigh's value for silver I have calculated the electro-chemical equivalents of the other elements usually so tabulated, adding to them potassium and magnesium, metals now reduced by electrolysis.

Although in tables of this nature it has heretofore been customary to employ round numbers to specify atomic weights, I have thought it desirable to base the calculations on the latest accepted atomic weights of the elements as given by Roscoe. In addition to milligrammes per coulomb I have calculated the coulombs per gramme and grammes per ampère hour, all of which figures are given in the following table, including, for the convenience of users, logarithms of the last two named values.

TABLE OF ELECTRO-CHEMICAL EQUIVALENTS, ETC.,

Calculated on the basis of Lord Rayleigh's recent determination of the electro-chemical equivalent of Silver, and the corrected atomic weights of the elements as given by Roscoe.

Elements.	Valency.	Atomic Weight.	Chemical Equivalent. e	Electro-Chemical Equivalent (Milligrammes per Coulomb.) z	Coulombs per Gramme. q	Grammes per Ampère Hour. w	Log. q	Log. w
Electro-Positive.								
Hydrogen	H^{i}	1.	1.	.010384	96293.00	0.03738	4.9836353	$\bar{2}$.5727090
Potassium	K^{i}	39.04	39.04	.40530	2467.50	1.45850	3.3922572	0.1642041
Sodium	Na^{i}	22.99	22.99	.23873	4188.00	0.85942	3.6221000	$\bar{1}$.9342055
Aluminum	Al^{iii}	27.3	9.1	.09449	1058.30	3.40160	3.0245989	0.5317066
Magnesium	Mg^{ii}	23.94	11.97	.12430	804.03	4.47470	2.9053411	0.6507614
Gold	Au^{iii}	196.2	65.4	.67911	1473.50	2.44480	3.1683501	0.3882433
Silver	Ag^{i}	107.66	107.66	1.11800	894.41	4.02500	2.9515306	0.6047659
Copper (Cupric)	Cu^{ii}	63.	31.5	.32700	3058.60	1.17700	3.4855227	0.0707765
" (Cuprous)	Cu^{i}	63.	63.	.65419	1525.30	2.35500	3.1833553	0.3719900
Mercury (Mercuric)	Hg^{ii}	199.8	99.9	1.03740	963.99	3.73450	2.9840725	0.5722325
" (Mercurous)	Hg^{i}	199.8	199.8	2.07470	481.99	7.46900	2.6830880	0.8732625
Tin (Stannic)	Sn^{iv}	117.8	29.45	.30581	3270.00	1.10090	3.5145478	0.0417479
" (Stannous)	Sn^{ii}	117.8	58.9	.61162	1635.00	2.20180	3.2135175	0.3427779
Iron (Ferric)	Fe^{iv}	55.9	18.64*	.19356	5166.4	.69681	3.7131894	$\bar{1}$.8431131
" (Ferrous)	Fe^{ii}	55.9	27.95	.29035	3445.50	1.04480	3.5372523	0.0190832
Nickel	Ni^{ii}	58.6	29.3	.30425	3286.80	1.09530	3.5167733	0.0395331
Zinc	Zn^{ii}	64.9	32.45	.33696	2967.10	1.21230	3.4723923	0.0839682
Lead	Pb^{ii}	206.4	103.2	1.07160	933.26	3.85780	2.9700097	0.5863897
Electro-Negative.								
Oxygen	O^{ii}	15.96	7.98	.08286				
Chlorine	Cl^{i}	35.37	35.37	.36728				
Iodine	I^{i}	126.53	126.53	1.31390				
Bromine	Br^{i}	79.75	79.75	.82812				
Nitrogen	N^{iii}	14.01	4.67	.04849				

* Becquerel's extension of Faraday's law showed that the electro-chemical equivalent of an element is proportional to its chemical equivalent. The latter is equal to its combining weight, and not to atomic weight÷valency as defined by Thompson, Hospitalier and others who have copied their tables. For example, the ferric salt is an exception to Thompson's rule, as are sesqui salts in general

WESTON LABORATORY, Newark, Dec. 13, 1884.

1. Sprague, 1.104; Thompson, 1.134, etc.

THE GROWTH OF TECHNICAL TERMS.

We are moved to refer once more to this subject by the rapid augmentation of words which, because oftentimes backed more by caprice than authority, must inevitably lead to great confusion. Here are a few of these terms of more recent genesis :

The erg.	The watt.	The metric horse power.
The volt.	The henry.	The kilowatt.
The franklin.	The microfarad	The megohm.
The dyne.	The ampère.	The ohm.
The force de cheval.	The centimetre-gramme-second.	

Some of these terms have, by general consent, taken their places as permanent additions to the language of technical science ; others are more in the line of test or suggestion. We see in all of this the struggle of a new branch of practical science for definite expression, and as such we welcome these new terms, but "on trial only." Some of them are useless, others barbarous—all of them confusing until brought to the best authoritative definition. The great trouble is that so many of these terms are sprung upon the technical world by self-appointed authorities, who, because their pet words chance to be made use of occasionally by third parties, at once jump at the conclusion that a valuable addition has been made to the language. For instance, it is proposed to call the fellow who runs the electric motor a "motoneer." [Note to the printer : Don't set this up "mutineer."] The next thing, we will have "gasetteer" for the man that runs the gas engine, "keeleteer" for the manipulator of the Keely motor, and "muleteer" for the engineer of the canal boat. Since we are in the midst of a rage for new words, it behooves all good citizens to invent one and then take to tall timber. The fool-killer is on his rounds.—*Iron Trade Review.*

THE MYSTERIES AND MISERIES OF SCIENCE.

An eminent Italian scientist who has been engaged in a new determination of the ohm by absolute measurement, gives in his official report the following harrowing details of the difficulties he has labored under. Some of the discordant results attained by various observers are possibly traceable to causes of this kind hitherto suppressed.

"An other circumstance for me very distressing, is come to influence the rigor of long series of experiences. My laboratory finds itself on the ground floor, in a vast room, very stable and situated at the north ; but alongside finds itself the laboratory of chemistry, so that I have the misfortune to have for neighbor, the Prof. Ugo Schiff, who (thing unbelieveable) himself is amused to carry from right and from left long pieces of iron, though he me had promised formally of it to refrain himself.

Now that I have inflicted to M. Schiff, the blame that he merits, in him denouncing publicly, I me propose to explain briefly the manner of which one makes the observations."

MEASUREMENT OF CURRENT STRENGTH WITH A SHUNTED GALVANOMETER.

BY CARL HERING.

The method of measuring currents by means of a shunted mirror galvanometer, or the "shunt method" as it is commonly called, consists essentially of a large, heavy copper wire, having near its ends 2 wires leading to a sensitive mirror galvanometer in series with an adjustable resistance, as shown in figure 1.

The different proportions of the parts are so chosen, that by varying the adjustable resistance any desired strength of currents can be measured with almost the same percentage of accuracy. The shunted galvanometer is calibrated by means of a voltameter, for any convenient steady current, and for a given resistance in circuit with the galvanometer.

The resistance of the galvanometer *in series with the shunt* is measured, and from it and the constant obtained by calibration, the various constants for different resistances can be accurately calculated, as will be described later. It is not necessary to determine the proportion of the galvanometer resistance to the shunt resistance, as is commonly supposed, and therefore the multiplication of errors and the error of measuring the small resistance of the shunt, are entirely eliminated, as will be seen below.

The 2 dimensions of the shunt—diameter and length—are calculated from the largest and smallest currents to be measured. The diameter is calculated so that the largest current used will not heat it to such an extent as to cause an error greater than the allowable error, say $\frac{1}{10}$ of 1 per cent. It is preferable, instead of using 1 wire, to use a number of smaller ones parallel, with their ends firmly fastened together with silver solder. The length of the shunt wire is determined by the smallest current and should be such that this current gives a deflection of the needle which can be read to the limit of error allowable, while the adjustable resistance is made zero. For instance,

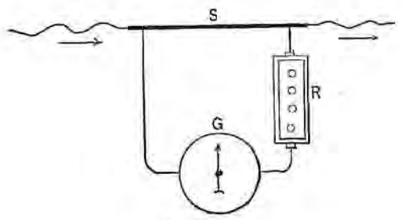

FIGURE 1.

if the allowable error is $\frac{1}{10}$ of 1 per cent., and the scale is in millimeters, the deflection should be at least 10 cm., as any good observer can estimate to $\frac{1}{10}$ of a mm. through a good telescope.

It is very necessary to have a secure contact where the galvanometer wires are fastened to the shunt. They should always be soldered and preferably with silver solder. The shunt wire must be so bent that the large currents in it will neutralize each other as much as possible, so as not to influence the galvanometer needle. It is well to place the shunt so that its plane passes through the plane of the needle. The influence of the current in it upon the needle can then be entirely neglected. Care should be taken that the shunt is well insulated from the ground, and that the effect of the current in the leads on the galvanometer is eliminated.

The galvanometer should be of comparatively low resistance, so that the adjustable resistance forms a large part of the total resistance of the galvanometer circuit, thus allowing for a large range of currents. It is, of course, very desirable to have the needle well dampened, so that the resistance will not have time to heat enough to cause error. The most convenient and accurate method of reading is with telescope and scale, as the cross hairs in the telescope admit of very accurate reading, and it is independent of the lamp used in the ordinary Thomson method. The distance from the scale to the mirror should be as great as possible so as to admit of using a large reading without causing an error. It may easily be calculated what the maximum deflection can be for a given distance of scale, so that the error of proportionality between current strength in galvanometer and reading of scale, is inside of a certain limit. Limiting the error to less than $\frac{1}{10}$ of 1 per cent., the deflection should not be more than 10 to 15 c m. for a distance of scale of about 2 meters. This makes the maximum deflection of needle about $1\frac{1}{2}$ degrees.

To eliminate the effect of a change of the earth's magnetism or any other magnetic change, it is necessary to put a commutator into the galvanometer circuit, and to take readings to the right and left, taking half their difference. This commutator and the leading wires should be carefully insulated from the ground.

For the adjustable resistance, an ordinary plug resistance box can be used. It is not necessary that the absolute resistances be known, as all the resistances of that circuit may be measured in terms of those in the box. It is necessary, however, to know their relative values. If this resistance is of copper, the effect of temperature of the room is entirely eliminated, because the resistance of the shunt and galvanometer circuit are changed in the same proportion; but if it is of german silver, the relative resistances of the shunt and galvanometer circuit will change for different temperatures of the room, necessitating a correction of the constant, as will be shown later.

The calibration is made by means of a voltameter in the main circuit, as shown in the sketch (figure 2) in which G is the galvanometer, R the resistance, C the commutator, S the shunt, V the voltameter and B the battery.

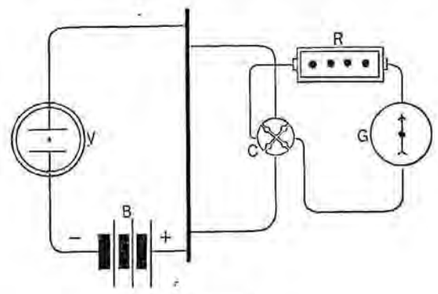

FIGURE 2.

The copper voltameter is generally used on account of its simplicity and the nature of the deposit, which, if proper precautions are taken, will always be a smooth, hard and firm one. The solution of copper sulphate should be as pure as possible, and about 3 parts saturated solution and 2 parts distilled water. It should be well stirred before using it. In using a fresh solution it is better to pass the current through it for 10 to 15 minutes before the calibration, as the first deposit is often imperfect. The anode should be of moderately pure copper, best obtained by electrolysis. The negative plate should be of platinum and not of copper; it should be accurately weighed before each calibration, as it is found that the weight decreases slightly by dissolving the copper deposits of the previous calibration or some other cause. The current strength used to obtain a good deposit is about .15 to .2 ampères for each square inch of single surface, or .3 to .4 ampères for double surface, when 2 copper anodes are used, 1 on each side of the platinum plate. The plate should be well washed with distilled water immediately after the calibration, and dried between filter paper, not over the gas jet.[1] The battery should be as constant as possible and should be put on closed circuit for a while before the calibration. Secondary batteries of low resistance are decidedly preferable. In case the batteries are not constant it is well to put into the main circuit an adjustable low resistance to keep the current constant.

The determinations of the electro-chemical equivalent by Kohlrausch and Rayleigh agree so very closely that their allowable error is entirely within the limits of ordinary practice.

1. It is better to have the platinum or negative plate larger than the copper anode, as it helps to diminish the tendency of the formation of a "beard" on the edges of the platinum plate. From ½ inch to 1 inch or even more, on all 3 sides has been found to answer very well, for a plate of 10-20 square inches.

Taking 19.686 mg. of copper per minute and per ampère (Kohlrausch, 1884), and letting

W = weight of copper deposited in milligrams,
D = average deflection during the calibration,
T = time in minutes,
C = current strength in ampères,
K = the constant required, that is, the number of ampères per unit of scale.

Then $$C = \frac{W}{T \times 19.686}$$

and $$K = \frac{C}{D} = \frac{W}{D\,T\,19.686}$$

This is the value for the resistance R in the resistance box used during the calibration. The constants for different resistances are calculated from the following formula:

$$K_1 = K\,\frac{R_1 + G + S}{R + G + S},$$

in which R_1 = the other resistance and G + S the resistance of shunt and galvanometer *in series*. G includes the resistance of leads and commutator. From this equation it is easily seen how very little the resistance of the shunt affects the calculated constants; being in both numerator and denominator of the fraction its value is generally beyond the third decimal place, so that it almost disappears in the equation.

To prove this formula, let

C = the current strength in main circuit,
a and b = the currents in shunt and galvanometer respectively, for a resistance R,
a_1 and b_1 = same for R_1,
The other letters are the same as above.

As the resistance of the shunt is such a very small part of the whole circuit, a change in the resistance of a circuit parallel to the shunt does not change the current appreciably, therefore

$$C = a + b = a_1 + b_1.$$

For the same current

$$\frac{K}{K_1} = \frac{b_1}{b},$$

and $$\frac{b}{a} = \frac{S}{G+R} \text{ and } \frac{b_1}{a_1} = \frac{S}{G+R_1}.$$

Combining these equations and eliminating the values of a, b, a_1, b_1 and c gives

$$\frac{K}{K_1} = \frac{R+G+S}{R_1+G+S},$$

or $$K_1 = K\,\frac{R_1+G+S}{R+G+S}.$$

The easiest way to measure the resistance of G + S in terms of the resistances of the box, is to take the deflections for 2 resistances R and R_1 alternately and for the same current. These deflections will then be inversely as the constants, the current being the same. Substituting in the above equation the deflections D and D_1 gives

$$\frac{K}{K_1} = \frac{D_1}{D} = \frac{R+G+S}{R_1+G+S},$$

or $$G + S = \frac{D\,R - D_1 R_1}{D_1 - D}.$$

This will be the same for any 2 resistances, but the best conditions are evidently when R and R_1 are near to the value of G.

When the adjustable resistance is of copper there is no temperature reduction necessary, as explained above. For german silver, the correction is as follows, for centigrade degrees:

$$\frac{k}{K} = 1 + \frac{r}{R+G+S}\,.00331\,(T-t).$$

Large letters represent the values for the high temperature and small ones for the low temperature.[2]

To demonstrate this, let

m = temperature coefficient for copper,
n = temperature coefficient for german silver,
Other letters the same as above, capitals for high and small for low temperatures.

$$C = a + b = A + B;$$

$$\frac{a}{b} = \frac{r+g}{s} \text{ and } \frac{A}{B} = \frac{R+G}{S};$$

$$\frac{k}{K} = \frac{B}{b}.$$

Eliminating A and a from first two equations, gives

$$b = \frac{CS}{r+g+s} \text{ and } B = \frac{CS}{R+G+S}.$$

Combining with third equation

$$\frac{k}{K} = \frac{S\,(r+g+s)}{s\,(R+G+S)}.$$

Substituting for $S = s[1 + m(T-t)]$ and for

$$R + G + S = r\,[1 + (T-t)\,n] + (g+s)\,[1 + (T-t)\,m]$$

and dividing, gives the desired formula, in which the values of m = .0037 and n = .00039 are substituted. This correction, though small, is very necessary for accurate measurements.

This method is essentially the same that was used at the tests of the Munich, Vienna and Philadelphia electrical exhibitions, where it proved to be an excellent one, especially on account of its convenience and sensitiveness.

In the tests made at the Philadelphia exhibition, 2 shunts were used with the same galvanometer; the first for currents from a fraction of an ampère to 50, and the second from 50 to 300. The first was made of 2 parallel No. 0 naked copper wires, each 4 meters long. The second had 10 parallel wires of the same diameter and 0m381 long, securely fastened at their ends in a brass casting into which the galvanometer wires were soldered. Neither of the shunts heated perceptibly with the currents for which they were used.

The resistances were an Elliott box of german silver from 1 to 50 ohms. The resistances of the galvanometer and shunt were measured by the method above mentioned, for many different resistances and were found to agree very well, giving as an average about 1.4 ohms.

The calibrations lasted from 20 to 40 minutes, reading every half minute. They were repeated for various resistances, current strengths and temperatures, and when reduced to like conditions agreed very well, notwithstanding the unfavorable circumstances at the test house.

The method can be made direct reading by making the adjustable resistance of copper, so that the constants are reduced each time by ½ or some other amount, and by dividing the scale into ampères for the resistance zero in the resistance box.

2. The calculations are very much simplified by calculating the constants for two extreme temperatures and interpolating for intermediate temperatures, taking the correction proportional to the number of degrees. This is accurate enough for almost all purposes.

STORAGE BATTERIES.[1]

The importance and desirability of an efficient and economical storage battery have been very widely recognized, but it is at the present time pretty generally felt that no existing form of storage battery is perfect, and that they are on the whole extravagant and wasteful to an extent sufficient to more than compensate for their undeniable convenience. It is perfectly certain that their employment has not become at all general, and that they have failed to realize the somewhat sanguine hopes of their early promoters.

It seems worth while to examine into the causes of this partial failure, and to inquire how far the evil opinion held by many practical men concerning our present method of storing electrical energy is justifiable.

One of the main objections is that storage involves a loss of some 50 per cent. of the whole. Now all methods of storing and transmitting energy involves some loss. To say that any particular method involves a loss of 50 or even 90 per cent. is not to condemn it utterly. There are many cases when the convenience of storage outweighs the evil of waste altogether; three principal ones may be specified.

(1.) When the power of the source would be otherwise so completely wasted that every fraction of it stored is clear gain. This is the case of much terrestrial water power. The energy of the tides or of Niagara is enormous, and wholly wasted so far as human activity is concerned; if 50 or even 10 per cent. could be stored in such a way as to be conveniently available, it would be of considerable value, and any arrangement capable of effecting this storage could only with injustice be stigmatized as wasteful. The solar energy of the carboniferous epoch has most of it been wasted; but a small fraction—probably not a millionth per cent.—has been saved and stored in the coal-measures. It is possible to abuse the coal for not having stored more, but we find it a useful modicum nevertheless.

(2.) A second case when the advantage of storage overbalances the loss is when regularity and continuity of supply is needed, and when the source is irregular and fitful. Wind and wave power illustrate this kind of source; it is manifest that wind power has not been so largely used as it would have been, had it been steady and dependable. A practicable method of storing up its energy and giving it out as wanted would gradually cause it to be very largely employed. This case is also illustrated faintly by a gas-engine or jerky motor of any kind, and the regularity and dependableness of a storage cistern may very well make it desirable to put up with some waste provided it be not excessive. Mechanical devices for approximating to regularity, such as the use of slack driving belts, undoubtedly give rise to a waste of power, and so does any form of regulator. But in the utilization of artificial forms of power like this, questions of economy become almost pre-eminent; and wastefulness is here a most serious objection, and, it may be, prohibitive defect. At the same time, if the engine is liable to stop, or if it is not always working, some mode of storing energy may be absolutely necessary, whether wasteful or not.

(3.) Another case, and to some extent the converse of the last, is when the available source is weak, though continuous, while the power is only needed for a short time, but during that time is required to be great. This is exemplified in the operation of pile-driving, where energy is stored in the slowly-raised weight to be suddenly expended on the head of the pile, also in the operation of drawing a bow; or again when a small waterfall or steam-engine, running continuously, is to be utilized for lighting during 5 or 6 hours each day; the obviously right plan in such circumstances as these is to store the energy during the hours it is not wanted, and thus virtually to double or treble the power of the source while it is actually in use. Unless, however, the loss occasioned by storage were reasonably small, there would be but small gain in attempting the process in this third case.

It is plainly advantageous to devise a method of storing that shall give out the greater part of what is put in; but we see by these examples that a reasonable loss may be more than compensated by convenience, regularity, availability, and dependableness. Again, when energy has to be transmitted over great distances, it is in practice difficult or impossible to make the expenditure of energy at one end depend upon and be regulated by its consumption at the other; and so, without some system of storage, great waste will ensue during intervals of small consumption. Looking to the immense development which the transmission of energy may be expected to undergo in the course of the next few decades, a convenient and manageable method of receiving large quantities of transmitted energy, and of holding it in readiness until wanted, must be of prime importance.

It was in view of such applications as these that the invention of the storage battery by Faure was hailed with enthusiasm by the highest scientific authority in Great Britain; while the public, jumping to the conclusion that a thing for which so many uses could be instantly found must needs be a profitable investment, hastened to provide money, not for commencing careful experiments and perfecting the arrangement, which would have been wise, but for manufacturing tons of apparatus in its first crude, immature, and untried form. Some day it may perhaps be recognized that because it can be shown that a thing will be extremely useful when perfect it does not follow that it has already attained that perfection, that indeed probabilities based on historical developments are enormously against such abnormal and instantaneous maturity, and that the careful nursing and rearing necessary to healthy maturity are better given in the seclusion of laboratory and study than in the excited and heated atmosphere of the Stock Exchange. It is doubtless recognized already that all preliminary operations are better conducted on a scale smaller than the wholesale manufacturing one. In developing a new industry there are scientific difficulties to be overcome, and there are manufacturing difficulties. By scientific difficulties we mean such as the determination of weak points, the best ways of strengthening them, and generally the discovery of theoretically the best modes of effecting the object in view: manufacturing difficulties begin with questions of expediency and economy—how most cheaply and satisfactorily to carry out the indications of theory, to obtain this or that material—and include the organization of a system of manufacture, of division of labor, of machine tools, which shall enable the work to be done with economy, security and despatch. Over-haste in the preliminary stages causes both these sets of difficulties to be tackled together, and so throws a grievous burden on both adviser and manager. All these untoward conditions have storage batteries experienced; and to say they have not fulfilled the hopes of their early promoters is no more than to say that those hopes were untimely and unreasonable. The period of maturity has been undoubtedly delayed by injudicious treatment, but its ultimate attainment seems to us inevitable; and it is at present a matter of opinion how nearly it has already been reached: certainly great steps towards it have been made. Let us inquire what some of the difficulties encountered have been, and it will be seen that, formidable as some of them are, they belong essentially to an infantile stage, and are not suggestive of constitutional debility.

The first form of manufacture consisted in rolling up sheets of lead and composition, with trousering to keep them separate. The difficulties found were that the coatings would not adhere, but became detached in large flakes; that the trousering got corroded through and permitted short-circuiting: and that free circulation of fluid being impossible, the acid became exhausted in some

1. O. J. L. in *Nature*.

places and concentrated at others, and thus every sort of irregularity began. Now regularity or uniformity is of the most vital and fundamental importance in any form of battery. If any part of a plate is inactive, that part is better away; if any plate in a cell is inactive, it is better away; and if any cells of a battery are inactive, they are infinitely better away. The rolling or coiling up of the sheets being found awkward in practice and liable to detach the coatings, flat plates came to be used, then perforated plates, and then cast grids; these last having such large hole space, that they held enough composition, and held it securely enough, to enable the trousering or intermediate porous material to be dispensed with. This was an evident step in advance: free circulation of the liquid became possible, and could be assisted by stirring; there was nothing to corrode except the plates themselves, and the composition, being in the cells or holes of the grid, might be reasonably expected to adhere. So far expectation was not altogether belied. The adhesion was not perfect, it was true, and pieces of composition sometimes fell out of the holes, especially if too powerful currents were passed through the cell, but still it was much better than it had been; and if the plates were well filled, properly formed, and fairly treated, the composition adhered extremely well and securely. The circulation of the liquid was not automatically perfect either, but mechanical agitation could be readily applied; without it the acid near the bottom of the cells tended to become more concentrated than that near the top, not by reason of gravitation undoing diffusion, which is impossible, but because during each charging fresh acid is formed, and in great part falls to the bottom in visible streams. Another great advantage was that some amount of inspection of the plates became possible, and experience as to the actual behavior and appearance of the plates, began to be accumulated. And painfully varied that experience was. Every variety of extraordinary behavior which could be suggested as probable, and a good many which no one could possibly have imagined beforehand, made their appearance. The hundreds of tons of batteries made at this period doubtless enabled these unpleasant experiences to be more rapidly acquired than would have been done on a small scale, but it was a costly series of experiments. However, the experiments were made, the public involuntarily assisted in the acquisition of experience, and, caring less for knowledge than for marketable commodities, they expressed dissatisfaction at the result. Many of these incipient difficulties are now overcome by the manufacturers, but the great dislike of the public to involuntary experiments, and the shock which their confidence underwent on being unexpectedly called upon to participate in research, have not yet altogether abated.

The main difficulty now experienced was how to keep the plates from touching. They might be put in wooden frames, or elastic bands might be stretched round each of them, and if they would only keep flat it was impossible they should touch unless the composition should drop out of the holes. Sometimes the composition did drop out of a hole, and bridge across the interval between 2 plates, but the more common and more fatal experience was that the plates would not keep straight. In a few months the positives were found to swell, and as they swelled to buckle—to buckle and twist into every variety of form, so that elastic bands, wooden frames, and every other contrivance failed altogether to prevent short-circuiting. The cause of the buckling is of course irregular and one-sided swelling, and the cause of the swelling is apparently the gradual peroxidation and sulphating of the material of the bars of the lead grid, which occupy less room as metallic lead than as oxide or salt. As the bars swell, they press on the inclosed composition, occasionally driving it out, but more frequently, and with properly made and treated plates universally, distending themselves and stretching the whole medial portion of the plate. The edge or frame of the grid is stronger than the middle bars, and is not so easily stretched; in a good and uniformly worked plate it does stretch, and an old positive plate is some quarter of an inch bigger every way than a new one, but if one face of the plate is a trifle more active than the other, it is very plain that the most active side will tend to become convex: and buckling once begun very easily goes on. To cure it 2 opposite plans have been tried: 1 is to leave the plates as free and unconstrained as possible, hanging free it may be from 2 points, thin, and with crinkled or crimped margins to allow for expansion; the other is to make them thick and strong, with plentiful ribs for stiffness, and besides to clamp them up one to another as tightly as may be, and thus in mechanical ways to resist buckling and distortion. I do not know that any one could say for certain beforehand which of these 2 plans would be likely to answer best, but practice is beginning to reply in favor of the latter, and well braced plates of fair thickness show no unmanageable tendency to buckle. It must be remembered that no material can buckle with a force greater than that necessary to restore it to flatness, and this force in the case of lead is very moderate. Hence it may be fairly hoped to overcome and restrain all exuberances by suitable clamps and guides arranged so as to permit flat and even growth, but to check all lateral warpings and excrescences.

Uniformity of action is still essential, especially if all the plates in a cell are clamped together. Plates mechanically treated alike ought to be electrically so treated also, and it is impossible to keep a set of plates working satisfactorily together unless the contact of each is thoroughly and equally good, so that each may receive its fair share of current. Defects of contact have been a fruitful source of break-down and irregularity. Clamps and screws of every variety have been tried, but the insidious corroding action of nascent oxygen exerted through the film of acid which by spray and creeping forms and concentrates on the lugs—this corroding action crawls between the clamped surfaces, gradually destroys all perfect contact, and sometimes produces almost complete insulation. Contacts on the negative plates give but little trouble; contacts on the positives have taxed a great amount of patience. Lead contacts "burned," *i. e.* melted, not soldered on, are evidently less liable to corrosion than brass or copper fittings, or than any form of clamp, but they are apt to be somewhat clumsy if of sufficient conductivity, and moreover they are awkward to undo again, and somewhat troublesome to do. However they have proved themselves so decidedly the best that now no other contacts will be used, and their re-introduction has been followed by a marked improvement in the behavior of the cells. So long as contact with one plate was better than with another, a thing quite possible to happen without any difference being perceptible to the eye, so long was it possible for 1 or 2 plates to remain almost wholly inactive while another 1 or 2 received far more than their share of current, and became distended, warped, overcharged, and ultimately crumbled away. If 1 or 2 plates in a cell are black, and giving off torrents of gas, while the rest are brown and idle-looking, it is pretty fair evidence of irregular and insufficient contact, or else of some great discrepancy in the age or make of the plates. This point also is one that was not attended to in the early stages of manufacture; plates were made for stock, and cells were made up with plates of all ages selected at random from the store. Directly uniformity is perceived to be essential, this is recognized as obviously bad. Plates intended to work together should be of the same age and make, and inasmuch as keeping does not improve them, the best plan is not to make for stock, but to keep material ready, and then quickly make up as wanted. Plates in work deteriorate slowly, but they are wearing out in the fulfilment of their proper function; plates in idleness deteriorate as quickly, and they are rusting out in fulfillment of no function at all.

Worn-out plates, however, are by no means valueless. Lead material has a well recognized price, and if attention were given to the subject, it is probable that decrepit and useless plates might be made to yield a very large percentage, if not the whole, of their original lead. For it must be remembered that plates deteriorate not by waste but by accretion: an old plate contains as much lead as a new one, but it contains it with the addition of oxygen and sulphion; no longer a tenacious coherent frame, but a crumbling mass of incoherent powder.

The age of plates is a point of vital interest, though but little is known as to the possibilities in this direction at present. A year may be regarded as a fair average age at the present time; but this is a low rather than a high estimate. Thick plates are found to last far longer than thin, which is only natural when it is remembered that the wearing out is due to corrosion, that corrosion proceeds mainly from the surface inwards, and that the internal portions of a thick plate are to a great extent protected by the mass of superincumbent material. If it can be shown, as we understand it can, (1) that the cost of materials is far more than the cost of manufacture; (2) that the worn-out material has a market value not incomparably less than the original; and (3) that the frequency with which plates have to be renewed is not such as to cause much inconvenience; then we hold that the first stage of the durability difficulty has been overcome. Much more may be hoped for in this direction as experience increases, and it is not extravagant to hope that a well-ribbed, properly-clamped, and fairly-treated thick plate may last as long as five years before it becomes disintegrated.

It is evident, however, that in a region where pure experiment is pre-eminent, and where the units of time are months and years, instead of hours and days, the accumulation of experience is a slow and tedious process. It is no use making statements involving periods of five years when no one has had the present improved form in use for so much as 6 months. Nevertheless it is possible to see that the present cells are better than their predecessors; and as their predecessors have lasted in good condition for a year and more it is not presumptuous to indulge in well-founded hopes. Many of the difficulties connected with the early forms of battery were aggravated by Utopian notions concerning internal resistance and compactness. The internal resistance of a cell was so beautifully small, that the manufacturers were tempted to diminish it still further by putting the plates far too close together. An eighth or tenth of an inch interval is well enough if the plates had been hard rigid slabs of perfect flatness; but it was madness to pack flexible lead plates full of composition certain to swell and liable to drop out so near together as this. Security and dependableness were sacrificed to a natural desire for sudden and Utopian perfection. We may hope that these lessons have been profited by, and that the manufacturers perceive that confidence and security are the first conditions of success, and that minutiæ as to the number of noughts before the significant figures in the specification of resistance begin, though those also are of importance in their turn, are yet of quite secondary consideration. Moreover, this packing of the plates so closely did not really do much to secure the result desired; the greater part of the resistance of half run-down cells is not in the liquid between the plates, but in the surface or scum separating each plate, and especially each negative plate, from the liquid, and hence putting the plates a safe distance, say a quarter or one-third of an inch apart, exerts an effect on the total resistance which is certainly far more than compensated by the ready opportunity thus afforded for access by both sight and touch. The old opaque boxes chock full of plates, with slight india-rubber bands between them, were started and left to Providence. No one could see what went on, nor could one readily get at anything to rectify what was wrong. In the present glass boxes properly arranged on accessible shelves with only plugs or studs between the plates, clear vision through the cell in any direction is easy, and accidental obstruction not only very seldom occurs but if it does it can without difficulty be seen and removed. But it must be granted that these boxes are less compact than their predecessors, and for some purposes, such as locomotion, compactness is of the first importance. Most true, for some purposes. It is not to be supposed that one type of cell will answer every possible demand. A dynamo to be highly efficient must have a large and massive field magnet, but in some places bulk and weight are fatal objections; and in these places smaller and more compact dynamos may be more suitable: something, however, must be given up to secure the required lightness and compactness, some sort of compromise must be effected. Just so with cells: we can point out what is theoretically the best form, and this form may, for large stationary electric light or power installation, be actually the most suitable; but we may also see that for boats, for tramcars, and for fish torpedoes, some very different and far more compact form may be quite essential.

Efficiency, Durability, Economy, Compactness: it may not be possible to attain all these at once—if it were, there would be small room for discussion—but sometimes one and sometimes another will be the pressing necessity, and manufacturers of storage batteries, like manufacturers of dynamos, must be prepared with forms suited to various needs.

We have spoken mainly of difficulties connected with the positive plates, and have said nothing concerning the negatives. It is not that these are not susceptible of improvement, but their faults have been of a less imperious and obtrusive nature. They are not perfect, but they do fairly well, and there has been little need to worry much about them, until the extraordinary behavior of positives had been taken in hand and checked. The time is coming to attend to these also. They fail not from exuberance, but from inertness. As they grow old, they do not swell, and warp, and burst, and crumble, like the positives, but they grow quietly hoary, and serenely decay. The composition in a worn-out negative consists of white sulphate through and through, but the frame remains intact, and it consequently never falls to pieces, nor does it swell. Impurities in the acid used tell upon a negative plate—nitric acid is fatal. Acid much too weak or very much too strong is also deleterious, and idleness is bad. The difficulties connected with negatives mostly depend on their aggravating property of always requiring a quite opposite treatment to positives. The less a positive is formed and overcharged the better. A negative delights in complete formation and frequent overcharge. In recognition of this it is now customary to form them separately, and to give the negative a thorough dose of hydrogen without commencing the corrosion of the positive by an overdose of oxygen. When the discharge from a cell begins to flag, it is the resisting scum of sulphate that has formed over the negative plate which is responsible for the flagging. The true E. M. F. of a cell is wonderfully constant throughout the whole discharge; but the internal resistance is all the time increasing, at first very slowly, ultimately, towards the end, with a rush. One such run-down cell in the midst of a lot of others therefore obstructs the current terribly. If only a series of cells could with certainty be made to work together uniformly, if a series could behave as well as some of the cells in it, no one would have cause to complain.

Through the whole history of the manufacture, from the very beginning, a few cells here and there have always exhibited astonishing efficiency;—the aim of manufacturers may be said to be to bring all cells up to the level of a few. Much progress in this direction has been made, and it may be very fairly expected that, as uniformity is gradually attained, a series of cells subjected to the same treatment may behave in the same manner. Whenever this is certainly accomplished, there will have been reached a high stage of efficiency, beyond which further progress need be only in the improvement of comparably insignificant minutiæ.

The subject of the electrical storage of energy is really one of national importance;—it is comparatively a small matter whether this or that form of storage, or this or that company of manufacturers, succeeds in bringing out the permanent form. It sometimes unfortunately happens that enterprising pioneers only clear the way, and retire just in time for other men to come in and reap the fruits of their labors. So much capital and so much labor have been already expended in the effort to bring storage batteries to perfection, so great progress has been made, and so apparently small are the steps which yet remain to be accomplished, that we may surely fairly hope that some of the original believers in their great, and as it seems to us inevitable, future may yet live to see their faith justified and their patience rewarded, and may even taste some of that so-called "substantial" reward without the hope of which great commercial enterprises would never be undertaken, and modern civilization would have scarcely yet begun.

NEW FORMS OF GALVANIC AND SECONDARY BATTERIES.

European inventors are devoting considerable attention to improvements in batteries, some of the more promising of which may be found described in this article, which has been compiled from different sources.

Among those in which peroxide of lead is used is that of D. Fitzgerald and T. J. Jones. The negative element consists of lead and carbon in contact with peroxide of lead, the peroxide being preferably obtained by the electrolysis of an oxide or salt of lead, or by the conversion of spongy lead into peroxide. When carbon is used as a negative element, it may advantageously be in the form of small fragments surrounding a rod or plate of the same material, the interstices between the fragments being filled with lead peroxide. Lead in a highly porous condition is used for the positive element. It is obtained by a greater or less degree of compression of the metal reduced from its oxides or salts by chemical decomposition or by electrolysis, or by the compression of lead in a state of minute subdivision produced by mechanical means. Dilute sulphuric acid is used as an excitant, which may be improved by holding in solution a small proportion of sulphate or tartrate of ammonia. A new form of carbon battery has been invented by Tommasi and Radiquet, which consists of a rectangular porcelain trough, with a carbon plate at the bottom, surrounded by a paste of peroxide of lead. The other electrode is also formed of a similar carbon plate, upon the upper side of which are placed fragments of platinized retort coke. The two plates are arranged one above the other, separated by a sheet of parchment paper, by which the cell is divided into two compartments. A saturated solution of common salt is then poured in to such a height that the fragments of coke on the upper carbon will be partially immersed. The plate of carbon which does not touch the peroxide of lead is the negative pole. Other saline solutions may be used without materially varying the electromotive force of the cell which is about 0.6 volt.

A battery invented by J. B. Spence and J. E. Chaster, has attained some notoriety because of the claim that it produces a current without expense. This is a copper-zinc battery in which a solution of caustic alkali is used as the exciting fluid, and the depolarizing substance around the copper is oxide of copper. When the spent or partially spent solution is withdrawn from the cells, the zinc therein contained can, it is said, be reclaimed as the commercial oxide of zinc, by passing carbonic acid into the solution which throws down the white carbonate of zinc, leaving carbonate of the alkali in solution. The white carbonate of zinc, when collected, washed, dried and ignited, gives off carbonic acid (which may be used again in another portion of the spent liquid,) leaving oxide of zinc. The solution of the alkaline carbonate obtained by this process may be evaporated, and crystals of alkaline carbonate obtained in the usual commercial form, but it is preferred to boil the alkaline carbonate with caustic lime, so as to convert it into caustic alkali, which when sufficiently evaporated is decanted from the carbonate of lime (formed by the double decomposition in boiling) to be used over again for acting upon a fresh quantity of zinc in the galvanic cell.

Other inventors have devoted their attention to regulating the consumption of zinc and preventing waste of material. The device of Mr. Courtenay is an example of this class. The zinc is coated with layers of asbestos paper previously prepared with an aqueous solution of gum lac, or similar substance, the object being to prevent the wasting of the metal while in the exciting fluid.

Several inventors appear to consider that there is an advantage in making cells with three divisions. Mr. Wenzel of Vienna, patents a voltaic cell consisting of a vessel of impermeable non-conducting material, divided by porous partitions into three compartments. In one of these is placed the positive element of platinum, carbon or the like, immersed in nitric acid of 30° to 40° Beaumé. In another of the compartments is placed the negative electrode, preferably zinc, immersed in a solution of salt about 1 part to 20. The third compartment which is between those containing the electrodes is filled with sulphuric acid of 50° to 70° Beaumé.

A syndicate with a capital of $60,000 has been formed in Paris to exploit the sodium battery invented by M. Jablochkoff. This element was devised for the purpose of obtaining a higher electromotive force than has been the case with any previous invention. Pure sodium in thin plates is used, coupled with compressed carbon, such as is employed in other batteries, or the plates may be placed in a metal capsule, in the midst of broken carbon. Under such conditions and subjected only to the humidity of the air, the battery yields the relatively high electromotive force of four volts, which may be raised to six volts by impregnating the carbon with certain metalloid solutions. This latter fact, however, has no practical value, because the price of such solutions, and the difficulty of using them, make the arrangement quite impracticable. With a couple of sodium and copper, the electromotive force falls to three volts. Such a battery, which may be of value in some cases, is made up of a thin plate of sodium, and a piece of red copper gauze. It will be seen that the force of this battery is considerably in excess of others now in use. On account of the avidity with which sodium decomposes water and absorbs oxygen, it is necessary to shield the battery from exposure when it is not in use, and for this reason it should be kept, except when active, in a bath of naptha, or at all events in a hermetically sealed vessel. M. Jablochkoff asserts that the waste of the sodium, that is to say, its combustion, beyond what is converted into useful energy, is extremely small. One of the objections, which naturally present themselves to this battery, is the great precaution which must be taken in using it, on account of the explosions which occur when sodium is brought into contact with water. With proper precautions, however, such a danger is not great, although more than one serious accident has happened from this cause.

Mr. Sellon has patented an improvement in secondary batteries, which is intended to prevent the leakage of electricity due to the spreading of moisture from various causes, such as through capillary attraction round or over the edges of the plates, or by the condensation of atmospheric moisture, or by the splashing which may occur in charging, and also has reference to modifications in the form of the upper part or edges of the plates in order to arrest the spray which may be given off during formation

or whilst charging in the ordinary way, and further to give a convenient form for packing in stacks or columns with ready access to the electrolyte, which may at the same time obviate the capillary attraction, or the effect of the splashing or spilling. For instance, with such forms as annular basin or pyramid shaped or other plates, the edges of which can be so treated, the inventor makes grooves, corrugations, or overlappings of suitable form either at or around the extreme edge or conveniently near thereto, or he casts upon, or works up with the plates, projections, or ridges, or bent portions which may serve an equivalent purpose, and into the space or cavity so formed he places any insulating material of a nature suited to arrest or entirely stop the spreading of the moisture which might otherwise form a junction with the moisture on the adjoining plate. A mixture of paraffine with asbestos, or paraffine alone is very suitable for this purpose.

Another improvement in storage batteries is that of S. Kalischer, which consists in the use of iron for the anode, in combination with a solution of suitable salts of lead, the latter being subjected to the process of electrolysis to produce a dense coating of peroxide of lead upon the iron. This coating, on being metallically connected with a cathode of lead in the liquid remaining after the process of electrolysis, will constitute a secondary battery of high electromotive force from which a constant current of long duration can be obtained. According to the principle of the invention, the peroxide of lead is precipitated upon the anode by electrolysis and by means of secondary action respectively, while the iron, which is employed for the anode remains unchanged.

In the secondary battery invented by M. N. Basset of Paris, any oxide is used which is capable of passing from an inferior to a superior state of combination, as well as any of the chlorides, sulphurets, or phosphurets. The most economical element is composed of two plates of retort charcoal or agglomerated carbon, covered with natural peroxide of iron, or granulated colcothar, wrapped in blotting paper, and held together by cords.

H. Woodward has invented a secondary battery made up of lead tubes rammed full of litharge peroxide, acetate or other suitable salt of lead. The tubes having been cut into the lengths required, and charged with the material, are set aside to allow the contents to dry; they are then pierced with a number of holes to permit the acid and the electric current to act upon the enclosed material.

EVOLUTION OF THE ELECTRIC RAILWAY:

ITS COMMERCIAL AND SCIENTIFIC ASPECT.

BY DR. WELLINGTON ADAMS.

(Continued from page 268, Vol III.)

As I have already stated, the most important application of this principle of electric transmission of power is exemplified in the *modern* electric railway. Now, I advisedly use the expression *modern*, because the electric railway, like all other inventions, has a history. It is not a thing of spontaneous development, but of gradual growth. In considering its evolution, we must cursorily glance over the history of the "*electric engine*," as electro-dynamic machines have heretofore been christened. The earlier "electric engines" or motors belonged to that class or type known as oscillating or reciprocating engines. First to make an oscillating electric motor was a learned monk, strange to say, of Padua—Salvator del Negro, who, in the year 1831, succeeded in operating such a motor. An oscillating motor, however, has many disadvantages, the most important of which is the fact that the moving part (the "armature") at the end of its stroke is at a considerable distance from the attracting electro-magnet (the "field"). This, in electric motors, is a very serious defect, since the electro-magnetic attraction or pull diminishes in intensity very rapidly, varying, as it does, inversely as the square of the distance; so that when the armature begins to approach the field there will be very little, if any, force pulling it. Hence motors built upon this principle proved very little more than pieces of physical apparatus. The first motor for producing rotary motion by electro-magnetism, without a reciprocating action, was invented in 1833 by our now deceased countryman, Prof. Henry, late of the Smithsonian Institution, a description of which may be found in Vol. XX. of Silliman's Journal.

This motor also was but a toy, having the same defect just referred to, as indeed did all motors brought out up to the time of the discovery of the modern "dynamo" principle. Between the time of the advent of Henry's motor and the period of Prof. Page's experiments, of which we shall learn further on, Davenport in our own country, Prof. Jacobi in Russia, Davidson in Scotland, and Mr. Henry Little in England, constructed electric motors of considerable size. Prof. Jacobi propelled a boat by electricity on the Neva, at St. Petersburgh, in 1839; Davenport and Ransom Cook had quite respectable electric motors working in New York in 1840; and Davidson ran an electric locomotive in 1842 on a railroad near the city of Glasgow, Scotland. A little later, Mr. Little operated an electric locomotive in England. Jacobi's motor was of about two h.p.; that of Davidson was a little over one h. p., and propelled a locomotive weighing five tons at the rate of four miles an hour. Excitement upon this subject reigned supreme in New York about 1841, when electro-magnetic engines became a kind of mania, and although commercially worthless, hundreds of them were manufactured to meet the market demand.

The experiments of Jacobi, Davenport and Davidson proved unsatisfactory however, as was predicted by contemporary scientists. This, naturally, caused disappointment and reaction; so that nothing of importance was added to the stock of knowledge concerning the subject until 1845, when Prof. Page, of Salem, Mass., revived and gave to the subject a new impetus by the invention of a new form of electric engine based upon the principle of the axial force of electro-magnetism, which proved to be the most perfect electric motor ever invented up to that time. A few years later, Prof. Page proposed electricity as a motive power for railroads, through the instrumentality of his own electric engine. This engine proved so successful and attracted so much attention that the idea gained favor to such an extent as to induce Congress to appropriate and place at Prof. Page's disposal a sum of money (thirty thousand dollars) adequate to construct and operate an electric locomotive in accordance with his plans. Such a locomotive was built in 1851, and used to propel a train of cars between the cities of Washington and Bladensburg, a distance of five miles. As was natural, such an undertaking created great excitement and discussion in the scientific world, both at home and abroad, more especially because of the governmental sanction and assistance lent the enterprise. The great mathematician and scientist, Dr. Joule, and many others, very properly contended that the system would be too expensive, and that electricity as then generated, could not be used as a motive power with sufficient economy to warrant its adoption on a commercial scale. In fact it was this very discussion which led Dr. Joule to that long and laborious investigation of the mechanical equivalent of heat, which now forms the basis of all our work in thermo-dynamics, and without which we should be groping in the dark.

It was on the 29th day of April, 1851, that Dr. Page made the trial of his locomotive, which ran at the rate of nineteen miles per hour, making the trip of five miles in thirty-nine minutes. The locomotive itself weighed ten and one-half tons, including the batteries, and carried seven passengers. There were many stops and delays on account of the breakage of his battery cells, which were carried up-

on the locomotive, the jars fulfilling the office of a steam locomotive boiler and furnace, zinc and sulphuric acid in the former case constituting the fuel. The sulphuric acid and zinc were burned or consumed in the production of electricity. This is the principle upon which it was sought to operate all the electric engines thus far referred to. Electricity was here called upon to serve as a prime motor, utilizing the energy stored in sulphuric acid and zinc.

The folly of such an error is manifest, since one pound of zinc costs twenty-five times more, and is not capable of being transformed into as much dynamic force, as one pound of coal. Although Dr. Page's hopes were not realized as far as refers to the commercial aspect of the enterprise, he nevertheless accomplished a great feat, and to the day of his death he contended that the time would surely come when electricity would be economically used as a motive power upon railroads.

Ever since Dr. Page's memorable experiment, thoughtful people have been looking expectantly and anxiously forward to the fulfillment of his prophecy. The time is now ripe for such fulfillment. In fact, it has even now passed from the stage of speculation and become *au fait accompli*, many miles of electric railway, notwithstanding their primeval crudity, now being in successful operation on a commercial scale in different parts of the world.[1]

You ask, I imagine, "What has rendered possible at this day that which was thirty years back demonstrated impracticable; and in what respect does the *modern* electric railway differ from that of the past?"

My answer is: that which has rendered the electric railway commercially feasible, is the discovery by Messrs. Varley, Siemens and Wheatstone, and the subsequent development by many others, of the dynamo-electric machine; and the further discovery or demonstration by MM. Fontaine and Gramme of the reversibility of that machine, which admits of its being transformed into the most efficient form of an electric motor, when a suitable electric current is passed through it. The *difference* between the ancient and the modern electric railway, consists in the fact that whereas the effort was formerly made to use electricity as a *primary* motive power originating from the consumption of zinc and acid, we now use the electric engine or electro-dynamic machine as a *secondary* motor, and the electric current simply as a means of *transmitting* power procured from natural sources or previously generated by any of the known economic methods, if some natural source of power is not at hand. Such a system contemplates the establishment of a central fixed station, where large steam boilers and engines of the most economic type are erected and used to set in operation dynamo-electric machines, which generate powerful currents of electricity. These currents are in turn transmitted through a copper conductor running along the roadway, and, by means of a moving contact, they are taken up into the cars while the latter are in motion, and there passed through an electric engine or electro-dynamic machine, which operates to propel the cars. This idea of the generation by dynamo-electric machines of powerful currents of electricity at stationary points, and the transmission of these electric currents to cars while in motion for the purpose of effecting their propulsion, was first put into execution in 1879, by Dr. Werner Siemens and myself, both of us working independently and mutually ignorant of the other's doings. I constructed a small model, such as was within my limited means, and used the same to demonstrate a lecture on electricity delivered at the time in Colorado Springs, Colorado; about the same time Dr. Siemens exhibited a more extensive model at the Paris Exposition.

In my system the method of applying the power was very different from that adopted by Dr. Siemens; my only object then being to demonstrate the principle of electric transmission of power to a moving car for the purpose of propelling the same. On receiving news of the work of Félix and Chrétien at the sugar plantation at Sermaize, they having resorted to electricity as a source of power for plowing, I was more than ever impressed with the value of the system and of the future which lay before it, and I accordingly began experimenting upon and studying the subject up exhaustively, going thoroughly into every detail.

Although at the time actively engaged in medical practice, and connected with the Medical College in Denver, so great were the allurements, I was induced to give everything up in Colorado and leave there rather precipitately for Washington, in quest of a generic claim upon this fundamental principle. My case being examined, it was, however, found that the same principle had been *proposed* and provisionally patented, although not put in operation or even demonstrated and made public, as far back as 1840, by one Henry Pinkus, a remarkably inventive genius of that period. In 1840, however, the dynamo was unknown, and the electric car motors of Pinkus, which existed only in his imagination, were *supposed* to be operated by galvanic batteries buried in the ground. The principle of the transmission of the current to the car while in motion for the purpose of effecting its propulsion was, however, the same. The inventor even went so far as to anticipate the future use of "mechanical generators, which should be more economical" than the batteries.

Dr. Siemens and myself are consequently antedated as regards the question of first conception of this broad principle, and the underlying feature of the *modern* electric railway becomes public property. My application for a patent upon this fundamental principle is a matter of record in the United States Patent Office. This application was abandoned on discovering the record of the Pinkus patent. Appreciating, however, the rich harvest in store for inventors in this new field who should devise the most practical and economical means of applying this principle, which comprehends an army of important details, I immediately began research into the necessary conditions to a successful solution of this most intricate problem. The results of this investigation, which has cost many thousands of dollars, will, I hope, in your judgment, prove meritorious.

We may, of course, crudely mount upon a car a dynamo-electric machine of our own or another's design, and connect this up with the wheels or axles of the car by means of cog-wheels or belting, and thus effect the propulsion of the car, temporarily for exhibition purposes, regardless of the cost or of practical commercial requirements, as several have done since the first public exhibition of the modern electric railway by Dr. Siemens and myself, the individuals in each instance styling the result as "their electric railway," which as a matter of fact differed, figuratively speaking, but by a bolt or a nut from Siemens's original road.

(To be continued.)

1 Page's motor in operation and stereopticon views of the others were here introduced.

FIRST PRINCIPLES FOR YOUNG MECHANICS.[1]

BY COLEMAN SELLERS.

A well grounded knowledge of the great law or principle of conservation of energy should be taught with the multiplication table. It can be so taught if the teachers themselves are certain that there is in the universe only so much energy, and that we cannot make one particle more than already existed. With a clear understanding of this principle, no time will be wasted in search after perpetual motion machines, and fewer mistakes will be made by really earnest seekers after improved machines for use or improved methods. When a young man brings to me some wonderful improvement over the ordinary crank motion,

1. *Scientific American.*

some device that is to supersede the crank of the steam engine, a feeling of utter helplessness comes over me; I know not where or how to begin; he has had no opportunity to learn the simple laws of mechanics, and to point out the fallacy of his argument means to teach him the laws of mechanics, so I can only say to him, "Don't," and may advise him what books to read.

We hear or read almost daily of the wonders of science, and what is to be accomplished by electricity. "It is to be the great power of the future." Is it a power now? We may use it indirectly to drive machinery, we may make use of it to propel the cars on our street roads, but is it a power in the sense that steam is a power? Let us think of this a few moments. We call steam a power, and our factories are driven by steam power; or we call water when falling a power, and we drive the machinery in other factories by water wheels; or we pump water into the reservoirs at Fairmount by water power. Where we have no fall of water, and where fuel is scarce but wind plenty, we grind corn in a mill driven by wind, and the wind is our power; these and other sources of power may be called primary powers.

Secondary power is that which is transmitted from the prime motor to a machine. One machine may be driven by belt power, and another may be driven by gearing, etc. Electricity, as we now use it, as a power must be classed in its greatest economy with the secondary powers, with the belt or the gearing, not with the steam engine and the water wheel. We dig from the earth coal that contains the stored up energy of the sun's heat expended on forests that existed long before man came to live on this planet. We burn that coal under our boilers, and the steam generated by this application of heat to water is used to drive the piston of the steam engine, and from thence is the power conveyed by belt or gearing by shafts, or even by electricity, to the machines to be operated. We can burn up zinc in costly acids, and generate electricity that can be used to drive an electric engine, and so in turn operate machines exactly as in the case of the steam engine. In this case electricity is a power exactly as steam is to be considered as a power; and what is more, the electric battery will give us more nearly the whole of the stored up energy of the metal eaten up in the battery than the most improved steam engine can give us of the stored up energy of the coal that is devoured in the furnaces under the boilers. With all this advantage, electric batteries are not used to drive machines with any hope of economical results.

Zinc has been gathered from the earth as an ore, it has been converted into a metal, or the metal has been gathered from the ore by means of coal and much labor; its market price is measured by the cost of its production. To burn up zinc at 5 cents a pound in acids costing but few cents per pound, with a certainty of getting from the metal 70 or 80 per cent. of its theoretical energy in motive force, yet makes the venture a more costly one than the burning of coal under a boiler with the knowledge that we are at the best getting but little more than 10 per cent. of the theoretical power that lies hidden in that coal. The electricity that is now lighting our streets, the electricity that is utilized in places to drive the street cars, has behind it the steam engine or the waterfall, the windmill, or some other motor.

By means of a steam engine we drive a dynamo electric machine, and the electricity thence proceeding lights our streets or may be reconverted, with some loss, back into the power that created it; for one dynamo machine can be made thus to drive another, the electricity being carried from one to the other by proper conductors. What, then, is electricity as we now use it in the way of power, but as the belts and the gearing that carries our steam power to the machines? It is a belt with more or less slip. But this is not to remain so forever. The future of electricity as a power is full of promise. The coal we now squander, using but a small percentage of its theoretical dynamic force, is capable of yielding its energy either as heat or as electricity; and the time will come when we will not burn this coal to boil water, and in that boiling lose say 1,000 units of its heat at the moment of the conversion of water into steam, lose all this, never to be getting it back, but we will take from the coal its energy in the form of electricity, we hope in more near ratio to its true value, and then we can convert that energy into whatsoever other form of energy we may require. The best that science can do is to point out just what energy there is in this or that source of power. The most we can hope to utilize of this energy as power will never amount to 100 per cent. Nature gives us nothing without exacting something in payment.

A pound of water is the same as a pound of metal so far as its power from gravity is concerned. In falling through space it will exert just as much force as any other pound weight is capable of doing, and no more; it will do the work due to 1 pound falling at any given velocity less the friction of the machine or of the moving parts. We turn water into steam with a certain knowledge of the power that can be gained by using the elastic vapor as a spring, or we may tear the gases, which combined form water, apart, and use these gases in recombination to produce power, but less power than was taken to tear them apart, never more.

Science has made us so sure of these facts that we can base our faith on them, and with this knowledge we are willing that others than ourselves shall invest their money in machines which are claimed to be able to develop from five drops of pure water inclosed in a ball, power enough to propel the largest steamship across the ocean. It is ignorance of the unalterable laws of physics that leads ignorant people into squandering money on so-called wonderful inventions that, out of nothing, are to give us great results. An ignorant man will spend his time pondering over perpetual motion machines, so will a man with brain gone wrong; the first will quit his folly with more learning, the second finds his home in a madhouse. A third and worse class aim to deceive, and, for a time, many a one has done so. When shrewd ignorance resorts to dishonest methods, the confiding public is apt to suffer in pocket

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THE METRIC SYSTEM.

We call the attention of our readers to the following remarks by Sir William Thomson during an address at Philadelphia last summer: "You in this country are subjected to the British insularity in weights and measures; you use the foot and inch and yard. I am obliged to use that system; but I apologize to you for doing so because it is so inconvenient; and I hope all Americans will do everything in their power to introduce the French metrical system. I hope the evil action performed by an English minister, whose name I need not mention, because I do not wish to throw obloquy on any one, may be remedied. He abrogated a useful rule which for a short time was followed, and which I hope will soon be again enjoined, that the French metrical system be taught in all our national schools. I do not know how it is in America. The school system seems to be very admirable, and I hope the teaching of the metrical system will not be let slip in the American schools any more than the use of the globes. I say this seriously. I do not think any one knows how seriously I speak of it. I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. The reason why we continue to use it is the imaginary difficulty of making a change, and nothing else; but I do not think in America that any such difficulty should stand in the way of adopting so splendidly useful a reform."

ELECTRIC RAILWAY PROSPECTS.

VIEWS OF EMINENT ELECTRICAL EXPERTS.

The possibility of the practical application of electricity as a motive power for such an important service as that of the elevated railways in New York city, has awakened renewed interest in this subject. Under the auspices of the *Mail and Express*, several interviews have been made public, which contain information of interest and value to all electrical workers. In a letter to Cyrus W. Field, Prof. Moses G. Farmer gives the following summary of the history of electro-locomotion:

My Dear Sir.—Now that the application of electricity to the elevated roads is agitated, it occurs to me that it may be interesting to glance at some of the steps in the progress of discovery and invention which made electro-locomotion possible in 1850 and practicable in 1883-4. It was in 1819-20 that Oersted, of Copenhagen, discovered that if a wire carried a current of electricity from south to north over a magnetic needle, it caused the north end of the needle to be deflected towards the west, and also, if the current passed from north to south under the needle, the deflection of the north end of the needle was still towards the west.

It was not long before Schweigger carried the wire and current several times over and under the needle and thus invented the galvanometer. Before 1826 Sturgeon had wound a wire several times around a bar of soft iron, and, when a current of electricity was sent through the coiled wire spiral, it made a temporary magnet of the iron bar, which magnetism remained as long as the current was flowing. Soon after, as early as 1831, Faraday discovered the principal facts of magneto-electric induction, and thus made the magneto-electric machine possible in the hands of Pixii in 1832. The Daniell and the Grove batteries soon after appeared, and in 1839 Jacobi, at St. Petersburg, constructed a boat which he propelled upon the river Neva with a two-horse power electro-magnetic engine, actuated by a Grove battery which had in it twenty square feet of platinum surface.

In 1840 Davenport and Cook, of Vermont, constructed a walking-beam engine with which they drove a printing press, using a zinc and copper battery with a solution of blue vitriol as the exciting liquid.

In 1842 Davidson, of Scotland, constructed a five-ton electric locomotive, which he propelled at the rate of four miles per hour with seventy-eight pairs of zinc and iron in sulphuric acid solution, the plates being thirteen inches square.

In 1844 Channing conceived the idea of substituting an electro-magnet in place of the permanent steel magnet in the magneto-electric machine of Pixii, and the further idea of using this electro-magneto electric machine to excite the field magnets of a still larger electro-magneto electric machine.

(This idea was subsequently, in 1863-6, further elaborated by Henry Wilde, of Manchester, England.)

In 1847 I constructed and exhibited in public an electro-magnetic locomotive, and with forty-eight pint cup cells of Grove nitric acid battery drew a little car carrying two passengers on a track a foot and a half wide.

In 1850 Page, of Washington, constructed an electro-magnetic engine of 16 h. p., and with a hundred cells of Grove nitric acid battery, each having platinum plates eleven inches square, he propelled a car carrying a dozen or more passengers on the Washington and Baltimore Railroad at the rate of nineteen miles per hour.

In 1851 Thomas Hall, of Boston, (then at work for Daniel Davis) constructed, and later exhibited at the Charitable Mechanics' Fair in Boston, a small electric locomotive which took its current from a stationary battery by means of the rails and wheels, as the following extract from a letter written to me by him, November 25, will show: "In the year 1851, when I was at work for Daniel Davis, I made a small electric locomotive, which ran on a straight track about twenty feet long. The wheels were insulated and the electricity was conveyed to the engine by means of the rails from two Grove batteries. The cut-off was in the engine and worked automatically or by hand, so that when the engine reached the end of the track, the switch reversed the engine and it went back to the starting point. In 1860 I exhibited in the Mechanics' Fair a small locomotive called the Volta, very finely made and finished, which ran on a circular track about eight feet in diameter. The current was conducted to the insulated wheels from two Grove batteries by means of the rails. I have a part of one of these engines on hand now, and photographs of the Volta; also wood-cuts of the first ones which were published in a catalogue between 1851 and 1860."

I asked Mr. Hall's permission to publish his letter, and in reply he says: "Shall be glad to have you publish the facts as I have stated them to you, and shall be obliged to you for doing it. You know they are facts as well as I do."

These four engines, therefore, of Davidson, Farmer, Page and Hall could be started and stopped, sent forward or backward, at the pleasure of the engineer.

In 1859 I conceived of the self-exciting dynamo, which I constructed in 1866 and which was also conceived of by Wheatstone, Siemens and Ladd in 1867 and by Gramme in 1871, so that by 1871 cheap electricity became possible, and nothing more was needed except to substitute the dynamo machine for the galvanic battery to make electro-locomotion both possible and cheap, and yet the invention slumbered on for a decade or more.

Now, in 1884, a host of inventors, by simply substituting the now well-known dynamo for the more expensive and troublesome acid battery, appear to be just on the eve of bringing to blossom and fruitage those buds of promise after their long forty years of germination, because there was then no demand, no elevated roads, and so they came not forth.

There are two principal methods of propelling an electric locomotive: 1st. The engine carries its source of electricity, such as a galvanic battery, as did Davidson's, Farmer's, and Page's. 2d. It is picked up from a stationary source by means of the wheels and rails, as did Hall's.

In the later days, since the advent of the storage battery, the supply of electricity can be economically carried on a tender, and it is worthy of very patient and long experimental inquiry, which method is the cheaper—to lay a third rail to carry the current to the locomotive, or to charge the storage battery, place it on a tender and attach it to the locomotive.

Respectfully yours,
Moses G. Farmer.

New York, Nov. 29, 1884.

In a subsequent interview, Prof. Farmer gave further details of his personal experience, as well as his opinion of practical success in the proposed application of electricity, which is reported as follows:

"I constructed an electric railway nearly 40 years ago. It was only a toy affair, but I thought I had discovered how to make a million or two in a week or two. I expended much time and money, and my contrivance attracted attention throughout the whole country, and was exhibited in several cities. I was a teacher at Dover, N. H., at the time, and I suppose Morse's invention of the telegraph turned my thoughts to electrical enterprise. It was in 1846 that the first telegraph line was built from Boston to Portland, and at the beginning copper wire was used, but it sagged so much that iron was substituted for it. I bought 300 pounds of the discarded wire for my experiments. A man by the name of Davenport had used electricity to operate a printing press in Vermont, and that fact probably helped to convince me that it could also be applied as motive power for railway trains."

"What kind of a motor did you use?"

"An electro-magnetic motor. The Grove battery was then the most successful invention of its class, and the one I used contained 50 cups and consumed 8 pounds of the acid and zinc per hour for every h. p., the cost being 15 or 20 cents."

"Why did not your scheme succeed?"

"The power cost too much. In 1850, 3 years later, Page constructed a similar motor with 100 cups, and the government gave him $20,000 for its development for use in the navy, but he did not succeed any better than myself. My enterprise decided the course of my life, however, for I have been engaged upon electrical problems pretty much ever since."

"And have you retained your faith in the practicableness of operating railway trains by electric motor?"

"I have, and there is reason to expect that its demonstration will soon be witnessed on the elevated railways."

"How would you advise the Manhattan Company to proceed to effect that result?"

"In the first place, much skill will be required in the test for the selection of a motor."

"But has that not been provided in the expert commission chosen to appraise and consolidate the rival motor interests?"

"Yes, the members of the commission are satisfactory, if only they will serve, but I do not see how Sir William Thomson can spare the time for the service, unless he is offered a great pecuniary inducement. However, it may take 6 months to prepare the track and motors, so that he

can devote his summer vacation to it. It might take 60 days for the test after all is ready."

"Have you studied the elevated railways with a view to the change from steam to electricity?"

"Yes, I have had my assistant examine the Ninth and the Third avenue lines. It seems that there are frequently 20 to 25 trains on each track at one time, and each locomotive has about 40 h. p., they say. Of course it will require 20 times as much electricity to move 20 trains as it would to move 1 train."

"Do you mean that a greater force will be required than can be applied with safety?"

"No, not if the proper methods are employed. I do not care to say at present what those methods are, for I am making investigations which I am not yet ready to disclose. I will say, however, that the trackmen will need to wear dry rubber shoes, and even then it may not be comfortable to touch both rails at the same time."

"Will the size of the rail make any difference as to safety?"

"Yes, the larger the rail the less the risk. The central rail should be at least 70 pounds, and the Manhattan Company may be glad if it is not found necessary to take up the 50 pound rails now in use and lay a much heavier track."

"How much cheaper will electricity be than steam power?"

"It all depends upon the system used. There ought to be no difficulty, however, in saving 100 to 140 pounds of coal per hour on each of the 40-horse locomotives now in use, if their consumption of fuel has been correctly represented to me. Stationary engines are much more economical than locomotives, and in Lowell, Mass., a steam pump is operated by only 1¾ pounds of coal per h. p. per hour, and I have no doubt the Manhattan Company can save much labor as well as fuel by the proposed change."

"Do you expect to see electricity substituted for steam on surface railways?"

"The problem becomes more difficult when transferred to surface lines, certainly, and I am not prepared to say what I expect, either as to the great freight and passenger railways or as to the street car lines of cities."

"Do you believe, like Mr. Edison, that some one will discover how electricity can be generated directly from coal?"

"The thermo-electric battery to which I devoted so much attention, especially from 1865 to 1868, was too expensive, and it converted not more than ⅛ of 1 per cent. of the energy of coal into electricity. One of my batteries cost $1,000, and was used to apply the copper to the first compound wire ever made, but it gave no key to the economical production of electricity directly from coal, nor has any other contrivance of which I have yet heard."

Prof. Morton, President of the Stevens Institute of Technology at Hoboken, while entirely convinced of the feasibility of the proposition, strengthens his opinion by carefully refraining from enthusiastic exaggeration. He is reported as saying:

"I think some of the electricians are wild in their estimates, but I am convinced that electricity can be advantageously introduced on the elevated railways of New York. I have read the recent newspaper articles on the subject, and while I think it necessary to make a large allowance for exaggeration, I heartily concur in their general conclusion that the scheme to substitute electricity for steam as motive power on the lines of the Manhattan Railway is perfectly feasible. I should not put the maximum of saving at more than 30 per cent., and the actual amount might be much less. I see that most of the men who have motors to introduce make the minimum about 30 per cent. and confidently predict a saving of 50 per cent. I should say that the cost of generating steam in a stationary engine and in a railway locomotive is as one to two. Clarke, a very high English authority, gives as a result of numerous experiments what is equivalent to 5 pounds of coal per h. p. per hour as the efficiency of locomotives, and recent experiments of the Pennsylvania Railway support his conclusion. As I have said, the plan to operate the elevated railways by electricity is perfectly feasible, and the economy of the new system would doubtless be very important, while the removal of smoke, dust, and some other disagreeable features of the present system would of itself afford adequate compensation for the change, were there no pecuniary advantage to be derived from it."

"The Siemenses use a dynamo as the motor on their electric railways in Berlin and other European cities, and each of the rival motors is a dynamo in a modified form. There is a double magnet surrounding an armature, and the current of electricity passing through the mechanism of this machine on its way from the central rail to the outer ones, by which it is to return to its source, causes the armature to revolve by magnetism, and thus the machine is made to move."

"Is there danger in its use?"

"No, and the current of electricity required would not be strong enough to do injury, either by causing fire or shock. Care should be taken, however, to secure uniformity of current, and there is a great difference of the dynamos as to the production of a uniform current. A force of 1,000 volts, if the current could be made uniform, would not be unsafe, I think, but of course no such force is contemplated in the estimates of the owners of the motors."

"Is a third rail necessary?"

"It would be possible to use one of the ordinary rails to carry the current and the other to return it, but this would require insulation of the rail and of the car wheels, making the problem more difficult. An insulated third rail for that service would be much better. I do not believe that electricity can be profitably substituted for steam on ordinary railways, at least for the present. Improved methods of generating electricity may ultimately make the change economical, but science has not yet made electricity available as motive power for railways, except on short lines. It is absurd, too, for electricians to talk of applying electricity on surface lines without an insulated track. Much of the calculation of enthusiastic inventors will be found seriously at fault in practice, I fear. Short lines which have numerous trains can be successfully operated by electricity, but the same cannot be said of ordinary surface lines."

"Are you also skeptical as to the substitution of electricity for horse power on tramways?"

"I do not see any reason to believe that the change can advantageously be made. The difficulties to be overcome are numerous, and some of them are of a very serious character. I doubt if the change will be made for many years to come."

Prof. Charles R. Cross of the Massachusetts Institute of Technology, who has been asked to serve upon the commission of experts, pointed out some of the difficulties which would be encountered in deciding upon the most satisfactory system to be adopted.

"There is much disagreement," he said, "even among experts, as to the methods of testing electrical apparatus, and it is difficult to secure an agreement as to the comparative merits of electrical machines. However, the Philadelphia Exhibition did much toward the establishment of correct methods of making tests, and I regard the testing of dynamos there as the most satisfactory work of the kind yet done. It will be more easy for the expert commission to perform its allotted task because of the tests made at Philadelphia, but it may require considerable time to determine what motor is best and what system should be introduced."

"If electricity can be substituted for steam as motive power on railways there will be a vast amount of money for the inventor who produces the motor which performs the desired service."

"But do you doubt that the achievement is possible?"

"I do not say that I doubt its possibility, and I will say that I think electricity can be advantageously substituted for steam on the elevated railways if anywhere, but there are so many things connected with the enterprise which are yet to be determined that I am not willing to express any opinion as to the results of the experiment."

"You may say that I think the change from steam to electricity will be advantageous pecuniarily, but I will not venture any prediction as to the per cent. to be saved. I think the problem to be considered by the commission is extremely important, both scientifically and pecuniarily, and I prefer to hold my opinion in reserve until investigation has removed some uncertainties which now enter into the case."

"Have you no prediction to make for the encouragement of the railway men who wish to apply electricity as a motive power?"

"Mr. Lowell says: 'Never prophecy unless you know,' and I think his rule is a safe one for me in the case you now present."

"What is the chief factor in the problem—the amount of power required, or the cost, or the risk to life and property?"

"Each of the three factors is important, but I do not think there will be danger in the use of electricity to move railway trains if proper precautions are taken."

"What force can be used with entire safety?"

"I should not hesitate to receive the shock of the current used on most of the electric railways now in operation, although their traffic is nothing like that of the New York elevated railways."

"What force would be required, supposing the number of trains on one track at one time to be 25 and the power of the locomotives now in use to be 40 horse?"

"It would be easy to make an accurate estimate, but without going into a careful calculation I should say roughly about 500 volts with a 1,500 ampère current. That would be approximately the equivalent for the steam power now employed, not taking into the consideration the element of waste in heating the wires. It might be advisable to use lower electromotive force and a higher current."

"But the inventors of the motors do not contemplate the use of so great a force?"

"It remains to be seen whether their expectations will be realized. However, there ought to be no danger in the use of even a much stronger current than I have mentioned.

"And as to the cost?"

"That must be ascertained by a test. The problem is to obtain the maximum of energy at the minimum of expense. The earlier dynamos were constructed with a great internal resistance, but that resistance has been much reduced in the recent inventions. The water-wheel gives the greatest per cent. of the original energy, and in some wheels it is as high as 95 per cent., but the recovery in some of the dynamos is said to be as high as 90 per cent., so that the prospect, from an economical point of view, is encouraging."

There are few people so well qualified to judge of the successful and economical transmission of power through the agency of electricity as Mr. Edward Weston of Newark, N. J. After briefly narrating his preliminary experience in the electrical field, he said:

"I do not wish to appear too sanguine, but electricity is certainly destined to play a much more important part in the economy of civilized life than most people dream of. The crudity and wastefulness of our principal motor, the steam-engine, is very seldom thought of by any except those who have made a special study of the subject. This apparently perfect piece of mechanism wastes nearly 80 per cent. of the energy of the fuel. The dynamo-electric motor would change all this, if we could convert the energy evolved in the combination of coal with oxygen directly into electricity. The dynamo machine will convert more than 90 per cent. of the power transmitted to it into useful energy, and good electric motors would certainly not fall far short of it.

"I suppose that the capital now invested in electrical enterprise, aside from telegraphy, is not less than $100,000,000. And the transmission of power I regard as a much more important branch of electrical enterprise than that of furnishing illumination. It is hardly true, as President Morton, of the Stevens Institute, says that 10,000 mechanical engineers are needed for every ten electricians, and certainly the development of electrical enterprise which the future promises must excite the keenest anticipations."

"How do you arrive at your conclusion that the transmission of power is more important than the production of light by electricity?"

"It is true that the transmission of power by electricity is still in its infancy, but the United States company would be willing to take a contract for the operation of the trains of the elevated railways by electricity, and as long ago as 1880, I made estimates which I presume to be still in the possession of the Manhattan company or some of its representatives.

"But in the operation of light machinery electricity is a safer, more convenient and more economical agent than steam. The small steam-engines now in use are expensive and not altogether safe, and it would be better for all concerned to remove them and substitute electricity.

"Dynamo stations would be required in districts of convenient size, with wires to transmit the power to consumers. A small dynamo—that is, a motor, which is a dynamo reversed—would be needed by each consumer, but its cost would be less than that of a steam engine of equal power, and it would require no fuel and could be controlled as easily as is an electric lamp.

"Ten h. p. engines and all smaller ones cost their owners more than would their equivalent of power in electricity. The United States company will extend its business in the transmission of electricity as power for light machinery as fast as possible."

"Your confidence in the electric motor is doubtless sufficient to enable you to give a favorable opinion as to the feasibleness of the substitution of electricity for steam as a motive power on the elevated railways, then?"

"I have no doubt whatever that the change can be made with advantageous results in more than one direction."

"Let me give you a problem. Suppose that on one track of the 'L' there are at one time 25 trains, each drawn by a locomotive of 40 h. p. What will be the force of electricity required as a substitute for the locomotives to move the trains?"

"It depends upon the pressure as related to the current. But a pressure of at least 500 volts can be safely used, with the proposed 70 pound central rail, and with that pressure a current of not quite 1,500 ampères would be required as an equivalent for 25 locomotives, each of 40 h. p."

"What size stationary engine and what dynamo would be required to furnish that force of electricity?"

"It would be unwise to use one dynamo to generate that amount of electricity, and about 6 dynamos, each of 200 h. p., would be needed. For the operation of these dynamos a stationary engine of 1,200 h. p. would be adequate."

"And what would be the expense?"

"The rule is that a stationary engine of the best kind costs $50 per h. p. annually, and at that rate the entire expense would be $60,000 a year. But there is this difference between a locomotive and an electric motor. The former has only its minimum power at the start, while the latter has its maximum, and so the locomotives need to have 40 h. p., although the average power required may not exceed 25 horse."

"There are great mechanical difficulties in the case, I admit," said Mr. Weston, in reply to a question, "but what great invention has been introduced without overcoming great mechanical difficulties? The introduction of gas is a good illustration. The opposition to its use was so great that its substitution for the old light was retarded nearly twenty years, and it is now very amusing to recall the objections which were made to it. Dynamite is hardly regarded with more dread now than was gas by many people less than a century ago. Only fifty years ago the citizens of Philadelphia passed resolutions entreating the Common Council not to permit the use of gas in that city, mainly because it was thought to be dangerous. The obstacles to the application of electricity as motive power are certainly not greater than were those encountered by the men who established the system of gas light."

Mr. Edison has also given his views upon the subject through the columns of the *Sun*, by which it will be seen that he considers the economy of electric locomotion settled, and that its immediate application is simply a question of proving it to the satisfaction of the management. He says:

"The application of the electric motor to the car is simple, and could be effected in no time if the men could be found with nerve enough to advance the money. It will need two stations to keep the current on the tracks. I could build one at Washington Park and one near 42d street, and keep all the trains in motion without any trouble, including switching and stops. It can be so arranged that all power will leave the trains as they approach on the same track, and so collisions will never occur. Speaking practically, I will take the 160 engines of the Manhattan company and put half of them in one of the stations I spoke of above and half in the other, to run the dynamos which will furnish a current of electricity. I will then buy enough old rails to reach from the Battery to Harlem and will set them up between the tracks of the elevated road. Wires from the two stations will be connected with this long railing, and the electricity will flow through it. It will be led to the electric motors and after furnishing power to run the train, will be allowed to escape through the regular rails of the road."

"What will be the saving to the Manhattan company?" Mr. Edison was asked.

"They will save in the number of employés necessary, for one man at each of the two stations can run 15 trains. One man can run the electric motor. The saving in coal will be very great. They can use more economical boilers than at present. To-day their property is depreciating on account of the great wear and tear. The power is now applied explosively, in jerks. There is a terrible racking of the whole structure. They might as well explode powder all along the line as to run as they do now. Electricity, on the other hand, is a continuous, velvety motion. There is no jar and no wear and tear to the structure."

"How soon can the change be made?"

"As soon as the money is forthcoming. The motor has reached such a degree of perfection that nothing more can be done to it in the laboratory. It is now only a question of mechanical engineering, or a draughtsman's work, to apply the motor to the elevated road. An experiment is likely to be made soon on the Second avenue line. If they let me put up my centre railing I can run my electric train right in with the others and not interfere with the steam trains."

"Will any other improvements be made in this connection?"

"There is one that ought to be made now, whether they have an electric road or not. I can increase their travel enormously if they will let me put in an electric elevator at each of the stations. Women will not ride because their clothes are so heavy they can't climb those frightfully long stairs. Old men can't get up there. Just think how nice to step on a platform and rise quietly to the station and come down the same way! Thousands who don't ride now would flock to the roads. The people of New York expend 26,250 h. p. in an hour climbing those stairs. The force consumed averages 2,187 per hour for the twelve hours of the day. Let me figure for you. The report of the Manhattan company says that they carried 50,000,000 people last year. We put these people into pounds, at 150 pounds each, and have 7,500,000,000 pounds. But they must be raised to the platform, which is twenty-five feet high at least, and that gives us 52,500,000,000 pounds raised one foot. The h. p. for an hour is 2,000,000 pounds raised one foot. If all those people were raised to the stations in one hour that would be an expenditure of 26,250 h.p., and dividing by twelve for the twelve hours of the day we get an average per hour of 2,187 h.p. expended by people in climbing those stairs. Why, that is about one-fifth the total power expended in running the whole elevated road. But people don't seem to mind it much—man is such a perfect motor, you see."

ABSTRACTS AND EXTRACTS.

TRANSMISSION OF POWER BY ELECTRICITY.

One of the most successful examples of the transmission of power for industrial purposes by electricity which has yet been made, is described in a recent number of *La Lumière Electrique*. The thriving manufacturing city of Bienne is situated on the Suze, a tributary of the Aar, in Switzerland. The river Suze, which descends from the heights of the Jura, for the greater part of its course is a veritable mountain torrent, but at a distance of about 2 km. from Bienne, it reaches the level land at the foot of the mountains, and is suddenly transformed into a sluggish stream. Several years ago a system of high pressure water works was established in Bienne, deriving its supply from above the lower falls, and not only furnishing an excellent domestic system, but also a convenient motive power to a large number of manufacturing establishments of moderate size, either by means of turbine-wheels or hydraulic engines. The enterprise proved so successful in this respect that the entire available supply was taken up within a brief period, the demand for power proving to be largely in excess of the capacity of the works. Two enterprising manufacturers, M. Roulet, lapidary, and M. Bourgeois, watch-case manufacturer, who occupied the same building and who had been obliged to supplement their water power by means of gas and steam engines, determined to make a trial of electrical transmission.

The volume of available water at the point where the turbines are placed is about 1,500 litres (375 gallons) per second, and the fall is about 54 metres (177 ft.). The Girard turbine which is employed is however capable of utilizing only 400 litres under a head of 46 metres, thus giving about 180 effective h. p. The water is led to the turbine by a tunnel cut through the rock 2 m. (6 ft. 6 in.) high by 1.5 m. (4 ft. 11 in.) wide. The turbine is belted to the dynamo electric generator instead of being directly attached. The dynamo machines used are of the Thury pattern, which is a modified form of Gramme. The distance between the generator and the motor is 1250 m. (about 4,100 ft). The amount of power required by the two manufactories varies from 6 to 18 h. p. One of these is a rolling mill for preparing silver plates for watch cases, and necessarily varies considerably in its requirements in this respect. The other, in which watch-jewels are cut and drilled, requires the utmost possible uniformity of speed. After several experiments a compound winding for the dynamos was adopted, by which a constant speed may be maintained without reference to the amount of power required. The conductors employed are two copper wires of 7 mm. diameter (No. 1, B & S. gauge) suspended in the air upon posts and tied to porcelain insulators in the usual manner of a telegraph line. The generator and the motor are of the same size, both being of the type designated by the makers as H 2. The generator makes 500 revolutions per minute and gives an E. M. F. of 350 volts. The motor makes 400 revolutions, under a potential averaging about 300 volts.

The speed of the motor is controlled by varying the resistance of the line conductor. A box of graduated resistance coils formed of brass wire, is provided with a rotating contact-arm and a series of contact terminals. The arm is operated by a pinion movement communicated through an endless screw, which effectually prevents the resistance from being varied so suddenly as to endanger the coils of the machines. It requires at least 20 seconds to withdraw the entire amount of resistance from the circuit by the screw movement, which gives the motor ample time to work up to its maximum speed after starting. Ordinarily a portion of this adjustable resistance is left in the circuit, for convenience in adjusting the speed of the motor. This provision is necessary, because the proper speed of the machinery for drilling watch-jewels must bear a certain relation to the temperature of the room in which the work is done.

It has been found necessary to furnish the line with lighting arresters at both ends, the locality having proved to be unusually subject to atmospheric electrical disturbances.

This admirable practical application has now been in operation for more than 7 months; occasional interruptions took place at first, which were mainly due to a lack of experience in properly adjusting the commutator brushes, but since the employés have become familiar with the machines these difficulties have entirely disappeared. Careful tests have been made to determine the percentage of power utilized; the results of which are promised in full in a future communication. It is unofficially stated that an efficiency of 70 per cent. has been reached under the most favorable conditions.

This installation is especially interesting as it establishes the entire practicability of the industrial application of a considerable force at a considerable distance from its source, and demonstrates conclusively that the work may be successfully accomplished on a much larger scale if required. The work of the installation was designed and executed by the establishment of Neuron & Cuenod of Geneva.

ELECTRICITY FOR CITY RAILWAYS.

A letter from Professor Moses G. Farmer to Cyrus W. Field, recently published in the *Mail and Express*, contains some interesting calculations as to the saving that could be effected on the Second avenue elevated railway by the substitution of electric motors for the steam engines now in use there.

I assume, says Mr. Farmer, that a stationary plant can be erected somewhere near the middle of the line, not far from Sixty-third street, this plant to consist of one or more stationary steam engines of the best type, capable of developing one h. p. by the combustion of 1¾ pounds of coal per hour per h. p. by the use of such coal as does not cost over $2 50 per ton of 2,240 pounds.

I assume that there are in use on this line 20 locomotives of 110 h. p. each at the busiest hour of the day, and that each locomotive consumes—per h. p. per hour—5 pounds of coal that cost $4 per ton of 2,240 pounds.

I assume that the rails now in use are of steel and weigh 70 pounds per yard, and that a central steel rail of 70 pounds per yard will be laid for the purpose of conveying the electric current to the motors.

I assume that 1 mile of such steel rail will offer about $\frac{1}{10}$ of an ohm's resistance, and that the aggregate internal resistance of the dynamos concerned in producing the current will not exceed $\frac{1}{10}$ of an ohm.

I assume that from this central station sufficient current will be supplied to both tracks to energize at the same instant all of the 20 electric locomotives, no matter on what part of the tracks these motors may be situated.

I assume that 1 h. p. is the equivalent. of 746 ampère-volts, and that $20 \times 110 \times 746 = 1{,}641{,}200$ ampère-volts, in the aggregate, reach these motors.

I assume that such dynamos can be constructed as shall convert 90 per cent. of the mechanical power applied to them into current electricity, and I also assume that such electric motors can be constructed and used as shall convert 90 per cent. of the electricity which they receive into power used to draw the trains which are attached to them.

I assume the Second avenue railway to be 6½ miles in length.

With these assumptions I have calculated the following tables:

Table I.

Volts.	Present power.	Future power.
500.....	2,200	3,360
1,000.....	2,200	2,879
1,500.....	2,200	2,787
2,000.....	2,200	2,757

Table II.

Volts.	Present coal.	Future coal.	Saving per hour.
500.....	11,000	5,896	5,104
1,000.....	11,000	5,080	5,921
1,500.....	11,000	4,889	6,111
2,000.....	11,000	4,825	6,175

Table III.

Volts.	Present cost.	Future cost.	Saving per hour.
500.....	$19 05	$5 58	$13 07
1,000.....	19 05	5 02	14 03
1,500.....	19 05	4 46	14 19
2,000.....	19 05	4 38	14 27

Table 1, column 1, contains the electromotive force developed by dynamos at the central station; column 2 contains the h. p. required by the 20 locomotives; column 3 contains the h. p. that must be used at the central station in order to deliver at the electric locomotives the equivalent of 2,200 h. p.

Table 2, column 1, contains the electromotive force, as in the first table; column 2 contains the hourly consumption of coal by the 20 locomotives now in use—5 pounds per hour per h. p.; column 3 contains the amount of coal consumed by the stationary engine that develops 1 h. p. by the combustion of 1¾ pounds of coal per hour; column 4 shows the saving in pounds of coal per hour made by substituting the better engine, the dynamo, the electric motor and the rail circuit.

Table 3 shows the hourly saving in dollars and cents by the substitution of electricity thus applied for the coal now used in the locomotives.

It will be seen from this last table that the lower and safer electromotive force of 500 volts is only about 9 per cent. more expensive than the 4 times as great 2,000 volts, and about 7 per cent. more expensive than 1,000 volts.

I must reserve for another letter my conclusions regarding what would be the savings resulting from the use of electricity on the Third avenue line, as I wish to obtain some further information as to frequency of trains.

JUSTICE AT LAST.

After long and weary waiting, after four years of contest, and an expenditure of money which would have ruined most litigants, a decree has been ordered for the Bell Telephone Co. in its suit against the People's Telephone Co., representing the alleged inventions of Drawbaugh, and the injunction against the People's company is now made perpetual, with the right of appeal, of course, to the Supreme Court, which will doubtless be taken. But, for all practical purposes in the near future, the decision is final, since it will take a number of years for the Supreme Court to reach the case, and in the meantime the defendants are powerless.

As yet we have not seen the full text of the decision, but enough of it has, at the present writing, been made public to show that the judge, in a large measure, bases his opinion upon the inherent improbability of the rightfulness of the claims of Drawbaugh, who, according to his own story, calmly stood by after he had made these important and well-nigh invaluable inventions, and without a word of protest permitted another to reap the glory and the reward. This the judge considers fatal, despite the great mass of evidence adduced in support of the Drawbaugh claims.

We have more than once, while this important suit has been pending, expressed our dislike and disapproval of "trial by newspaper," and certainly now that the appointed tribunal has rendered a learned and exhaustive decision, any judgment that we or any other newspaper might render would be highly unimportant and unnecessary. But we may be permitted to say, now that the case is settled and an award has been made, that we have steadily been of the opinion that the Drawbaugh claims were founded upon a conspiracy to rob men of their just rights under the patent laws. We are very far from expressing the opinion that all or any considerable number of those who have been prominently connected with the enterprise were either cognizant of or parties to the conspiracy. On the contrary, we are firmly convinced that it was part of the scheme to get honorable and innocent men honestly interested, so as to give character and respectability to an enterprise which had none of its own. And we further believe, now that the case has been decided in favor of the Bell company, that the conspiracy, no longer held together by the cohesive power of prospective plunder, will fall to pieces, and that we shall yet see the inside of one of the greatest pieces of rascality ever concocted, to the disgrace of the few who devised it, and the chagrin and mortification of very many more who were honestly misled

into believing the story to be genuine and staking their money on the result.

Believing this, and feeling that nothing more than exact justice has been done—and who, having read even a synopsis of the evidence, could doubt what the result would be?—we feel like offering our congratulations to the Bell company, and to all who, directly and indirectly, will be benefited by the fact that an end has come to the long suspense. The sub-companies, operating under licenses from the parent company, will take new courage, their work will be extended and enlarged, the number of outstanding telephones will increase, and the whole industry will take a new start.

Of all the men who will receive congratulations no one deserves them more than Mr. Storrow, now taking a well-earned rest in Europe. We venture to say that, for sustained effort, for intimate knowledge of the subject in hand, for exact accuracy in the plain, straightforward recital of facts, their bearing upon one another, and the deductions to be drawn from them, his argument stands alone in the long list of pleas that have been made before the United States Court in patent causes. It was the justice of the company's cause which won the case, but it was the way in which it was put by Mr. Storrow that made its justice apparent.—*Electrical Review.*

MEASURING ELECTRIC CURRENTS.

Lord Rayleigh has suggested the application of Faraday's discovery of the rotation of the plane of polarized light by an electric current as a means of measuring the current. Mr. J. E. H. Gordon found that the reversal of a current of 4 ampères circulating 1,000 times round a column of bisulphide of carbon through which the polarized ray passed, produced a rotation of the plane of polarization of the ray of about 7½°. With heavy glass, which is more suitable for measuring purposes, the rotation is somewhat greater. The method does not seem very promising, but in Lord Rayleigh's hands something may be made of it. It has the advantage of requiring no springs or gravity indicators, the ray of light serving this purpose. One drawback exists in the depolarizing properties of heavy glass. A more useful, if less novel, method of measuring currents by means of the ordinary apparatus is also given by Lord Rayleigh. A standard cell is connected through a high resistance, such as a set of resistance slides, and 2 points in the slide are found which have the same difference of potential on 2 points of a strip of german silver through which the current to be measured is passed. The equality of potentials is found by a galvanometer in circuit which gives no deflection where the 2 points are found. Knowing the difference of potentials on the slides (it is equal to the electromotive force of the cell x, the resistance between the 2 points on the slide divide the whole resistance of the slides), and the resistance between the 2 points on the german silver sheet, the strength of current is easily found by Ohm's law. It is equal to the above difference of potentials divided by the resistance between the 2 balancing points on the slide. This method is well known; but the use of a german silver strip with lugs or projections on it at a given resistance apart to serve for the points of connection in the balance, is a new modification.

THE PROBLEM OF POWER.

A prominent engineer is reported by the New York *Tribune* as saying: "Scientific invention runs in grooves. Electricity has unquestionably been the great development of the past 20 years. While nothing is impossible, I think the limit of electrical invention has been reached. Applications of the inventions already made are engrossing attention. In that direction the great problem is power. It is a singular fact that since the discovery of steam and its application as a motive power there has been no great invention in steam. Now that inventors are applying themselves to extending the electrical inventions, they find cheaper motors necessary. You will see that inventive genius will improve steam making by revolutions as wonderful as any that have taken place in other branches of scientific investigation. What discoveries will be made I cannot predict, but I believe the next step in scientific progress will be in that direction."

LITERATURE.

REVIEWS.

Bell's Electric Speaking Telephone: Its invention, construction, application, modification and history. By George B. Prescott. With 380 illustrations. New York: D. Appleton & Co., 1884.

Dynamo-Electricity: Its generation, application, transmission, storage and measurement. By George B. Prescott. With 545 illustrations. New York: D. Appleton & Co., 1884.

The introduction of the speaking telephone for commercial and business purposes, which had begun to be quite general in this country in the early part of the year 1878, excited in the mind of the average citizen an unprecedented interest in the phenomena of electricity, and in the details of some of its more recent, and at that date surprising applications to industrial uses, and it created an immediate demand for literature relating to the subject, which has not merely continued, but has ever since continued to increase. In the year mentioned Mr. Prescott issued a work under the title of the *Speaking Telephone and other Novelties*, which was, we believe, the first attempt to treat these subjects in detail, and in a manner adapted to the popular comprehension. The general favor with which this work was received led to its reissue with material changes and additions some two years later. In the new edition, a considerable amount of space was devoted to the subject of electric lighting, so far as it had at that time been practically developed. The growth and evolution of the industrial applications of electricity has, however, been so rapid that Mr. Prescott has now found it necessary to depart from the plan of his original work, and to divide its subject matter into two distinct volumes, one of which is devoted to the telephone and the other to the general subject of dynamic electricity, of which electric illumination is at present by far the most important practical application.

The present work on the telephone is evidently designed to be an exhaustive one, and it certainly embraces a far greater amount of information relating to all branches of the subject than any other one which has yet appeared. A portion, perhaps one-third, of the present volume, contains substantially the same matter as the edition of 1880, although this has been somewhat revised, as the progress of the art seemed to render necessary. The remaining portion of the work is for the most part entirely new.

We find here given, for the first time, detailed and fully illustrated descriptions of the principal telephone exchange systems in practical use. The account of the central telephone system in Paris is especially complete, and is moreover exceedingly interesting. The leading systems which are or have been in use in the United States are described at length, especially the so-called "Chinnock" and "Law" systems which are employed in the telephone exchanges of New York city. One long chapter is entirely devoted to descriptions, for the most part well illustrated, of the more prominent of the innumerable modifications, improvements and mis-improvements which have been made by others upon the original invention of Bell. Among these, however, the Blake transmitter is passed over with a description much more meagre than would seem to be warranted by its unquestionable merit as an invention, and the enormous extent to which it has been adopted and used in connection with the fundamental invention of Bell. By some unaccountable oversight, no mention is made of the Hunning transmitter, which has developed such a surprising capacity for the transmission of articulate speech to great distances, and which has, we believe, been definitely adopted by the American Bell Telephone Co. for its long lines, such for instance as that between Boston and New York—a distance, as the wire runs, of perhaps 275 miles.

The space which has been devoted to a description of some of the abortive conceptions of Edison having no particular relation to the subject in hand, such, for example, as the "aerophone," the "harmonic engine," the "megaphone" and the "phonemeter," might perhaps have been utilized to better advantage in giving some account of the individual-call system, one of the ingenious outgrowths of the telephone exchange which has found

a not inconsiderable application in practice, especially in sparsely settled localities.

Another chapter is devoted to the history of the invention of the speaking telephone, embodying a considerable amount of interesting information not hitherto accessible to the general public. It contains, among other things, the substance of the able and exhaustive report of the Examiner of Interferences in the United States Patent Office, in which the entire history of the invention, as developed by the several claimants, is set forth with great minuteness. While we entirely agree with the conclusion of the author that Bell was unquestionably an original inventor as well as legally the *first* inventor of the speaking telephone, and that it is to him and those associated with him to whom the world is indebted for the benefits of this invention, yet we feel compelled to dissent from the somewhat summary manner in which he dismisses the claims of Elisha Gray. The evidence in support of Gray's claim is perhaps sufficiently well presented by Mr. Prescott, the facts as between Bell and Gray appearing to be simply these: Prior to 1875 Bell had dimly conceived the possibility of transmitting and reproducing articulate speech by electricity. On June 2d, 1875, he accidentally noticed that very slight vibrations of a thin armature in front of a magnet induced magneto-electric currents capable of appreciably affecting a receiving instrument—a fact which gave him the key to the telephonic problem. Under his direction, his assistant Watson immediately constructed a pair of membrane instruments, which were tried in June and July, 1875, but with exceedingly unsatisfactory results, although in the light of present knowledge it is plain enough that articulate speech might have been, and probably in fact was, transmitted by the apparatus as then used, although the ear of the listener, being as yet untrained, was not able to detect it under the conditions of the experiment. Nevertheless, in the latter part of 1875 and the early part of 1876, Bell prepared a specification which he filed on February 14, 1876. This document contained a drawing and description of an apparatus which was substantially that used in the experiment of June, 1875. It appears, however, that until after the time of the issue of this patent, March 7, 1875, the invention was not successfully reduced to practice.

The so-called lover's telegraph, a street-vender's toy consisting of two membranes united by a string, suggested to Gray, in December, 1875, a definite idea of the true principle of the speaking telephone. He did not disclose this conception to others, nor reduce it to form until February 11th, 1876, when he made a sketch from which a caveat was prepared, which by one of these remarkable coincidences which are of such frequent occurrence in the history of invention, was filed in the Patent Office on the same day as Bell's application, and only a few hours later. It seems well established, however, that until after this date neither Bell nor Gray had any definite knowledge of the character of each other's work. The caveat of Gray contains a far more complete exposition of the principle of the transmission of articulate sounds than the patent of Bell, and it seems certain that at that date, he was farther advanced upon the right road than his competitor. For some reason, however, he was dilatory both in reducing his invention to practice and in filing his application for a patent, and thus it happened that Bell, who had been the earliest to definitely conceive the invention, was also the first to obtain a patent, and the first to reduce it to actual practice, which he appears to have done on the 8th of May, 1876. Singularly enough, it has been shown by the evidence taken in the Drawbaugh case, that the first transmission of speech was accomplished by Bell with an instrument substantially the same as that described in Gray's caveat, and entirely unlike that shown in Bell's own patent. Without, therefore, detracting in the least from the claims of Professor Bell, it would seem that Mr. Prescott has scarcely given Gray his due in his summary of the history of the invention.

Mr. Prescott gives a curious bit of the inside history of the controversy between the Western Union Telegraph Company and the Bell Telephone Company, and of the negotiations which led to the existing alliance between these organizations. He says:

> The history of this controversy shows how great results sometimes follow insignificant causes. In the summer of 1877 Mr. Bell asked permission of the Western Union Telegraph Co. to conduct experiments in the office of their electrician at New York. This was granted; but shortly after Mr. Bell began his experiments there, Mr. Orton, the president of the company, learned that Mr. Gardiner G. Hubbard, who was personally obnoxious to him, was pecuniarily interested in Mr. Bell's inventions, and immediately directed that the permission to conduct his experiments should be withdrawn. After Mr. Bell had brought his invention before the public, and was endeavoring to perfect it by experimenting over actual telegraph lines, orders were given to exclude him from the Western Union wires. In spite of these orders, however, telephone experiments were conducted over them; but for a long time the results, while regarded with interest, were looked upon as possessing little practical value, and it was not until the summer of 1877 that the progress of Mr. Bell's invention was deemed to have arrived at such a state of efficiency as to threaten to be a serious competitor of the telegraph. At this juncture, August, 1877, Mr. Frank L. Pope, the electrical expert of the Western Union Telegraph Co., saw and talked through a speaking telephone in Boston for the first time, and soon after mentioned the fact to Mr. Orton, who said: "I have been looking into this matter of the telephone somewhat, and regard it as a matter likely to be of considerable future importance. If this proves to be the case, it is very necessary that we should have the right to use it; therefore I wish you to make a careful and thorough investigation of the whole subject, and ascertain what are the fundamental principles of the invention, and what inventions or patents it will be desirable or necessary for us to acquire the control of, in order to be able to use the invention in connection with our business."

The result of the expert's report was that the right to Gray's inventions was acquired, in addition to those of Edison which the company already controlled, and the manufacture and leasing of telephones was commenced through a sub-company known as the Gold and Stock Telegraph Company. An action for infringement was at once instituted by the Bell company, which was in progress during the summer of 1879. Mr. Prescott says:

> After a very vigorous defence had been made by the Gold and Stock Telegraph Co., and testimony at great length and great expense had been taken in support of the answer, and the testimony was substantially closed on both sides, Mr. Gifford (the leading counsel for the Western Union) became convinced that Bell was the first inventor of the telephone, and that his patent had been infringed by the use of the telephones in which carbon transmitters and microphones were elements, and that none of the defences which had been set up could prevail against him, and advised the company to that effect, and suggested that the best policy for them was to make some settlement with the Bell company.
>
> For the purpose of effecting such a settlement, the position of the Gold and Stock company was very strong. They controlled, through the Western Union Telegraph Co., the celebrated Page patent, which covered the induction coil used in the transmitters of the telephone, and was of great importance to them, and which the Bell company were using.
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> Under Mr. Gifford's advice a negotiation was opened with the Bell company on the basis of the claims which the Western Union Telegraph Co. made, that the telephone used by the Bell company was an infringement of the patents and applications for patents owned or controlled by the Western Union Telegraph Co. Mr. Gifford met Mr. Chauncey Smith, counsel for the Bell Telephone Co., by arrangement, at the White Mountains, where they remained for a week in negotiation. Mr. Gifford opened the negotiations by admitting that Bell's patents were valid, and that the Gold and Stock company infringed them, and these questions formed no part of any discussion between them, but claimed, on the part of the Gold and Stock company, in view of their patents, that all the patents should be put together, and that they should have one half in the joint property. This claim was refused by Mr. Smith, and the negotiations failed at that time. After Mr. Gifford's return, Mr. Prescott, the vice president of the Gold and Stock Telegraph Co., then in charge, had an interview with Mr. Causten Browne, who coincided in Mr. Gifford's views, and said that the Court would undoubtedly sustain the Bell patent of March 7, 1876, the fifth claim of which, viz., "The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth," covered all electric speaking telephones in use. Upon the receipt of this advice, negotiations were immediately reopened with the Bell company, and soon resulted in a contract, in which, instead of the Gold and Stock company and its associates getting one half of the joint property for the inventions which they contributed, and which were essential for the satisfactory operation of the best telephone system, they got only 30 per cent. of the earnings, and agreed to go out of the business and never to make use of any telephones, excepting such as they should acquire the right to use from the Bell company and pay them the market price for, the same as other people have to do. They transferred to the Bell company their exchanges for cost, and sold them their instruments at 25 per cent. less than cost, and thus ended the first attack on Mr. Bell's invention of the electric speaking telephone.

The reader will find the history of the claims of various rival claimants to the invention, or to some portion of it, including McDonough, Dolbear, Voelker, Edison, Drawbaugh, etc., given at length, with copious extracts from the opinion of the Examiner of Interferences in which he passed upon the evidence presented in behalf of each.

In an appendix to the work, the decision of Judge Lowell in the case of the *American Bell Telephone Co.* v. *Spencer*, and that of Judge Gray in *American Bell Telephone Co.* v. *Dolbear*, are given in full, which will be found convenient for reference.

The mechanical execution of the book is excellent, and the illustrations are not only profuse, but are far more artistically executed than has of late been usual in works of this description.

We find that we have scarcely left ourselves space for an adequate notice of Mr. Prescott's work on dynamo electricity, which is for the most part a descriptive one, although a considerable amount of historical information is given. The first two chapters of the work are substantially unchanged from the edition of 1880, and give a sufficiently satisfactory exposition of the subject as it existed at that date. It is a question, however, whether it would not have been a better plan either to have omitted these chapters, or to have placed them by themselves in an appendix, as they really contain but little material which is of value in the present state of the art. These chapters, however, form but a small portion of the work; the remainder contains an amount of useful information upon the general subject which it would perhaps be difficult to find elsewhere within such moderate compass.

Something like 100 pages are devoted to an exceedingly well illustrated description of the Edison system of electric lighting, including not only the generators, lamps, conductors and fixtures, but the process of manufacture as well. The account of the central station lighting system in New York city is particularly complete, and will be found of much interest. It would seem, however, that the information might have been brought down to a later date, for no mention is made by Mr. Prescott of the improved Edison-Hopkinson dynamo, which we believe is now used by Edison in lieu of the older forms, nor of the ingenious three wire system of distribution which has been in operation in Brockton, Mass., and elsewhere, for a year or more. Mr. Prescott gives credit, and we believe properly, to Edison as the first to adequately appreciate the economical advantages of an exceedingly low internal resistance in the generator. He also attributes to him the invention of the sectional armature made up of thin discs of iron, whereby the injurious eddy currents are broken up. This, however, is a mistake; Mr. Weston undoubtedly constructed an armature in this manner at least as early as 1874, and described it in an application for a patent filed by him on June

4th, 1878, which was before Edison took up the question of dynamo machines at all. The extraordinary size and partial saturation of the field magnet in the earlier forms of the Edison dynamo are also mentioned as advantageous, but experience has demonstrated that this is not the case, and accordingly the field magnets of the later machines have been largely reduced in weight, while their efficiency has at least not been diminished by the change. The Maxim, Swan, Weston, Bernstein and Lane-Fox incandescent lamps are sufficiently well described, and the reports of the tests of these and other incandescent lamps at the Paris Exposition of 1881, with the tabulated results, are given at length.

Turning to the chapter on arc-lamps and regulators, the reader will find described and illustrated almost every one which has attained any prominence whatever. The author has very properly paid particular attention to the descriptions of the lamps principally in use in this country, as being of more importance and interest than others.

In the chapter on dynamo-electric generators, the principle of the machine is first set forth, and this explanation is followed by a description of the principal inventions of this class now in use throughout the world. We note particularly an illustrated account of Hjorth's machine, which was patented in England in 1855, and which in fact embodied the great discovery of the mutual interaction of the armature and field which constitutes the fundamental principle of the modern dynamo. The portion of this chapter which relates to the work of Mr. Weston and the evolution of the remarkably efficient dynamo machine now so well known by his name, is noticeable for its clearness and completeness. We find here for the first time an adequate description of Weston's self-regulating dynamo, of which the electromotive force remains constant under all variations in the resistance and the external work, a machine which excited the utmost interest and admiration among the scientific visitors at the recent Philadelphia exhibition.

A brief account is given of the more prominent of the electric motors which are of interest either from a historical or a practical point of view, together with a succinct account of the different electric railway systems which have thus far been brought forward.

The final chapter, which treats of electrical measurement, and especially of the measurement of powerful currents, is deserving of unqualified commendation. We know of no treatise which will bear comparison with it, either in its masterly exposition of the principles upon which the methods of measurement are founded, or in the clear and satisfactory manner in which these methods are explained so as to render them available to the practical electrician and experimenter. Almost every one of the recently invented instruments adapted to this class of measurements is fully described and illustrated, and its excellencies and defects pointed out. The adaptation of particular instruments to particular methods of testing are also suggested, and the sources of probable error indicated. To the student, the experimenter and the electrical engineer, this portion of the work will be simply invaluable, and Mr. Prescott could confer no greater favor upon the profession than to republish it separately in a compact form convenient for the pocket and the laboratory table.

Stationary Steam Engines, especially as adapted to electric lighting purposes. By ROBERT H. THURSTON, A. M., C. E. New York: John Wiley & Sons, 1884.

THE electrical engineer of the present day who aspires to a more than superficial knowledge of the higher branches of his profession, must include the subject of mechanical engineering—at least so far as it has to do with steam-engines and the use of steam power—among his subjects of study. The development of the steam-engine within the past few years, due mainly to the exacting conditions as to efficiency, regulation and smooth action at high speeds arising from the requirements of electric lighting, has been very great. At the request of the editor of this journal, Professor Thurston prepared, some time since, a series of papers containing a systematic outline of the evolution of the now accepted type of high-speed engine for electric lighting plants, in such form that the causes of the various modifications of construction and operation which have resulted therefrom might be readily understood. Many of our present readers are familiar with these papers, which appeared in our columns during a portion of the years 1883 and 1884, and will doubtless be pleased to know that they have been reprinted, with corrections and some additions, in a neat little volume of 187 pages. Professor Thurston, who is one of the best of authorities on this subject, has studied his subject in connection with descriptions and discussions of representative standard types of engines. The electric light engineer will here find set forth the distinctive characteristics of nearly every one of the modern stationary engines which have proved themselves especially adapted to his work, and will find Professor Thurston's analysis of the subject of great value in making an intelligent choice for the particular purpose which he may have in hand. The book is handsomely printed and well illustrated, and while indispensable to every electric light engineer, is by no means without value in other departments of industry.

Map and Plan Drawing. By C. COOPER KING, Lieutenant Royal Marine Artillery. New York: Cassell, Petter and Galpin.

A FEW years since a treatise on map and plan drawing would have had no possible relation to the ordinary work of the electrical engineer. At the present rate of progress, however, he will soon be called upon, among other things, to lay out electric railways and hydraulic works to provide for the transmission of power by electricity from inaccessible places where it is not wanted, to accessible places where it is wanted. In this class of work, a knowledge of the subject of Lieutenant King's little work will be found to be of material value. Although the subject is treated mainly from a military point of view, the instructions are equally applicable to the work of the civil engineer. We have seen no treatise so well adapted as this to serve the purpose of the busy man who desires to obtain the greatest possible knowledge of the subject with the least expenditure of time and trouble. The volume is in handy pocket form, and may be carried about and studied at leisure.

RECENT PUBLICATIONS.

Buchanan, W. M. Dictionary of Science and Technical Terms. New York, *Scribner & Welford*, 1884. 12°. 824 p. Cloth, $2.40.

Bowser, E. W. Elementary Treatise on Analytic Mechanics. New York, *Van Nostrand*. 515 p. 12°. $3.00.

Matheson, E. Depreciation of Factories. New York and London, *E. & F. Spon*. 8°.

Paice, W. Energy and Motion; a text-book of elementary mechanics. London, *Cassell*, 1884. 116 p. 12°.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper,
All communications should be addressed EDITOR OF THE ELECTRICIAN AND ELECTRICAL ENGINEER, 115 *Nassau Street, New York city.*

THE EDISON ELECTRIC LIGHTING SYSTEMS IN THE UNITED STATES.

[28]—In reply to your letter of the 8th inst., I beg to state that the total number of incandescent lamps in the United States at the present time in isolated plants is 75,000, and in central stations 34,800, making a total of 110,000 lamps in all, within the United States, which would represent 14,000 h. p. The most important part of our business is that of licensing and organization of local companies for central stations, where the current is furnished to the consumer from a central point, and charged by a meter according to the exact quantity of light consumed, at prices not exceeding the ruling prices of gas, and leaving a profit to the sub-company. This has never been accomplished either electrically or commercially by any other system of electric lighting in the world. In the city of New York, we have 600 customers, using 13,000 lamps all lighted from 1 station, and we have applications from 100 customers more than we are able to supply with our present capacity. That station is now earning a very handsome profit, and has been running day and night for more than 2 years. Very truly yours, F. S. HASTINGS,
Secretary and Treasurer.

The Edison Company for Isolated Lighting,
65 5th Ave., New York, December 17.

[The above information was kindly furnished in response to a request, and we are sure will be of interest to our readers.—EDITOR.]

QUESTIONS AND ANSWERS.

[49.]—**Raising and Lowering Arc Lamps.**—T. D. R., referring to our Chicago letter, page 247, Vol. III, wishes to know if a successful device for this purpose would be a paying investment, also if required in incandescent lighting. Ans. This is one of those cases of detail, which even if successfully treated and appreciated would probably not be considered a *valuable* invention. It is unnecessary in incandescent systems.

[50.]—**Battery for Incandescent Lamp.**—I. B. La M., Montreal, asks for information regarding a battery sufficiently strong to operate a small incandescent lamp experimentally. Ans. See replies to questions 10 and 11, vol. III, page 67.

CORRESPONDENCE.

NEW YORK AND VICINITY.

The Tribulations of the Pooling Telegraph Companies.—Anxious Telegraphers.—Journalistic Enterprise.—Subterranean Progress.—Electric Light Competition.—The Commercial Cable Co.—The Manhattan Kiosk Co.—Automatic Protectors Wanted for City Wires.

SINCE the retirement of the Baltimore and Ohio Telegraph Co. from the tri-partite agreement, the Postal and the Bankers and Merchants' companies have been working together in harmony, so far as could be observed by the public. It is generally understood, however, that behind the scenes there have been symptoms of a final rupture ever since the pool was formed. All concerned appear to be in good spirits over the dissolution. It is well known that these separate organizations cannot pay expenses on the basis of the present tariff. It is hardly probable that any solvent company will care to assume the bonded obligations of the Bankers and Merchants' Co., especially during the present commercial depression.

The reported action of the Western Union Telegraph Company in discontinuing its practice of paying extra for overtime, in different parts of the country, has created considerable anxiety in this city, where no such notice was posted. This is believed to be a repetition of the old device to first feel the pulse of the fraternity at distant points, while not admitting at headquarters that there is any truth in the reports. While there is no immediate apprehension of a strike, it being well understood that this is the dull season of the year in the northern states, advantage is being taken of the existing excitement by the operators to perfect an organization which will be ready for any future emergency.

One of those great feats of modern journalism, which can be fairly appreciated only by those familiar with the work, was the publication of the proposed Spanish treaty by the *New York Times*, in advance of its official promulgation through the regular channels. It was telegraphed from Madrid in Spanish, and translated in this city. It contained over 6,000 words upon which the telegraph tolls were $4,400. It is such exhibitions of enterprise as this on the part of a single newspaper, which seem to indicate that journalism has outgrown the antiquated machinery of the Associated Press.

The New York and New Jersey Telephone Co. has inaugurated the subterranean era in Brooklyn, and began work in Joralemon street, December 10th. This company will use the Callender and the Patterson cables. In this city the Edison, Patterson and Brooks systems are to be used, with a view to eventually determining which is practically the best and most economical.

The close competition between the rival electric lighting companies is aptly illustrated by the proposals received for establishing an electric light plant on Ward's Island. The Board of Estimate and Apportionment, granted $15,000 for the purpose. The Edison company's bid was $13,500; the Sawyer-Man company's $14,078, less $500 if certain fuel be supplied for 30 days, and the Brush-Swan company's $13,735. The successful bidder will be compelled to furnish two bonds of $10,000 each, and guarantee the working of the plant for six months. According to the specifications 870 burners will be used on the island. It is expected that better and purer air will be obtained in the hospitals by using electricity instead of gas.

The Commercial Cable Co. has completed the laying of its subterranean connection with the office at 21 Wall street, by drawing a cable through an iron pipe laid under the pavement, from the East River Bridge via Water and Wall streets. Cable telegraphy is a novelty in this city, and the syphon recorder has been placed where it is easily viewed from the sidewalk through the plate-glass front, and the curious may readily satisfy their desire to see the mechanism without violating the secrecy of the establishment. The broken ocean cable was spliced December 19th, and the company opened December 23d for regular business. It has been thoroughly advertised; has a good business location; a most competent and experienced manager, and will probably secure a fair share of patronage, if the alleged antipathy to Jay Gould has any foundation in fact.

There is considerable curiosity as to the real intentions of the Manhattan Kiosk Co., which is making strenuous efforts to secure from the city authorities, permission to erect newsstands or kiosks at various points in the streets. They are to be fitted up with police, fire-alarm and district telegraph communication, and possibly lighted by electricity. Considerable opposition has been awakened by the owners of existing street privileges for various huckstering purposes, and the movement certainly has the outward appearance of what may be as offensive a monopoly on the surface, as the elevated railroad news company is above ground. The scheme has been buried for the present, but will doubtless be resuscitated eventually.

In consequence of the damage to the police telegraph instruments caused from time to time by the crossing of the electric light and the city wires, application has been made by Superintendent Crowley for authority to use some system of automatic protection, which will obviate such difficulties in future.

NEW YORK, Dec. 26, 1884.

NEW ORLEANS.

The World's Industrial and Cotton Centennial Exposition.—The Provisions for Steam Power.—A Glance at Some of the Leading Features.—The Distribution of Time.—The First Telegram from Washington to Baltimore.—How the Machinery Was Not Started by Electricity.—The Opening Ceremonies.

NEW ORLEANS, famous as it is for its holidays and carnivals, has never yet seen such a day as this. Business in general was suspended, public buildings, stores and dwellings profusely decorated, while the people turned out in full to attend the opening of the "greatest exposition the world has ever seen."

Advertised as it has been, everybody knows of its great main building—the largest ever built, its roof covering 33 acres of exhibits from all quarters of the globe. Vast as are these proportions, they have proven entirely inadequate. Forty-five hundred exhibitors cannot all be satisfied. Twice has Machinery Hall (part of the main building) been enlarged by extensions. The Director-General stated to the Board of Management that if they would roof the entire park—247 acres—he could fill it with exhibits in sixty days!

Boilers aggregating 5,200 h. p. are situated a safe distance from the building, and furnish steam through a 30-inch pipe to 22 engines of various sizes, of a total of 4,500 h. p. Of this, 1,600 h. p. are needed to drive the electric plant used in lighting the buildings and grounds. Eleven thousand feet of shafting will drive machines of almost all known kinds. Worthington pumps distribute 3,000,000 gallons of water daily through a comprehensive system of pipes. Fifty-two hydrants are situated judiciously in the main building as a safeguard against fire.

Several systems of electric lighting will be shown conspicuously, contracts having been given the Edison, Brush, Jenney, Thomson-Houston and Leavitt-Mueller companies.

As with all other expositions, the exhibitors are coming in with a rush at the last moment; and although hundreds are ready, much still remains to be done, and probably several weeks will pass before all are installed. When, however, it is taken into consideration that every state and territory in the Union will be represented, and that 27 foreign governments applied for space, it is only to be wondered at that so much is already accomplished. To allow the delinquents a little more time, for a few days the gates will close at 4 P. M. After that the closing hour will usually be 10 o'clock.

Though by no means an electrical exhibition, the electrical features will be most striking. When we recall the Philadelphia Centennial, only eight years ago, and remember that an electric lamp was then almost a curiosity, we are amazed at the wonderful strides made since then. Here everywhere the numerous wires and lamps greet the eyes by day, and at night the vast buildings and extensive grounds will be in a blaze of glory. The great Corliss engine, the object of admiration of all who visited the Centennial, would prove incapable of driving the dynamos alone of this the greatest of all similar enterprises.

An astronomical clock in the main building will be connected electrically with the one in the Naval Observatory in Washington, and its time will be governed to the fraction of a second at noon daily. Time from this clock will be distributed electrically throughout the grounds and buildings. An electric railway is spoken of, but as yet no visible signs of it are apparent.

Among the Maryland contributions to the Exhibition is the first telegram sent from Washington to Baltimore. It was also at the Centennial, and for the benefit of those who have seen or will see it the following anecdote is related: In the spring of 1844, Morse, the inventor of the telegraph, proposed to make the first trial of his invention in a room in the Capitol at Washington. Several gentlemen were present, and when the question arose as to who should send the first message over the wires, one of them proposed that President Tyler should have that honor. No! no! no! was the rejoinder from every quarter. Mrs. Madison, the widow of our illustrious President, was next named. The eyes were then unanimous. She was sent for, and came down to the Capitol shortly afterwards. "Gentlemen," she said, on entering, "I understand you wished for my presence. What is it you expect of me?" Hon. John Wethered (now of Catonsville, Baltimore County), then a Member of Congress, who was present, informed her that she could send a message to Baltimore and receive an answer in 15 minutes. The expression of her face would have made a study for a painter as she rolled up her large blue eyes and said: "Can that be?" The message she sent was to Mrs. John Wethered, wife of ex-Congressman Wethered, and daughter of Philip E. Thomas, the first president and projector of the Baltimore and Ohio Railroad, and was as follows: "I send my love to Mrs. John Wethered."

Great regret was expressed upon all sides at the absence of President Arthur upon this occasion, as it was first expected that he in person would formally open the Exposition and set the engines in motion. However, the novelty of the opening being controlled by the President some 1,200 miles away, in a measure compensated for this disappointment. At the appointed time all available space in and about Music Hall (situated in the centre of

main building) was filled to its utmost capacity. Upon the orchestral platform were seated the officers and boards of the Exposition, commissioners of the states and foreign governments, the Governor and his staff, the Mayor and city officials of New Orleans, the orchestra and invited guests. Immediately in front was the Mexican band. In a conspicuous position was placed the telegraph instrument in direct communication with the President in Washington, and near it another, in charge of General Burke's little son, in connection with a bell placed upon the cylinder of the largest of the engines in Machinery Hall. The ceremonies were brief but imposing. Upon the appearance of Director-General Burke the air rang with cheers, which were repeated when Colonel Edmund Richardson, president of the Exposition, came forward and presented, by telegraph, the Exposition to President Arthur. The returning signal being received, Master Lyndsey Burke, in the presence of the great audience, repeated it to Consulting-Engineer Gilman, stationed at the engine, who at once opened the valve, and the big wheel commenced to move. Instantly five more engines were started, and hundreds of feet of shafting began their incessant revolutions. At that moment a large picture of President Arthur was swung in full view at the head of the platform, the Exposition was declared open, and, amidst cheers and music, the audience dispersed throughout the buildings and grounds. Thus favorably was this great enterprise inaugurated.

NEW ORLEANS, Dec. 16, 1884.

CHICAGO.

Explosive Subterranean Systems.—The Dorsett Underground Conduit.—Merchants Petitioning for Sidewalk Lighting Permits.—Growth of Electric Lighting During the Past Year.—The Western Union Underground System.—New Fire Alarm Plants.—Telephone Gossip.

A NEW phase in the underground question—the occasional blowing up of the gas in the conduits—seems to complicate, where in all conscience there was sufficient complexity before. It is evident that in large cities, where the "ground hog" ordinances are necessary. this new bugbear is playing mischief. Your Philadelphia correspondent, and since that, personal information from members of the Philadelphia fire department, show conclusively that no underground system which permits of the ingress of gases from the surrounding earth, is safe. The iron pipe in use by some of the telegraph companies in other places besides Philadelphia have proven faulty for similar reasons, and I am told the pipes laid during the summer and autumn of last year, in Chicago, have on more than one occasion blown up, seriously injuring one or more unfortunates who happened to stand in front of the gun.

Prof. J. P. Barrett, in an interview published in the *Tribune* a few days since, highly endorses the Dorsett conduit, and says, having "spent five years examining and testing devices for this purpose I finally recommended the use of the Dorsett system by the city."

The Dorsett system is that which is being laid for the electric light, telegraph and telephone wires, which, as has been previously stated, are all to be "sent below."

The conduit company has broken ground on Lasalle and Washington streets and is working southward at a fair rate of progress. The plan is to place proper "leading in" conveniences 20 to 25 feet apart, so that the wiring of two consecutive buildings can be readily accomplished, and the present system of spider-web or clothes-line decoration along the fronts of buildings be discontinued.

In the matter of lights upon the outside of buildings, there is continued difficulty. The electric light companies—or a portion of them—acting in concert for the first time I think, asked the opinion of corporation counsel Winston, relative to the prohibition of lights outside the building line of stores, etc. His opinion was adverse to the wishes of the gentlemen, and sustained the order, under Sec. 2,022 of the code, which, originally framed to cover the overhead wires of the telephone and telegraph companies, still included "electrical conductors," as among the "tabooed" abominations. So, at the last meeting of the city council a petition from sundry citizens was presented, asking permission to place outside lights at their several places of business. An order was also presented, and its passage asked, which will empower the sup't of city telegraph to grant such permits, subject to such regulations as he may deem proper. Their particular flurry just now is the desire to get lights out for the holiday trade, which seems to need a little extra boosting to bring it up to the average. The above communications were referred to the committee on fire and water—and Christmas is close at hand.

The forthcoming annual report of the electric light inspector to the sup't of city telegraph will show that there has been a very large increase in the number of electric light plants during the year, both arc and incandescent. One life only has been sacrificed in the city, and the peculiar circumstances of that occurence seem to throw a shadow of uncertainty on the cause of the death. Unfortunately the deceased was alone in the engine room at the time, and when found was lying upon his face, at least twelve feet from the back of the dynamo, with a shovel at his side. He had been at work with the shovel just before supper, and finishing before the rest of the employés, had returned to his work, alone. As he was a new man at the business, he had been repeatedly warned of the necessity of the utmost caution in handling the lamps and dynamo, and circumstances show that if he did come to his death by means of a current of electricity, it is quite certain that the accident arose from disregard of the frequent warnings he had received. *Per contra*, between May and November, 12 deaths are recorded from improper handling of gas.

The Western Union Co. has laid a four inch iron pipe from the office, corner of Washington and Lasalle streets to the city limits, at 39th street, in which to hide its wires. Electrician C. H. Summers, could give me no details as to the number, size or insulation of the wires which will be laid in this conduit. Information on these points it is presumed will emanate from headquarters in New York.

Mr. E. B. Chandler, Gen. Western Agent of the Gamewell Fire Alarm Telegraph Co., informs me that business for the past year has been prosperous, many new plants having been placed, and seven of those already in, considerably enlarged. Of the former he mentioned Algiers, La., Racine, Wis., Fargo, Dakota, and the town of Lake, in this county—the last being quite important as an adjunct to our city system, with which it joins territory. Among those extended are Milwaukee, St. Louis, Minneapolis, St. Paul, Oshkosh, Peoria and Denver. A temporary plant has also been placed in the New Orleans exhibition.

Telephone matters are moving along much in the same old way. Much satisfaction is evident among officers and stockholders of the Bell telephone adherents, at the decision in the Bell-Drawbaugh case. Central Union, which previous to the decision was only worth about 40 cents is now on the up grade, and has reached 70 and above. During the past year this stock has paid no dividends, but it is now very generally expected, that sometime in January a regular dividend will be handed to all the faithful, and that extra dividends will subsequently follow, to make up for those which have been passed. The Chicago company goes right along; apparently has known nothing of hard times, and the stockholders say they have no complaints to make on the paying quality of the scrip.

The Overland people are hard at work, but like Joe Bagstock, they are sly. A test was made a few days since between here and Milwaukee, which was said to be highly satisfactory. It looks now as if their promise of an exchange here on the first of January would hardly materialize, but—we shall see.

CHICAGO, Dec. 18, 1884.

SAN FRANCISCO.

The Question of Subterranean Lines.—Electric Lighting Maintained by Private Subscription.—Supposed Prospecting for the Postal Company's Extension.—Gold Medals Awarded in Return for Gratuitous Lighting.—Progress of Electric Lighting on the Coast.—Competing District Companies.—Active Telephone Management.—Reduction of Telegraphic Force.—An Electro-Political Candidate Defeated.

WHETHER our city fathers will force the various companies which operate lines in this city to run them underground is a question of much interest to shareholders and managers. If subterranean wires can be operated without creating unusual difficulties, their advent should be hailed with delight, particularly by the chief operators of the Western Union in this city, where the wet, thick fogs from the Pacific make Morse telegraphy almost impracticable for the time being, and allow very little margin in the box of a duplex. To the Telephone, Gold and Stock, and District companies it would work great pecuniary damage, and to some would be ruin. The Electric Light Co. is now sustained by private subscriptions, and it would be impossible to make it a pecuniary success on the basis of a subterranean plant; but as all flesh is grass, and grass is hay, it will be a new experience if some of the city fathers do not make hay while the electric sun shines, and allow the wires to remain as they are.

James Gamble is here, and his movements are watched with a great deal of suspicion and interest. It is surmised that he is laying plans toward building the Postal lines to the Missouri river, and that for this purpose he has entered into partnership with his brother-in-law and Mr. Booth, of Oakland, under the firm name of Coleman, Gamble & Booth. Whatever truth may be in the rumor remains to be demonstrated, but scarcely a better man could be selected for that purpose, as he knows every inch of this coast, as well as every business man of any prominence here. He would know where poles would have to be set with more than usual care, and other details which a stranger would pass over as trivial. Whether the advent of the Postal will be beneficial or otherwise to the skilled operator, certain it is its completion to this city is hopefully looked forward to by the fraternity.

At the annual fair held in this city the Brush and the Thomson-Houston companies alternated nights in lighting the pavilion *free*. The Sperry company had also a fine display of incandescent and other lights, for which it received the silver medal, and the other companies gold medals—not on account of superior lights, but because of their liberality. The Thomson-Houston company lights the cities of Oakland, San Jose and Sacramento, and is negotiating for Portland, Oregon, and Los Angeles, while the Brush system seems to have a monopoly of San Francisco, and with a shrewd business man and influential politician like P. B. Cornwall as its president, it would not surprise me to see this city lighted exclusively by that company, and gas superseded; but ere that occurs some of the city fathers will leave office wiser and richer men.

George S. Ladd, the President of the Telephone company, is also President of the Edison Incandescent Light Co., and he is waiting for a favorable moment to demonstrate to our people that his light is much superior to gas. He is at the present moment in excellent humor over the decision in the Bell-Drawbaugh suit, and even Mr. Sabin does not begrudge the various suits of clothes he lost on Blaine.

The Gold and Stock and American District companies, under one management, are almost exclusively owned by the Western Union Telegraph Co. Although the mining stocks do not create as much excitement as they used to do in years gone by, the united companies seem to be doing a good business. As the District company does most of the Western Union city delivery, it is thus enabled to make a better showing than would otherwise be the case, as the San Francisco District Co. is taking a great deal of its business away.

The Telephone company, under the management of Messrs. Ladd and Sabin, has in a measure reduced Western Union local receipts, they having exchanges in every town on the coast, and some of the most prominent are connected direct with San Francisco, where their wires are a net-work. Certain it is that business was never so dull in the San Francisco office as at present, and Mr. Rankin's eye moistens when he is ordered to dispense with four of his best men from the 1st of December. He regrets the necessity, but such events must occur if the telegraph is not properly patronized.

L. N. Jacobs is expected to succeed E. C. Fleming as night chief at the Western Union office, the latter gentleman being seriously ill. Mr. Jacobs received the Republican nomination for County Clerk, but failed to poll the necessary number of votes for election, partially because a third candidate was in the field, and partially because he stood by the Western Union during the strike. For this reason, the labor organizations went against him, and none so bitterly as the operators, who clearly demonstrated that they were more thoroughly organized than in July, 1883.

SAN FRANCISCO, CAL., Dec. 8, 1884.

BOSTON.

The Western Union Subterranean Line.—The American Electrical Exhibition.—Rumored Amalgamation of Electric Light Interests.—Gossip About the Telephone Patent Suits.—New Electric Light Plant.—Proposed Development of Long-distance Telephoning.—Harvard Students on Government Telegraphy.—Introduction of the Weston Incandescent Lamps.—The Western Union Abolition of Over-time.

THE result of the controversy between the city authorities and the Western Union Telegraph Co. relative to poles on Friend street, referred to in my last, resulted in the latter putting down an underground system, extending from the Eastern railroad station through Friend, New Washington, Devonshire and State streets to the Western Union offices. The system is simply iron pipes laid in a trench 2 feet deep with manholes every 450 feet. The cables will be drawn in. The newspaper electricians think that this settles the matter for all electric wires, and hug themselves to think how much they know about such plain and simple matters.

The electrical exhibition, after as many false starts as an agricultural horse trot, has finally opened the ticket office. The first opening was to be Nov. 24—then Dec. 1, afterwards Dec. 3—and it finally opened Dec. 8. The hesitation was owing to the fact that the principal exhibitors had not made up their minds to exhibit when the first opening date was announced. It would have been more attractive if some of the local characters known in the electrical line had been connected with the enterprise. Although the exhibition has been opened ten days the display is not large as yet. The principal exhibits are those of Edison, composed of lamps and his private exhibit; and that of the American Bell Telephone Co. The Arago electric light shows up well, on the outside and inside of the building. The historical collection is small, comprising Western Union and fire alarm models. The Dudley Electric Manufacturing Co. show a system of individual calls for telephone lines, and show it well. Seth W. Fuller exhibits a variety of electrical apparatus, etc. Blodgett Bros. exhibit their railroad time apparatus, etc. The New York Insulated Wire Co. is on hand. The New York Consolidated Electric Light Co. has its dynamo in position and its exhibit is progressing. Ocean telegraphy is graphically illustrated. The Rhode Island Telephone and Electric Co. has its clock system working—as have also the American Watchman's Time Detector Co., the Martin Automatic Fire Alarm Co., the Municipal Signal Co. and Orcutt's Electric Railroad Signal. The Bidwell railway looks well, composed of tracks and cars—the former encircling the gallery. The cars, two in number, are built with open sides; the first car carries the driver in front where the apparatus is located. The power is obtained from a Weston dynamo on Stanhope street, some distance from the building. The cars are lighted by electricity from the rails. The incubator man is here with his "electrical" exhibit. The "Orne" battery has a show case. Prof. Dolbear has his box on the main floor and illustrates his telephonic system; he has a Reis transmitter connected with it, to show that the Reis instrument *can* be made to talk, notwithstanding the sneers of an unbelieving world.

There are rumors of consolidation in electric light circles, in this city. The three companies—American, New England Weston and Brush have been engaged in a ruinous competition, and while not exactly losing money are not paying dividends. The consolidated stock appears to be an obstacle; as each company has a reasonable capital now; to consolidate to make money, means to squeeze somebody.

It is the world's news now, that the Drawbaugh claimant has gone to join the long line of which the Tichborne claimant is a shining example. The news of Judge Wallace's decision was first received at the American Bell Telephone office, in this city, and over their telephone line from New York—the brokers getting their information later by private wires. The stock of the company sold in the morning stock board at 220 and 215—but, after the brokers had picked the lambs clean, the stock shot up to 275—and holders expected to realize at 300, but the public did not come in with that tumultuous rush of former years, so there was a sag. The announcement by the company of a special dividend of 3 per cent. for holders to put in their Christmas stocking, sent it up again, but the first wave was the highest. The result was of course very gratifying to those who were fortunate holders of the stock; there were many, however, who *intended* to participate, but had not nerve enough to jump in. The Overland Telephone case, suspended last January in Philadelphia, will now be the next thing to settle; the judges in that case holding off, it will be remembered, to hear the decision in the case now decided, as the Drawbaugh evidence was introduced by the Overland people. Of course the Overland case was practically decided when Judge Wallace sat down so hard on Dan. With the Drawbaugh and Overland companies enjoined, the telephone field will be comparatively clear; whether the Baltimore and Ohio telegraph people, who are sponsors for the Meucci first-inventor-claimant will make a stand remains to be seen. The recent decision would seem to be a wet blanket to claimants whatever their pretensions; and the Meucci-man who evidently thought he could speak numberless miles through a hollow tube, using a battery and key for signaling, will not use up the "monopoly" very thoroughly.

A company has closed a contract with the American Electric and Illuminating Co. of this city, for the immediate installation of a complete 100 arc light plant, with accompanying machinery for incandescent lights and motors. Real estate is to be purchased and construction commenced immediately.

The statement comes from a director of the Bell company that among the enterprises to be pushed by the company is the long-distance talking business, and that soon New York and Philadelphia, and eventually New York and Chicago, will be connected, using the hard-drawn copper wire, such as now connects New York and Boston. Connections are to be made with subscribers by means of private switch-boards without the intervention of the central office.

The telegraphs of the country will surely not pass under the control of the U. S. government now, as the Harvard College students in the debate in the Harvard Union the other evening, settled that point and clinched it down hard by a vote of the members.

The New England Weston Electric Light Co. is now putting in the new large incandescent lamps of 125 candle power, along the line of available circuits. The light is very steady, pleasant to the eye, and is free from the disadvantages of the arc system, especially for interior illumination. Small lights of 16 candle power can be run from the same circuit.

The Western Union telegraph operators have been notified that hereafter they will be deprived of their "extra." This order reduces salaries in some cases $30 and $50 per month.

BOSTON, Dec. 18, 1884.

PHILADELPHIA.

Too Many Subterranean Enterprises.—Financial Embarrassment of the Sectional Conduit Co.—Referee's Decision on the Question of the Telegraph-Pole Tax.—Underground Privileges Granted.—

THE chief topic among electricians in this city is the "underground" problem. As there are some half-dozen different systems here—all claiming to be the best—it is a difficult matter to see where they all propose to make money out of their enterprises. To be a little more forcible than elegant, "somebody is going to get left." The embarrassments of the Philadelphia Sectional Electric Underground Co. seem to be on the increase. In my last letter to THE ELECTRICIAN AND ELECTRICAL ENGINEER I spoke of the trouble this company has been having in the shape of explosions that have occurred in their trenches, caused by the accumulation of foul air and gas. *Now* a new difficulty has been sprung on them, inasmuch as a judgment has been taken out against the concern for non-payment of a promissory note, amounting to $5,669.12, with interest. The most important piece of property belonging to the concern is said to be the conduit which extends from Third to Broad streets on Chestnut, with a branch to the Public Buildings, and another down Eleventh street a short distance. This conduit has been leased to and is now operated by the Electric Light and Power Co., which corporation is said to be controlled by men largely interested in the Underground company. The Councils have granted to the Underground company the right to lay conduits on Chestnut street, and this franchise is regarded as one of the most valuable assets of the company. The conduit and city franchise are estimated to be worth much more than the amount of the iron firm's claim, and it is intimated that the matter will be arranged before it comes to a sale.

The decision of the referee in the suits brought by the city against the Mutual Union, the Western Union and the Bell Telephone companies, who yesterday filed his report in the Court of Common Pleas, is of considerable importance. The claim was contested by the companies on the ground that it was exorbitant, and the referee, in his opinion, sustains this view of the matter strongly.

The city sued to recover an aggregate of $6,885, which, it was claimed, was due and owing by these companies for licenses for the year 1883 upon poles and wires, as provided in ordinances of January 6, 1881, and March 30, 1883. The entire amount claimed from all the companies for tax on poles and wires was $14,208, of which $9,500 was for the former and $4,658 for the latter uses If the referee's judgment is approved by the court, and the case is allowed to rest, a loss of $11,708 annually would result to the city from this source. The referee thinks $3,500 a reasonable charge. Superintendent Walker, of the electrical department, said this afternoon that the subject was purely a legal one now, and that if the tax is not proper Councils will be compelled to frame a new ordinance. "It is immaterial to me," the superintendent said, "what shall be charged, as I am required only to enforce the ordinances referring to my department. I can tell you, though, that the pole tax here is a dollar, while in other cities it is higher, being in Baltimore $2 per pole."

Superintendent Walker yesterday told the chairman of Councils Electrical Committee that the various companies owning overhead wires, who had been notified as to the penalty of a non-compliance of the ordinance requiring them to be placed underground, had informed him that the penalty would be paid under protest. The referee to whom the question of the legality of the ordinance was referred decided that as the penalty was in the nature of a tax upon the companies, Councils had no authority to levy it.

The committee considered favorably the ordinance granting the Baxter Overland Telegraph and Telephone Co. permission to lay a cable in certain streets from Point Breeze to Germantown. An amendment to the ordinance provides that the entire circuit of the cable be completed within one year from the date of the granting of the privilege. The ordinance granting permission to the Morse Underground Co. to lay its conduits in the streets was reported negatively, the representatives of the company having failed to appear before the committee.

PHILADELPHIA, Dec. 19, 1884.

WASHINGTON.

No Government Telegraph Legislation this Winter.—Underground Electric Light System.—Telephone Affairs.—Prospective Reopening of the Postal Office.—The New Baltimore and Ohio Building.—The War on Overhead Lines.

ALTHOUGH Congress has not formally taken a recess, it is as certain there will be no legislation before the 5th of January as if the usual adjournment over the holidays had taken place. Thus two-fifths of the session has gone and nothing has been done regarding the control of the telegraph by the government, unless it be in the nature of taking nought from nothing, for by the action of the Senate caucus on the order of business, so many other matters were put to the front that the bill of Senator Hill was left so far in the rear that it cannot hope to see daylight in the eight remaining weeks of the session. Senator Hill has consequently given up the effort, and has been looking to the House for something on which an effort for action in the Senate could be based. This being the situation of affairs, Mr. Money, chairman of the Committee on Post-offices and Post-roads of the House, has diligently sought to get a day assigned for the consideration of his bill, which proposes contracts by the government for a term of years for telegraphic service; but the obstacles have thus far been insurmountable, and as the time for final adjournment draws nearer the difficulties will increase. As I understand the case, the advocates of a *bona fide* government control of the telegraph are not satisfied with the bill of Mr. Money, and charge that it is inspired by the companies, while the companies do not desire it, but would prefer it to the threatened more radical legislation. They would prefer to be "let alone," and as there is therefore no powerful influence behind this measure it is not likely to make headway. Mr. Anderson, the author of one of the bills for a government telegraph, says the old companies would sooner have the Money bill for ten years than risk the future in Congress. There will be some speeches on the subject even if the bill does not come up. These will probably be made on the post-office appropriation bill when it comes up, or they may go into the *Record* on "leave to print," but there will be no legislation on the telegraph by this Congress.

The United States Electric Light Co. has completed its underground wires for lighting F street from 9th to 14th street, and has supplied the light for the past two or three weeks. The laying of the wires was quite expensive, as the concrete pavement had to be cut up, but the business men on the street generously contributed a sufficient sum to make up the difference, and the street is now beautifully illuminated. The lamps are placed on posts about 10 feet high at short intervals along the curb, the wires running up inside from beneath the ground, and are not visible. A further extension of this mode of street lighting is contemplated by this company. They already have a number of subscription lamps in front of business places on Pennsylvania avenue, which in some localities make this broad avenue quite brilliant. This company has an energetic management, and seems to be doing a good business. A semi-annual dividend of 4 per cent. was made on the 1st of July, and a like dividend has been ordered, payable January 1st. I am assured these are made from the net earnings, and that a handsome surplus remains in the hands of the treasurer. The company is now engaged in putting in 160 incandescent lamps in the printing office attached to the Treasury department and located in the Treasury building. This work is being done under the superintendence of Mr. Charles F. Burns, of the New York office. It will be completed soon after the holidays.

The Chesapenke and Potomac Telephone Co., a consolidation of the Washington, Baltimore and Maryland systems, has declared its usual semi-annual dividend. Under General Manager S. M. Bryan the telephone is regaining the popularity which was so badly shattered under the former management, when a purely local enterprise

W. F. Allen, late local manager of the Postal company, is here to reopen an office, and is looking up the old employes of the office. It will require some time for the two smaller companies to regain the footing they had gained before the attempt at consolidation.

The new railroad and telegraph office of the Baltimore and Ohio company was rapidly run up to the third story, when the cold weather put a stop to the work. The structure when completed will be quite imposing, and have a strong tendency to preserve the popularity of the old telegraph corner, despite the gradual movement of the business centre westward. In this connection it may not be uninteresting to state that 30 years ago all the telegraph offices—Morse, House and Bain—were located (and centrally, too) east of 6th street, with a single branch office in Willard's Hotel.

The war on overhead wires continues. No efforts have been made to compel those up to come down beyond refusing to permit new poles where the old ones are rotting away; but no new lines are permitted. An effort is being made to get the question into the courts, in order that its legal status and the powers of the commissioners and the rights of the corporations under the law may be judicially determined. The last utterances by the authorities were made on Wednesday by Commissioner Edmonds, who said that if citizens would examine the matter they would not complain of poles erected in the alleys. "The commissioners," he said, "have forced the telephone and telegraph companies to begin placing their wire underground in the streets. They leave the streets free, and we let them erect a distributing pole in the alleys. It would be impossible for them to go underground in the alleys, as they would have to dig up the citizens' property in order to furnish each patron in the square. As it is now, they run a distributing wire in the alley, and connect all the patrons, and that is a great deal better than having the streets burdened by the wires.

WASHINGTON, D. C., Dec. 20, 1884.

ELECTRICAL NEWS AND NOTES.

OPINION OF JUDGE WALLACE IN THE TELEPHONE CASE.

DECEMBER 1, 1884.

STATEMENT OF THE CASE.

This suit is brought to enjoin the defendants from using and furnishing to others for use the several inventions described in two patents granted to Alexander Graham Bell, of Salem, Massachusetts, being No. 174,465, bearing date March 7, 1876, for "Improvements in Telegraphy," and No. 186,787, bearing date Jan. 30, 1877, for "Improvements in Electric Telephony." The issues made by the pleadings are practically resolved into the single question, to which the proofs and arguments of counsel are mainly addressed, whether the patentee Bell, or Daniel Drawbaugh, of Milltown, in Cumberland County, Pennsylvania, was the first inventor of the electric speaking telephone.

Concededly Bell was an original inventor of the telephone, the principle of which with the essential means for its application, are described in his first patent, and of the improved apparatus described in his second patent. The fifth claim of the first patent is for "the method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds substantially as set forth." This patent has been judicially construed in two cases in the Massachusetts Circuit; and in both cases it was substantially held that Bell was the discoverer of the new art of transmitting speech by electricity, and that the claim should receive the broadest interpretation to secure to the inventor not the abstract right of sending sounds by telegraph without regard to means, but all means and processes described which are essential to the application of the principle. American Bell Telephone Co. *vs.* Spencer, 8 Fed. Rep., 509. Same *v.* Dolbear, 5 Fed. Rep., 448.

In view of the conclusion reached upon the merits of the issue, it is not material whether Bell's inceptive invention did or did not antedate the time of filing his application for the first patent. That application was filed Feb. 14, 1876. It describes apparatus which was an articulating telephone, whether Bell knew it or not. Mr. Cross, an expert, caused apparatus to be made in conformity to the description and to drawings as shown in figure 7 of the patent, which proved itself to be an operative, practical telephone. Probably the date of his inceptive invention might be carried back to July, 1875, but, irrespective of the time of the invention, the justice of his claim to be an original inventor of the telephone must remain unchallenged. It was through him also that the telephone was made known to the scientific public, and thence introduced into commercial use.

THE DEFENDANTS' ANSWER.

The defendants contend that, long before Bell had perfected his invention, and long before its mental conception by him, Drawbaugh had not only made the same invention, but had perfected improvements in organization and detail which Bell never reached, and which were only reached years afterwards by the work of many other inventors in the same field of improvement. Their theory of the facts is stated with substantial accuracy in the answer to the bill of complaint. The answer, among other things, avers that Drawbaugh "was and is the original and first "inventor and discoverer of the art of communicating articulate "speech between distant places by voltaic and magneto electric-"ity, and of the construction and operation of machines and in-"struments for carrying such art into practice; . . that the "said electric speaking telephones so constructed and success-"fully and practically used by him contained all the material "and substantial parts and inventions patented" in the two patents granted to Bell; and also contained other important and valuable inventions in electric and magneto telegraphy; . . "that some of the original machines and instruments invented, "made, used and exhibited to many others long prior to the "alleged inventions of Bell are still in existence, and capable of "successful practical operation and use, and are identified by a "large number of persons who personally tested and used and "know of their practical operation and use in the years 1870, "1871, 1872, 1873, 1874, and both subsequently and prior there-"to; . . that said Drawbaugh for more than ten years prior "to 1880 was miserably poor, in debt, with a large and helpless "family dependent upon his daily labor for support, and was "from such cause alone utterly unable to patent his said inven-"tion or caveat it, or manufacture and introduce it upon the "market; and that said Drawbaugh never abandoned nor "acknowledged the claims of any other person thereto, but al-"ways persisted in his claim to it, and intended to patent it as "soon as he could obtain the necessary pecuniary means there-"for."

DRAWBAUGH'S STORY OF HIS INVENTION.

Drawbaugh, in his testimony, adopts the statements of the answer as true. He also testifies that he commenced his experiments with the electric telephone as early as 1866; that prior to or as early as in 1867 he had made apparatus (in which he employed a teacup as the transmitter) through which speech could be transmitted feebly and incoherently; and that as early as the time of the birth of his son Charles he had so progressed that his wife, who was then confined to her bed, could, by listening with one of his instruments, hear the words spoken by him in the other instrument in a distant part of the house. His son Charles was born in 1870, and, if Drawbaugh's narrative is true, he had succeeded at that time in transmitting speech distinctly through the instruments, although whispered words would not be accurately heard. He describes instruments which, he says, were made by him from time to time, as experiments which led him from one movement to another. He testifies that he thinks he made his first telephone apparatus prior to November, 1866, and is positive he had it before he moved his shop to the "Clover-Mill," in 1867.

As he describes it, the body of the transmitter was a porcelain teacup, the diaphragm was of membrane, the electrodes interposed in the circuit were two copper discs, the upper one of which was connected to the diaphragm by a wire, so as to vary its pressure upon a low conductor of fine earth or pulverized charcoal interposed between the discs through the action of the sound waves upon the diaphragm; and the receiver was a tin can without a top or bottom, having a membrane diaphragm stretched over one end, connected by a tense cord to an armature supported on a spring, and arranged close to the poles of an electro magnet in the electric circuit. He testifies that subsequently he constructed apparatus upon the same general principle, with some change of detail; and he produces Exhibits "F" and "B," —the former a transmitter and the latter a receiver—as the remnants of the original instruments. Exhibit "F" is a glass tumbler; and he states that at first he used a membrane diaphragm over it, and then one of thin metal; and that for the conductor he used pulverized carbon or carbon mixed with bronze powder, and used various tops or mouthpieces to speak into it. The Exhibit "B," he says, was the receiver; and in this he had discarded the string and the spring of his earlier receiver. He says that experiment led him to improve the transmitter "F" by substituting a metal diaphragm in place of membrane, and he produces a sketch. A reproduction of this instrument has been made by him for use in the proofs, which is designated as "Exhibit F reproduced." In this the mouthpiece is modified in size and in distance from the diaphragm.

He made, according to his testimony, a new receiver of more perfect construction, and produces the remnant of the original, which is designated as "Exhibit C." As he describes the instrument, it was a decided advance upon the former receiver. In using this, he says he tested it also as a transmitter with some success, and then improved it by placing a permanent magnet against the heel of the electro magnet, and thus made a magneto telephone. A reproduction of such an instrument as he describes is made and referred to in the proofs as "Exhibit Reproduced C." After Exhibit "C," he produces Exhibits "I," "A," "E" and "D," as likewise original instruments, made respectively in the chronological order of their production as exhibits. He states that "I" was used by him as a companion instrument to "C." Exhibit "A" discloses a modification of form and a higher degree of mechanical adaptation.

The last two, "D" and E," are concededly perfect, practical instruments; and, according to the testimony of Mr. Benjamin, an expert witness for the defendants, would compete successfully for public patronage with any magneto telephone which had been introduced into use in 1882. It is asserted of these instruments by counsel that no higher development of the magneto telephone has been reached at the present time than is indicated by Exhibits "E" and "D." Drawbaugh does not attempt to fix the time at which he made any of these instruments, or even the year. He testifies, however, that he made all of them prior to the time the "Axle Company" commenced business, which was in December, 1874, except "E" and "D," which were made about that time.

THEORY OF THE DEFENCE.

The theory of the defendants is, that Exhibits "F" and "B" were used by Drawbaugh in 1867, 1868 and 1869, Exhibit "C" in 1869 and 1870, Exhibit "I" in 1870 and 1871, Exhibit "A" in 1873 and 1874; and that Exhibits "E" and "D" were made in January or February, 1875, although cruder instruments essentially similar were made somewhat earlier. It is in proof that 33 patents were granted for improvements in telephones in 1878, 64 in 1879, more than 100 in 1880, and 94 in the first 6 months of 1881. According to the theory of the defendants, therefore, as early as February, 1875, Drawbaugh had not only distanced Bell in the race of invention, but also Gray and Edison, and had accomplished practically all that has since been done by a host of other inventors.

The case for the defendants must stand or fall by this theory. The proofs leave no room for fair doubt that defendants contention is substantially true, or that the defence has no foundation in fact. It is either true that Drawbaugh had long been treading his solitary path of investigation and experiment in poverty and obscurity, but had perfected his work when the inventions of other explorers were in embryo, or his story is an ingenious fabrication. And, as will hereafter appear, if the defence is a fabrication, many disinterested witnesses have contributed innocently to give it color and strength; but Drawbaugh has deliberately falsified the facts.

POSITION OF THE COMPLAINANT.

The complainant starts with the benefit of the presumption of law that Bell. the patentee, was the inventor of that for which the Letters Patent were granted him. Whoever alleges the contrary must assume the burden of proof. Evidence of doubtful probative force will not overthrow the presumption of novelty and originality arising from the grant of Letters Patent for an invention.

It has been frequently held that the defence of want of novelty or originality must be made out by proof so clear and satisfactory as to remove all reasonable doubt. Washburn *v.* Gould, 3 Story, 227; Smith *v.* Fay, 6 Fish, 446; Hawes *v.* Antisel, 2 B. & A., 10; Patterson *v.* Duffy, 20 Fed. Rep, 641; Wood *v.* Cleveland Rolling Mill Co., 4 Fish, 560; Parham *v.* American Button Hole Co., do., 482. In U. S. Stamping Co. *v.* Jarrett, 18 Blatch., 469, Blatchford, J., said the defendant had not fulfilled "the necessary obligation of showing beyond any reasonable doubt" that Weber (the alleged prior inventor) was prior to Heath (the patentee). In Coffin *v.* Ogden, 18 Wall., 129, Mr. Justice Swayne delivering the opinion of the Court, stated the rule applicable to the defendant as follows: "The burden of proof rests upon him, and every reasonable doubt should be resolved against him."

To overthrow this presumption and disprove that Bell was the first inventor, the defendants introduce the testimony of nearly 200 witnesses tending to prove the priority of invention by Drawbaugh. As the complainant concedes that Exhibits "E" and "D" are highly organized, practical telephone instruments, and fully capable of perfect articulation, the patents are invalidated if these instruments were in existence at the date of Bell's invention; and, as will hereafter appear, either they were in existence as early as in 1875, or it is incredible that they existed at all until long after Bell's first patent had been granted, and his invention had attracted general public attention at the Centennial Exposition and elsewhere.

In the argument for the defendants, great stress is placed upon the evidence of a gradual and natural development of Drawbaugh's invention shown by the original instruments produced, beginning with Exhibit "B," and ending with the perfect magnetos "E" and "D"

It is strenuously urged that these exhibits fortify his testimony describing the instruments no longer extant, and mark the origin and culmination, beginning with the cup machine and Exhibit "F" of two separate lines of invention; one leading to the battery telephone, in which the undulatory vibrations are controlled by variations in the resistance of the circuit; and the other to the magneto telephone, in which the vibrations are created in the act of producing the current itself.

SUMMARY OF DEFENDANTS' TESTIMONY.

The general theory of the defence is substantiated by three classes of witnesses: those who heard of the existence of Drawbaugh's "talking machines" at various times; those who talked through the machines on various occasions, or heard others talk through them; and those who attempt to identify one or more of the exhibits as the instruments they saw used. Only an outline of their testimony will be given.

More than fifty witnesses testify to having heard of the talking machines prior to Feb. 14, 1879.

Of these witnesses, 3 think they heard of them in 1869; 3 in 1870; 2 in 1871; 5 in 1872; 3 in 1873; 3 prior to 1873; 8 in 1874; 2 in 1875; from 1866 to 1870, 1; from 1868 to 1871, 1; from 1868 to 1873, 1; from 1869 to 1870, 1; from 1869 to 1876, 1; from 1871 to 1872, 2; from 1872 to 1873, 1; from 1873 to 1874, 1; from 1873 to 1875, 3; from 1874 to 1875, 1; from 1874 to 1876, 1; from 1872 to 1876, 1; prior to 1869, 1; prior to 1872, 2; prior to 1875, 1.

Sixty witnesses do not attempt to identify any particular instrument, but testify that they saw a talking machine or talked through it, or heard it talked through at Drawbaugh's shop on occasions subsequent to 1867, and most of them fix the occasion as prior to 1876. The substance of the testimony of some of them will be given.

Wilson G. Fox testified that he saw the talking machine at Mr. Drawbaugh's shop about the year 1867 or 1868, when the old Faucet company was in operation there. Prior to March, 1871, the witness was employed in the carding room of the Harrisburg Cotton Mill, and Drawbaugh came there to get material to wrap his wire to use for the talking machine. Henry Bonholtzer testified that he was at Drawbaugh's shop in 1869, and saw talking machines there. Margaret Brenneman testified that she saw the talking machines at Drawbaugh's shop in 1869. Abraham May testified that he did work on Daniel Hart's house at Milltown in August and September, 1870, of which he produces his account books; that he never did any work for Daniel Hart after that; that while doing that work he was at Drawbaugh's shop to get a boring machine mended, which he was using in the work, and Drawbaugh showed him his talking machines, and talked through them from one floor of the shop to another. The witness understood and heard through the machine the words that Mr. Drawbaugh spoke into it. His testimony is corroborated by Jacob H. Kilmore, William H. Martin, and John A. Smith.

Cyrus Orris testified that he saw Drawbaugh's talking machines at different times, from about the 1st of April, 1871, down to 1880, and took his son-in-law, Jacob E. Smith, to Drawbaugh's shop to see the machines about April 1, 1871. Benjamin K. Goodyear testified that in 1871 he seized the personal property of George W. Kissinger, of Milltown, upon an execution issued Nov. 13, 1871; that on Dec. 4, 1871, the attached property was appraised, and on that day witness went to the workshop of Daniel Drawbaugh to find J. B. Drawbaugh, to summon him as an appraiser, and had to wait for him there a short time; that while waiting there Daniel Drawbaugh showed him his talking machines, and talked through them to him, and witness heard him speak, and understood distinctly the words that he spoke through the instrument; and that he was never in Drawbaugh's shop afterwards, so far as he can recollect.

George Natcher testifies that he lived at Milltown in 1871-1872, and never has been in the town since Aug. 9, 1872; that while living there he was at Drawbaugh's shop, and saw and talked through the talking machines on different floors, and listened at the same machine and understood what was said through it. Mrs. B. B. Spangler, a sister of George Natcher, testifies that she moved away from Milltown in 1872, and never has been there since; that she talked into Drawbaugh's talking machines while she lived there; and that she was so small that Harman Drawbaugh had to lift her up to enable her to talk into the machine. Mrs. Mary Free testifies that she was with her sister, Mrs. Lydia Drawbaugh, at Drawbaugh's shop, in September, 1872, when he talked through the machines to them, and she remembers hearing through the machines, "Good afternoon, ladies!" Drawbaugh told them that the machines operated by electricity.

Mrs. Lydia Drawbaugh testifies that she saw the talking machines in September, 1872, her sister, Mrs. George Free, being present. David M. Ditlow testifies that he saw Drawbaugh's talking machines about 1872, when Drawbaugh talked through it, and witness heard and understood through the machine what he said. David K. Ernest testifies that he was at Drawbaugh's shop with John B. Bloser about the middle of June, 1872, and talked with Drawbaugh about the talking machines, and thinks he saw them at that time. This testimony is corroborated by John Bloser. N. W. Kahney testifies that he saw the talking machines about 1872. William H. Martin testified that he was at Milltown with John Keefauver, to get George Hosler to make him a pair of boots. Hosler lived at Milltown only from March, 1872, to March, 1873. At that time witness and Mr. Keefauver went down to Drawbaugh's shop, and talked through the talking machine, from the basement to the attic, and heard and understood what was said through the machines. They talked and listened at the same instrument.

John F Keefauver corroborates Mr. Martin, and also states that he talked through Drawbaugh's talking machine with Jacob M. Sadler, in April, 1873, prior to the death of George B. Hick, and that about two or three years before he saw the talking machines he had heard a good deal about them, and first heard of them at a place seven miles west of Carlisle. Wm. W. Snyder testifies that he was at Drawbaugh's shop on Wednesday, Feb. 5, 1873, and saw the talking machines. He verifies the date by an entry in his diary. Jacob Barber testifies that he was a candidate for the office of County Commissioner of Cumberland County in the summer of 1873, and, in connection with his canvass, went to Drawbaugh's shortly after the death of George B. Hick. While at Drawbaugh's shop he saw the talking machine, and was never in the shop after July or August, 1873.

Ezekiel Worley testifies that about the year 1873 he saw the talking machine at Drawbaugh's shop. His statement is corroborated by John K. Taylor. Abraham Ditlow testifies that he knew of Drawbaugh's talking machine in 1874, and saw it and talked through it at that time. He had forgotten the fact, but was reminded of it by Mr. Alexander Milner, of Porter County, Ind., whom witness told about it in May or June, 1876, in Indiana. William Eppley testifies that he visited Drawbaugh's shop for the last time in May or June, 1875; that he was there several times during the two years preceding that period, and had seen talking machines. Jonathan Fry testifies that he was at Drawbaugh's shop with Mr. Hamme and Mr. Frederick in the winter of 1875-6, and saw the talking machines there. Jacob Evans testifies that he was at Drawbaugh's shop with his wife, his brother Andrew, and his sisters Margaret and Sarah, about Dec. 1, 1875, and saw and talked through the talking machines,

Henry L. Hamme testifies that he was at Drawbaugh's shop either in the last of January or the beginning of February, 1876, in company with George Frederick and Jonathan Fry, and saw and talked through the talking machine at the time; that he heard and understood very plainly what was said through the machines, even when Mr. Drawbaugh talked in a whisper. George Frederick testifies that he was at Drawbaugh's shop with Mr. Hamme and Mr. Fry in January or February, 1876, and saw the talking machine. S. S. Rupp testifies that he was at Drawbaugh's shop with Mr. Hammacher and his scholars on Feb. 1, 1876, and recollects that Mr. Drawbaugh at that time spoke about a machine that he had which he called a talking machine, but the witness was interested in other things and did not pay much attention to it. George H. Bowman testifies that he saw talking machines in Drawbaugh's shop in February, 1876, at which time somebody was talking to Mr. Drawbaugh through them. Charles L. Drawbaugh testifies that he saw and talked through the talking machines at Drawbaugh's shop a year or more prior to May 1, 1876, and heard and understood what was said.

The third class of witnesses are those who identify more or less positively one or more of the several exhibits as the instruments used by them, or which they saw used by others prior to March 7, 1876. Exhibits "F" and "B" are identified by the following witnesses: Brooks saw them in 1874; Smyser, in 1872; Eberly, before December, 1870; Wagner, in the fall of 1874; Freese, in 1869 or 1870; Yetter, about Christmas, 1875; Fry, spring of 1875; Carl, in 1870; Scherick, in 1869; Balsley, between 1870 and 1874; Good, before 1872; Kahney, in 1871 or 1872; Schettel, about 1872; Nichols, in 1875; Renneher, in May, 1875; Weber, late in 1874; Stephen, before 1875; Shireman, about 1872; Hawn, about 1872; H. B. Eberly, in May, 1873; J. C. Smith, between April, 1872, and April, 1873; Sternberger, in October, 1871; Fettrow, in April, 1876; Halsinger, prior to 1876; Shoop, in 1869; H. F. Drawbaugh, in 1872; Zimmerman, in 1871; Bates, in 1874; Guistweit, in July, 1870; Hale, in fall of 1873; Stone, in June, 1871; Free, in June, 1872; J. A. Oyster, in June, 1875; Harmon K. Drawbaugh, in January, 1871; J. B. Drawbaugh, in 1869; G. W. Drawbaugh, in 1870; Lenseman, in July, 1871; Fisher, in 1868 or 1869; Hubler, in fall of 1873; Updegraff, in 1874; W. H. Decker, in 1873; and a number of other witnesses saw one of these two exhibits.

The identification of Exhibits "C," "I" and "A" is made by a smaller number of witnesses. Some of them think they saw "C" in 1870, and others at various dates after that and as late as March, 1876.

One of the witnesses thinks he saw "I" in 1871, the others locate the occasions in 1873, 1874 and 1875. Some of the witnesses think they saw "A" as early as 1872, one of them in 1870; but most of them saw it, they think, in 1875.

Exhibits "E" and "D" resemble each other very closely in appearance, and most of the witnesses produced to identify them saw both at the same time. They locate the time as follows: Fry, laborer, in May or June, 1875; Fry, farmer, in April, 1875; Bayler, in June, 1873 (Exhibit "D"); Springer, after April, 1876; Shettel, about 1875; Shoop, after February, 1877; Musser, in June, 1876 (Exhibit "D"); Millard, in 1875; Holsinger, in summer of 1875; Shoop, in 1874 or 1875; Bates, between 1874 and 1877; Dellinger, in March, 1876 (Exhibit "E"); Guistweit, between 1870 and 1876; Bowen, in September, 1878; Hale, in fall of 1875 (Exhibit "D"); Michael Dillinger, in November, 1877 (Exhibit D"); Harmon K. Drawbaugh, in January, 1875, and helped put up wire for them; J B. Drawbaugh, prior to Jan. 26, 1875; George W. Drawbaugh identifies all the exhibits as seen by him some time between 1871 and 1878; Updegraff & Musser, in 1876; Smith, in 1872 or 1876 (Exhibit "E"); May, in 1876 (Exhibit "D"); J. H. Smith, in May, 1876 (Exhibit "D"); Decker, in 1874 (Exhibit "D"); Vannasdale, in February, 1875; Evans, in fall of 1875; Mrs. Erb, in fall of 1875; S. E. Evans, in fall of 1875 (Exhibit "D"); M. E. Evans, in fall of 1875 (Exhibit "D").

Some of the witnesses who identify exhibits identify the whole series. Other witnesses besides those named identify one or more of the exhibits as seen by them at times subsequent to the date of Bell's application for his patent. Some of the witnesses who identify one or more of the instruments exhibited to them by Drawbaugh as the Exhibits "F," "B" or "C" saw or used them in 1875 or 1876. Among these are the following, to whose testimony a reference will be made:—

Mr. Springer testifies that he repeatedly talked and listened with Drawbaugh through the instruments after the 1st of April, 1876, using Exhibits "F" and "B" as the instruments. Mr. Musser testifies that he talked through "F" and "B" in June, 1874; but the proofs show that this occasion was as late as in the summer of 1876. Mr. Moore, who is produced to show that Drawbaugh applied to him to acquire an interest in the invention, testifies that the talking machine which Drawbaugh produced was Exhibit "B." This was in May, 1875. Mr. Bayler testifies that he talked through "F" and "B" in 1873; but the proofs show that the occasion was between 1875 and 1877. Mr. Nichols locates the middle of January, 1875, as the time when he saw Exhibit "B" in use.

DRAWBAUGH'S TALKING MACHINES WERE ELECTRIC.

That the talking machines referred to by the witnesses were electric instruments is clearly established. Drawbaugh testifies explicitly that they were always used with a closed circuit, and without breaking the current, some of them being battery telephones and some magneto telephones. He always represented them as actuated by electricity to those to whom he explained or described them, and claimed his invention would supersede the telegraph. His assertions show them to have been electrical instruments.

He stated to the witness Shank "it was the greatest invention ever known. If he had the means to go on with it, they could talk, or rather be a time to come as to talk, to the old country, same as we can talk here." To Zacharias, that "he could run it out for miles, and parties could talk in at one end and be heard at the other end, the same as persons in a room together." To Smith, that "parties between Harrisburg and Philadelphia could communicate as if they were speaking together; there would hardly be any limits;" it was an "instrument to convey the voice, to supply the place of the telegraph;" to Smyser, that it would work "from here to California;" to Fry, that one "can talk as far as the wire goes;" to Carl, that "he could hear a man talk from that place to New Cumberland or Harrisburg, and understand distinctly what he said;" to Sherwick, that it was "better and handier than the telegraph; that you could just talk through it in place of writing;" to Balsley, that "by attaching two wires you can hear it away off; the telegraph is nowhere with it;" to Kahney, that "he could talk the same for miles as he could for a short distance;" to Shettel, that, "if he had a wire from the shop in connection with the telegraph wires at White Hill, he could talk to Mechanicsburg by having a machine there or an instrument in the office; that it would be better than telegraphing, and that it would be worth a great deal of money;" to Reneker, that "he thought he could make it that he could talk through to Harrisburg; he thought they would take the place of telegraphing;" to Weber, that "it beats all the others of my inventions; he could carry sound, or rather talk, as far as Shiremanstown;" to Hawn, that "he would be able to operate that a man preaching in New York, that a congregation in Philadelphia would hear the same sermon;" to Kahney, that "he could just as easy speak ten miles as one, or any distance he would choose to;" to Rupp, who was there with Hamacher, that "it was worked by electricity, would take the place of the telegraph, and that he could make it so that he could talk to San Francisco;" to Musser, that "he was going to make a machine to talk from Harrisburg to Philadelphia, and it would be cheaper and quicker way than telegraphing;" to Smith, that "he believed they could talk for a hundred miles;" to Fettrow, that "I could speak ten, fifteen or twenty miles, or even to California, if there was a wire extended;" to Wisler, that "he could attach a wire to it and talk for ten miles, as far as he could have a circuit around;" to H. F. Drawbaugh, that "he could talk across the continent;" to Free, that "the talking machine could be used to talk at a long distance—from Philadelphia to California;" to Landis, "that it could be used a thousand miles; it would take the place of the telegraph;" to Lenig, that "he could talk hundreds of miles through that;" to Updegraff, that, "instead of using the old mode of telegraphing, he could talk directly through the wire; he thought he could talk as far as you could use the ordinary telegraph wire;" to Draper, that "he thought it was, or would be, one of the greatest inventions of the age, and would take the place of telegraphing;" to A. Evans, that "he could take this machine and talk clear out to Europe, cross the ocean;" to Eicholz, that "if he could only get some one to help him once, he would run it to Harrisburg, and convince them, and then he would run it from Harrisburg to Philadelphia."

He stated to the witness Shank that "it works by electricity;" to Smith, "it was by electricity;" to Nichols, that "the sound was conducted by electricity;" to C. Eberly, that the instruments were "to convey sound by electricity;" to Coudry, that "they were operated by electricity;" to Shoop, that "it operated by a battery;" to Shireman, that "they operated by magnetism;" to Hawn, that "they would be operated on by a battery;" to N. W. Kalmey, that "the machine was operated by electricity, by a battery;" to Zimmerman, that "it was electricity that would pass it over the wires; that it would carry the sound right along;" to Hale, that "it was driven by a magnet;" to H. K. Drawbaugh, that "the sound could be carried to a distance on a wire by the use of electricity;" to Lenig, that "electricity was used in connection with it;" to Prof. Heiges, that "in connection with a talking machine both magnetism and electricity were applied;" to Goodyear, that "his talking machine was also done by electricity over wires;" to Woods, that "it was to be an electric machine used in place of telegraphing;" to Young, that "it was an electric talking machine, which he had invented."

IS DRAWBAUGH'S STORY CREDIBLE?

Thus Drawbaugh is corroborated by a cloud of witnesses whose testimony tends to substantiate his narrative. Without

stopping at this point to consider the credibility and probative force of their testimony, it suffices to state that, although some of the witnesses seem to have been reckless and unscrupulous in their statements, the great body of them are undoubtedly honest witnesses. It is impossible, however, to believe that Drawbaugh can be mistaken in the substance of his testimony, and the conclusion cannot be ignored that either his testimony is true in its essential parts, or his narrative has been manufactured to fit the exigencies of the case. In order to ascertain what effect is to be given to the corroborative proofs, it is important to determine whether Drawbaugh is an honest witness, or whether he has intentionally falsified collateral facts, and is therefore to be deemed discredited.

If the defence is to be believed, he had been experimenting with his talking machine from 1866, and had successfully transmitted speech as early as 1870, if not before that time. He testifies that he had used Exhibits "B" and "F" in transmitting speech for two or three years before he made Exhibit "C." According to the theory of the defendants' Exhibit "C" was made in 1869 or 1870. At that time he had reached a secondary stage in the development of his invention, and certainly as early as in 1872, when Exhibit "C" had received its latest modifications, the invention had passed out of the period of rudimental forms embodying principle merely, into a form embodying nice details of construction, and had reached a perfection not reached by Bell in his earlier patent. Drawbaugh was well aware of the merit and of the great pecuniary value of the invention; he had obtained patents for several inventions of minor value; yet from 1870 until July 1880, he did not apply for a patent for the telephone.

THE STORY OF DRAWBAUGH'S POVERTY DISPROVED.

It was of the first importance to explain the reason of his inaction, because it seems incredible that the inventor of the telephone should not only omit to patent it as soon as he could, but should also remain silent for years after others were winning the fame and profits of the invention. Only one explanation was possible, and that has been attempted. As stated in the answer, and in his testimony, it is that he was unable to do so by reason of his poverty. The answer alleges "that for more than ten years prior to 1880 he was miserably poor, and utterly unable to patent his invention or caveat it. He was asked the question: "Do you mean to have it understood from your last answer that there was any other reason for some period prior to 1870, except your poverty, whether greater or less, which prevented you from patenting your invention, or filing a caveat for it?" His answer was: "If I understood that right there was no other reason that I can think of now." He proceeds to state that Exhibits "F" and "B" exhibited the principle perfectly enough to patent.

In the elaborate efforts of the defendants to substantiate the theory of Drawbaugh's inability from poverty to patent his invention much testimony has been produced to show, and which does show, that he was always more or less in debt, often a borrower of small sums of money, was dilatory in paying his debts, and used to plead his inability when dunned, and was often sued and judgments and executions were obtained against him; but it is clear from a few plain facts that the theory of extreme poverty is unfounded, and that Drawbaugh is dishonest in putting it forward. In 1867 and 1869, besides what he received for his wages, he received $5,000 from the Pump Company for his faucet invention, besides $1,000 in the stock of the concern. On the first day of April, 1869, he received $1,000 from one Gardner, for the sale of a half interest in a faucet invention. He invested $2,000 of the $5,000 in real estate, lost $400 of it in an apple speculation, and used the $1,000 received from Gardner to buy a house and lot for his father. Between 1867 and 1873 he paid $1,200 to the Drawbaugh Manufacturing Company for assessments on his stock, besides $870 in labor; and in July, 1873, received from that company $425 cash in settlement of its affairs.

From 1867 to April, 1872, he was the owner of real estate, for which he had paid $2,300 in the fall of 1867, and upon which he expended in improvements, in the spring of 1868, from $300 to $400, and which was encumbered only by a prior lien for $300. In the spring of 1872, he encumbered it for $1,000, not as a principal, but as a surety. He was in receipt of $110 annually, as rent, for a part of this property, occupying the rest himself, until he sold it in 1876, and bought another house in the town of Mechanicsville. He was always in receipt of fair wages for his labor.

From April 1, 1875, to April 1, 1876, he received nearly $450 for wages from the Axle Company, irrespective of his earnings from other sources, and declined steady work at times, because he could make more by job work. Thus it appears, that although at times it was not convenient for him to pay his debts, or he was careless or indifferent, he had not only the means of raising money during all this period, but that on many occasions he had means for investment and for speculation. The pretence that he could not raise the fees to caveat or patent his invention is transparently absurd.

He was accustomed to prepare specifications of patents, and was a maker of models, and advertised himself as an inventor, designer, and solicitor of patents. During the time he was experimenting on his talking machine, and before he applied for a patent, he found time and materials for experimenting with and making the Giffard injector for steam engines, the autograph telegraph, the magneto dial telegraph, the magneto key, the automatic fire alarm, and the electric clock. During this period he was a friend of Mr. Weaver, a patent solicitor, who frequently gave him advice and professional assistance, in return for mechanical services rendered by Drawbaugh, and who drew specifications for him for a measuring faucet and for the magnetic clock. If he was not competent himself to make an application for the patent, it cannot be doubted that, with the assistance of Weaver, he could have made a proper application at a trifling outlay, if any, beyond the fees of the office.

Drawbaugh devoted a good deal of time between 1867 and 1878 to the invention and construction of his electric clock; and the time and money expended by him in experimenting and constructing this clock in its various forms, especially those made in 1877-1878, was much more than would have enabled him to patent his talking machine. These clocks were built by him with his own tools and out of his own money, and to build them economically he made a gear-cutting machine, which must have cost him more than it would to patent his telephone. In April, 1878, he received $500 from the Electric Clock Company for the privilege of using his clock invention.

DEFENDANT'S TESTIMONY ON THIS POINT EXAMINED.

In order to fortify the theory of Drawbaugh's inability from poverty, to patent his invention, the defendants have attempted, by testimony from him and from others, to show that he was extremely solicitous to patent it, and tried to induce others to furnish the means. Mr. Springer testifies that "his (Drawbaugh's) whole mind appeared to be on his talking machine. He told me that many a night he didn't sleep, just studying how to improve it." After May, 1872, according to the testimony of Jacob Hawn, the talking machine superseded the clock in Drawbaugh's interest. According to Mr. Holsinger, from 1873 to 1876 "he appeared to be crazy on it. I often tried to get information from him on other subjects, and about half a minute's talk would turn him right on the talking machine."

Henry F. Drawbaugh, his brother, testifies: "Every time I was down there, from the summer of 1872 to 1879 or 1880, he was working at it, and talking, and wanted me to go in with him and furnish means." Mr. Bates says he "was in Drawbaugh's shop eight or ten times between the summer of 1874 and the fall of 1877, and "his general conversation was about the talking machine; said he would like to get it patented, but had not the means, and could make a fortune out of it." Drawbaugh testifies as follows: "Question. A good many witnesses have testified that you were at various times talking of patenting your electric-speaking telephone invention; what is your recollection about that? Did you intend to patent it or not? Answer. Yes, sir; I intended to patent it. I had spoken to a number of persons to assist me. I would state to them that I would give them an interest in the invention for them to furnish the money to have it patented. Question. Why did you not patent it with your own money? Answer. I didn't have any money. Question. At how early a time did you have the intention of patenting it? Answer. I could hardly say how early. I spoke to persons even at an early time. I spoke to Christian Eberly. It may have been prior to 1870, I spoke to Frank Lee. I spoke to them about taking an interest. They were among the earliest. I can't remember all the persons, as I had spoken to a great many. Lee is not a witness, having died in 1872."

Christian Eberly locates the time as between 1867 and 1870. He had been a partner with Drawbaugh in a number of inventions, and was a capitalist. He was asked, "When Mr. Drawbaugh showed you his talking machine, state whether he proposed to you to go into partnership with him, and furnish the money for that also, as you had before that time on the other inventions?" He answered: "Not altogether; he intimated that he would take me in. I don't recollect as I said anything, or what I said." The witness was often in Drawbaugh's shop subsequently, in 1871, 1872, and 1873, but mentions no other proposition."

The only other persons Drawbaugh specifies as having been applied to by him are Capt. Moore, Henry Bayler, and Simon Oyster. Oyster was not called as a witness. Capt. Moore was examined as a witness for the defendants, and his testimony is significant. He was the principal of the Soldier's Orphan School, an institution in the vicinity of Eberly's Mills, and was the secretary and treasurer of the Axle Company, a concern that in part occupied Drawbaugh's shop in 1875 and 1876. He testifies that about May, 1875, Drawbaugh showed him a talking machine; said he was unable to patent it himself, and desired witness to "go in with him and get a patent." He states that he told Drawbaugh he didn't want to go into any new inventions, but that it would be a fortune to any person bringing it out, if it could be put to practical use. He identifies "Exhibit B" as the only machine shown him at that time by Drawbaugh.

Although he and Drawbaugh maintained intimate business relations for a year after that time, the subject seems never to have been referred to again. Mr. Moore was an intelligent capitalist. It is strange that Drawbaugh should have shown him "Exhibit B," one-half of the crude instrument of 1867-1869, if the perfect instruments "E" and "D" were in existence; and more strange that the subject was never mentioned again between them, or that no attempt was made to speak through any machine, if they had any faith in the value of the invention.

Mr. Bayler, the other witness, carried on lumbering and a saw mill from 1873 to 1877, in the vicinity of Milltown, and employed Drawbaugh frequently to repair machinery. He testifies that in June, 1873, Drawbaugh showed him the talking machine, and he said to Drawbaugh, "Why, Dan, that is virtually a talking telegraph," and advised him to take out a patent for it; to which Drawbaugh replied, "If I had the means, I would. If you'll advance me the means to procure a patent, I'll give you a half interest." The witness continues: "Generally on him meeting me he would urge it, urge me to take an interest by furnishing him the means to take out a patent." He also identifies Exhibits "F" and "B" as the instruments shown him by Drawbaugh. But his books show that during all the time from April, 1873, to May, 1876, he owed Drawbaugh more than the fees necessary for procuring a patent.

The defendants produce other witnesses to prove that from 1870 to 1879 Drawbaugh was showing his telephone, adverting to his property, and trying to induce somebody to assist him. Mr. Herr may be cited as an illustration. He testified that in 1870 or 1871 Drawbaugh wanted money to get a caveat to secure his invention, and told the witness if he would help him, or procure any person to assist him, he would give him a half interest. Without adverting further to the testimony on this subject, it is sufficient to say, in view of the fact that there never was a time from 1867 to 1880 when Drawbaugh did not have the money to caveat and patent his invention or the means of borrowing it, that the only legitimate effect of such testimony is to discredit the whole defence by exciting the suspicion that it is bolstered up by exaggerated and unreliable testimony.

It will hereafter be shown that among the men with whom Drawbaugh maintained business and friendly relations during this period, there were many of intelligence and means. Some of them may have distrusted his judgment, and regarded him as a visionary. Some of them may have been indifferent or timid. But it is incredible that when only a trifling sum was required for a half interest in the invention, none of them could be sufficiently impressed with its merit or financial value, to investigate it seriously as a speculation or an investment. He induced persons to invest in faucet inventions, and in his magnetic clock; and it cannot be true that he could find no one to entertain the talking machine, which, according to the common rumor of the neighborhood, was to supersede the telegraph, and, in the words of one of the witnesses, "make Drawbaugh the richest man in the Cumberland Valley."

It was very natural that a hard-headed old farmer like William Darr, on being told by Drawbaugh that he had a machine by which he could talk across the Atlantic Ocean, should advise him to "try it first in talking across the Yellow Breeches Creek," but it is beyond comprehension or belief that none of the capitalists or speculators about him could be induced to seriously consider it, if it was an operative device.

DRAWBAUGH'S VERACITY IMPEACHED.

Where a witness falsifies a fact in respect to which he cannot be presumed liable to mistake, Courts are bound "upon principles of law, morality, and justice to apply the maxim *falsus in uno falsus in omnibus*." (The Trindad, 7 Wheat. 283.) Drawbaugh could not be mistaken in asserting that it was his poverty which prevented him from caveating or patenting his invention. He was not led to the assertion inadvertently. Those with whom he is associated in the defence understood fully, and so did he, that the fact that a professional inventor and patentee did not go to the Patent Office to secure an invention like the telephone for ten years after it had been completed and demonstrated, was almost conclusive against the theory that he had made the invention; and that unless this presumption could be parried, no Court would credit his story. The theory of constraining poverty was therefore formulated in the answer, elaborately fortified by witnesses, and testified to by Drawbaugh. It is overthrown by a few plain, indisputable facts, and Drawbaugh's veracity falls with it.

TESTIMONY OF CORROBORATIVE WITNESSES CONSIDERED.

The defence must rest upon the testimony of the witnesses who corroborate Drawbaugh. The case made by these witnesses is sufficiently formidable to overcome the legal presumption of the validity of the complainants' patents. It is met by the complainant with rebutting evidence direct and circumstantial, showing the intrinsic improbability of the theory that Drawbaugh was the inventor of the telephone, and showing his conduct or declarations inconsistent with any hypothesis that he was more than an unsuccessful experimenter with the invention. Many witnesses have also been produced by the complainant to attack the credibility and reliability of the testimony of the defendants' witnesses. Of necessity the testimony of most of the defendants' witnesses can only be attacked by showing that the witnesses are mistaken as to the time when they saw Drawbaugh's talking machine, or as to what they really saw on the occasions they refer to.

The way in which the testimony of Uriah P. Nichols is met will illustrate the general tenor of such testimony. Mr. Nichols was one of the most intelligent and trustworthy of the defendants' witnesses, a farmer and machinist, who testified that on the 18th day of January, 1875, he visited Drawbaugh's shop on business, saw two instruments, which he identified as Exhibits "B" and "A," and he described their mode of operation as stated to him by Drawbaugh at the time. He says he listened at one instrument while a boy spoke into another 200 feet away, connected by wires, and heard the boy say: "Is it you, father, speaking?" The complainant produces nine witnesses to show that the occasion could not have been prior to February, 1878. The witness fixes the date by a purchase of lime made by him on the visit, and states that he went to Drawbaugh's to see an electric clock of which he had recently read a description in a newspaper, and soon after the visit told Mr. Maish and others about the telephone he had seen at Drawbaugh's.

The complainant proves that the newspaper article was not published until February, 1878; that when the witness told Mr. Maish of the telephone at Drawbaugh's, the latter, who was then a member of Congress, remembered the occasion, knew all about Bell's telephone at the time, and had used it in Washington. Mr. Maish states that, as Drawbaugh was one of his constituents, he would have been deeply impressed by the conversation if he had understood Drawbaugh claimed to be the inventor. Without attempting to particularize the rest of the testimony for the complainant upon this issue, it suffices to say that several other witnesses were introduced to show that the lime was not purchased by Nichols before 1876. Much testimony is given by complainant upon collateral issues of a similar character.

One of these issues relates to the time when Thomas Draper ordered a hydraulic ram of Drawbaugh. Mr. Draper was an important witness for the defendants. He testified that he went with Mr. Kissinger, a tenant of his, to Drawbaugh's shop in May or the early summer of 1874, for the purpose of ordering of Drawbaugh a hydraulic ram to be used upon the farm Kissinger had leased of him in April, and that he was never at Drawbaugh's on any other occasion. He identified Exhibit "C" positively, and Exhibit "I" less positively, as the instruments used and through which he listened while Drawbaugh talked.

The complainant proved that the hydraulic ram was not put to use until the fall of 1878, and undertook to locate the date of Draper's visit approximately by that fact. Seventy-five witnesses were introduced by the respective parties upon this collateral issue. These illustrations show how hopeless a task it would be to review the testimony satisfactorily or analyze it minutely. Five hundred witnesses have been examined by the parties upon the main question and the collateral issues, and their testimony is in a printed record of over six thousand pages. If it were practicable to do so, it would not be profitable, because a microscopic view of the controversy would be inadequate and misleading.

LEADING FACTS IN THE CASE MUST GOVERN.

In cases where such a chaos of oral testimony exists, it is usually found that the judgment is convinced by a few leading facts and *indicia*, outlined so clearly that they cannot be obscured by prevarication or the aberrations of memory. Such facts and *indicia* are found here, and they are so persuasive and cogent that the testimony of a myriad of witnesses cannot prevail against them.

The first group of facts of this nature are those which bear upon the capacity and character of Drawbaugh as an inventor, and tend to show that it is not only highly improbable, but almost impossible, that he could have been the author of the telephone.

AUTOBIOGRAPHY OF DRAWBAUGH.

In the summer of 1878 he composed a biography of himself for publication in the history of Cumberland County, which presents a graphic picture of the inventor and of the man. He commences by describing himself as "born in the quiet, secluded village of Milltown, three miles from Harrisburg," and as "one of the greatest inventive geniuses of this age, who has spent the greater part of an active life conceiving and producing, as the result of the conceptions of an unusually fertile brain, a score of useful, ingenious machines and devices. It appears," he says, "by examining a list of his inventions, that the manufacturing interests of the place in his boyhood days gave direction to his thoughts and incentive to his actions." He proceeds to enumerate a list of his inventions as follows: "His first invention was

an automatic sawing machine; then a number of machines used in wagon making; then a machine for boring spoke tenets; then a machine for sawing tenets; a barrel stave jointing machine, patented in 1851 This machine was pretty generally introduced, and its merits appreciated; an automatic grinding machine was next invented to meet a demand created by the introduction of the jointer; then followed several machines for making stave headings and shingles, all of which were patented in 1855; after which, machines for rounding, heading, crozing, dressing and finishing outside of barrels were invented; these were again followed by device for running mill-stones; one for dressing mill-stones; a device for elevating grain in mills. He then invented and had patented four improvements in nail plate feeding; next a tack machine, and a new design in tacks. Photography next engaged his attention. He fitted himself for action in this field by manufacturing his own camera, ground and fitted aeromatic lenses for camera, prepared the necessary chemicals, and improved the process for enlarging pictures. Next electricity and electrical machinery attracted his attention, and an electric machine was produced throwing out of consideration the galvanic battery and electric pile; then a machine for alphabetical telegraphing; then the justly celebrated electric clock, and the machinery necessary for its construction; and several kinds of telephones, one of which is operated by battery, and another by induction." He concludes as follows: "It will be seen from the foregoing that Mr. Drawbaugh has penetrated vast fields in search of information, and with what success we leave it to the readers to determine. We are proud to own Mr. D. as a citizen of our township, and deem him worthy of a position at the head of the list of our prominent men, and are happy to accord him that position." This portrait, drawn by himself, depicts without the aid of extrinsic evidence, the ignorance and vanity of the man, and incongruous and fantastic assortment of his inventive projects. It suggests, also, the character of a charlatan.

DRAWBAUGH NOT AN INVENTOR IN THE LARGE SENSE.

That he was a skilful and ingenious mechanic is undoubtedly true. Invention was his hobby and his vocation, but that he was an inventor in the large sense is disproved by the nature and results of his work. Every patent that he obtained was for some improvement on existing devices which involved mechanical skill rather than any high degree of inventive faculty. This is shown to some extent on the face of his patents, the list of which is as follows:

Nov. 11, 1851, "for improvement in stave jointing machines;" May 22, 1855, "for stave machines;" April 28, 1864, "for improvement in mill stones;" May 12, 1863, "for improved machine for leveling the faces of mill stones;" Dec. 12, 1865, "for improvement in nail plate feeders;" Nov. 20, 1866, "for improvement in faucets;" Nov. 19, 1867, "for improvement in nail feeding device."

His own testimony, given in an interference proceeding in the Patent Office in 1879, shows that none of his inventions were sufficiently meritorious to prosper vigorously. That proceeding involved a question of priority of invention between himself and one Hauck, respecting an improvement in a faucet. He had filed his application for a patent in January, 1879, and undertook to carry back the date of his invention to 1869. The scope and range of his inventive faculty became a subject of inquiry. He there testified that he had made "he might say fifty inventions, and had patented over a dozen." He was cross-examined respecting certain inventions to show that they did not work satisfactorily. He was then asked: "Since 1866 what machines have you conceived and perfected that have worked satisfactorily?" He answered: "To the best of my knowledge, I think they all have. The nail machine gave satisfaction. I had it running in the works, but the nailers drove it out. The tram and red staff was a good machine, and adopted by a number of millers. The magnetic clock I consider a good thing, but I am not through with experiments on it yet. I believe this last faucet to be a good thing."

If his nail machine had induced the workmen to drive it out of the shop, it ought to have commended itself to the capitalist. His magnetic clock had not been patented at this time, though it had been for a time the wonder and admiration of the community in which he lived; but when it was patented, in 1870, it was as a "new article of manufacture," consisting of a galvanic battery for electrical clocks, which had two old elements united instead of being disconnected as in former devices. The history of this clock shows clearly that it was of no practical merit; and the clock had been substantially described in Tomlinson's Encyclopedia, and he had the book before he made his alleged invention. His other electrical devices he never patented, and in his testimony in the interference proceedings he did not refer to them as among his perfected and successful inventions. One of these was his magneto-electric machine for short line telegraphing and fire alarms, sometimes mentioned as his "magneto key." It was not a new device, and the proofs show that it was a failure.

CHARACTER OF THE TELEPHONE INVENTION.

When the speaking telephone was first introduced to the attention of the scientific public, it was pronounced by one of the most eminent electricians of the day "a result of transcendant scientific interest,' and "the greatest by far of all the marvels of the electric telegraph." The inventions attributed to Drawbaugh include not only the conception of the principle of the unbroken, undulatory electric current, and of the delicate and complex instrumentalities essential to its efficient application in transmitting and reproducing articulate speech, but also of many other devices involving a nice adjustment of forces, and requiring sensitive mechanism. These were inventions of a peculiarly scientific order, which would seem to demand a special conversance with the principles of acoustics and electricity. Besides making the cardinal discovery of the theory of the unbroken, undulatory current, Drawbaugh is assumed to have perfected a brilliant and extraordinary series of original discoveries, for which, to use the words of Mr. Benjamin, "there is no parallel instance in the whole history of invention." Mr. Benjamin, referring to the microphone, which was introduced to the public in 1878 by Mr. Blake. but which is one of the instruments asserted to have been invented by Drawbaugh at an earlier date, says: "It was looked upon as a great and original discovery."

THE LABORS OF BELL AND DRAWBAUGH CONTRASTED.

It was said by Chief Justice Taney (O'Reilly v. Morse, 15 How., 111), speaking of the invention of the telegraph: "No invention can possibly be made consisting of a combination of different elements of power without a thorough knowledge of the property of each, and the mode in which they operate on each other. For no man ever made such an invention without having first obtained this information, unless it was discovered by some fortunate accident." None of Drawbaugh's alleged discoveries were made by accident His statement is that starting with the belief that speech could be transmitted by electricity, he made first one contrivance and then another, gradually obviating difficulties and making advances experimentally, until he finally perfected the several inventions.

In view of Bell's special equipment for investigation and experiment in electrical and acoustic science, it would not seem strange that his persistent efforts to effect the electrical transmission of speech were eventually successful, were it not that others as intelligent, as well equipped, as ingenious, and as persevering as he, had devoted years to the same object in vain. He had the assistance of Mr. Watson, an expert in electricity and a skilled workman in electrical mechanism, in constructing the apparatus employed in his experiments. and who also aided him in his experiments. He had demonstrated his inventive proficiency by inventions in telegraphy, for which patents were granted to him. And yet, had it not been for an accidental discovery made by him in June, 1875, and which would probably have escaped one whose trained faculties were not centered on a careful study of the phenomena, he might have failed.

Drawbaugh, on the other hand, was not only untutored, but he was isolated by his associations and occupations from contact with men of advanced science; he had narrow opportunities for instruction, and few incentives for profound research. Among the multitude of his inventive conceptions was one that a talking machine was a possibility. According to the testimony of Lory, a witness for defendants, before Drawbaugh began his practical experiments, he exhibited a sketch of a machine that he was about to make that would talk a distance of twenty miles, and work something like a telegraph. If this is true, he commenced on his telephone as the architect plans a building, or the engineer makes a draught of his structure. His own testimony shows that he did not attempt to qualify himself for electrical inventions by any systematic study after he began experimenting with his talking machine. Although he had undoubtedly acquired considerable desultory information about electricity, and especially about the mode of operation and detail of construction of electrical mechanism, it is obvious that when he commenced with his talking machine he was a tyro in electrical science, essaying the most difficult work of the electrician. It is almost incredible that the subtle intellectual discoveries, which were a closed book to the ablest electrician, could have been reached by a smatterer in science, or by any series of empirical experiments.

MENTAL DEVELOPMENT OF INVENTION UNACCOUNTED FOR.

As has been remarked, he seems to have discovered nothing accidentally; yet, from the beginning to the end of his narrative, there is nothing to indicate the conceptive origin or the mental growth of the alleged invention. He presents a number of devices in the chronological order of their production, and testifies that he made one and then another and another, as experiments led him to modifications and improvements. He cannot describe what receiver or other apparatus he used with his first transmitter, and testifies: "I had a number of crude apparatuses, but can't remember exactly the shape of any of them. I had membranes stretched over hoops—over a hoop—I remember that; and I had electro magnets, and the arrangement was varied; I don't remember exactly the arrangement."

He testifies that when he used the cup machine he used it in a continuous electric circuit, and thinks he used it as a receiver with Exhibit "B" as a transmitter. He states that he succeeded in transmitting speech with these two instruments, and, of course, he could only have done this by employing the unbroken undulatory current of electricity. He cannot state how he conceived the initial idea of the undulatory current and the continuous circuit, or subsequently the theory of any of the remarkable devices which he produces. His answers to questions intended to elicit such information may be illustrated by giving one of them: "I don't remember how I came to it; I had been experimenting in that direction; I don't remember of getting at it by accident either; I don't remember of any one telling me of it; I don't suppose any one told me.' He produces sketches, or models, or originals of instruments, which he says he made from time to time; he states that they were used to talk through on various occasions; and from these outlines of accomplished facts, leaves the history of his inventions to be filled out by inference and conjecture. An inventor can hardly forget the process of thought by which a great intellectual conception germinates and matures into the consummate achievement; but Drawbaugh's memory is a blank. If the untutored mechanic educated himself into an accomplished electrician by his own experiments and observations, the incidents and phenomena which revealed new discoveries and illumined the way for new advances would be indelibly impressed upon his mind. It seems a little short of the miraculous that a man of his capacity and equipment should have produced these inventions at all; more marvelous still that he should have produced them without any intellectual perception of his discoveries.

DRAWBAUGH'S STORY DISPROVED BY HIS OWN CONDUCT.

Another group of important facts, which are satisfactorily shown by the proofs, are those which indicate Drawbaugh's own knowledge that he was not an original inventor of the telephone. Reference has been made to some of the evidence bearing upon his neglect to patent or caveat his invention, in discussing the question of his credibility as a witness.

If no honest and reasonable explanation can be given for his conduct, the inference is very strong that he knew he did not have a practical telephone to patent. He may have had a talking machine, which was well calculated to excite the curiosity of the community in which he lived; he may have indulged in expectations that in time he could succeed in making a practical speaking telephone and reap fame and profit from it; but his conduct is almost decisive against the supposition that he had even deluded himself with the belief that he had produced anything sufficiently practical and valuable to patent. He never attempted to exhibit it outside of his own shop to prove that it would transmit speech at a distance of even a quarter of a mile. The proofs show that during all the years, from 1867 to 1878, he did not attempt to avail himself of opportunities for demonstrating his invention and bringing it to the notice of friends who were peculiarly qualified to appreciate, and were favorably circumstanced to assist him. One of these persons was a Mr. Kiefer, who resided at Harrisburg, from 1868 to 1881, and during that period had charge of the telegraphs of the Pennsylvania Railroad Company, and was a member of a firm whose business was the manufacturing of fine electrical machinery.

In 1878 he put up a fire-alarm system for that city. Drawbaugh made his acquaintance in 1874 or 1875, and brought his magnetic fire alarm to Mr. Kiefer for examination. At another time, he brought the works of his electric clock. He visited Mr. Kiefer on various occasions, obtained small supplies from him, and habitually conversed with him upon the subject of his electrical contrivances. The period of these visits begins just about the time when, according to the theory of the defendants, Drawbaugh had constructed Exhibits "E" and "D," and the invention was complete. He never mentioned to Mr. Kiefer the fact that he had experimented with a telephone. Mr. Wilson was superintendent of telegraphs for the Northern Central Railway Company, at Harrisburg, from 1864 to 1875. He was also mayor of Harrisburg. The company had an electrical workshop and supply establishment there for Mr. Wilson's department between 1871 and 1875. During this time Drawbaugh often came to the supply shop, and talked with Mr. Wilson about electrical experiments, and obtained parts of batteries, coils, magnets and other electrical material which the company had cast aside. He brought Mr. Wilson his electric clock and his magneto-electric key, and tried his machine for short line telegraphing at Mr. Wilson's office. He talked with him frequently about his inventions: but he never mentioned the telephone. His relations with David A. Houck were such that the latter procured him an opportunity to test his magneto key at the telegraph office of the railroad company at Mechanicsburg. Mr. Stees was the superintendent of a car company at Harrisburg, having shops in different parts of the city connected by telegraph lines. He was the first person to employ Bell's telephone on these lines, when they were introduced into Harrisburg late in 1877 or early in 1878. He was a friend of Drawbaugh, and Drawbaugh would naturally have applied to him if he wanted to test his telephone publicly and practically.

Isaac Lloyd was a school teacher and an alderman at Harrisburg; had known Drawbaugh long; was accustomed to visit his shop from time to time; saw many of Drawbaugh's inventions; was present on one occasion when Drawbaugh experimented with his magneto device for telegraphing at Mr. Wilson's telegraph office. Drawbaugh visited him frequently, and they were accustomed to converse about Drawbaugh's inventions. Drawbaugh showed him his dial telegraph, his electric fire alarm apparatus, and numerous other inventions. Witness assisted him about the electric clock. He was an owner of patents and a friend to whom Drawbaugh applied for loans, and was interested in mechanical subjects generally. The only mention ever made to him by Drawbaugh about a telephone was in 1878, when Drawbaugh told him he was experimenting with a telephone. From 1867, to July 1873, Drawbaugh was intimately connected with the persons composing the Drawbaugh Manufacturing Company, which was engaged in manufacturing devices under Drawbaugh's patents. He was a stockholder and the master mechanic of this company. Among the officers and stockholders were many men of capital and enterprise. There came a time when the managers of this company wanted Drawbaugh to suggest new devices for the company to manufacture. He never suggested the telephone nor attempted to induce the managers of that company to investigate or exhibit his talking machine. A number of the managers and employees of this concern testify that they never heard of the existence of the talking machine during the life of the company. Without attempting to refer to other testimony to the same general effect, what has already been referred to, shows that if Drawbaugh had seriously desired to bring his talking machine into public notice and secure the fruits of his invention, he had ample opportunity to do so. Who can doubt that if he had a practical telephone to exhibit, he would have selected just such men as Kiefer, Wilson, and the others to demonstrate it to them, and enlist them to demonstrate its utility and value to the public?

Such an invention was of a kind well calculated to excite public interest and to impress practical men with a quick appreciation of its commercial importance and its pecuniary value. It was so sufficiently perfected, according to the theory of the defence, that a patent could have been obtained prior to 1870, to secure the application of the principle and to compel every subsequent inventor to pay tribute to the discoverer of a new art. For years it was mechanically perfect, and its efficiency and importance as a great factor in human intercourse could have been demonstrated to the public without appreciable inconvenience or expense. Drawbaugh fully appreciated its importance and value. He had the means to patent it himself, and friends to assist him in introducing it into public use. He had the talent to induce others to invest in his inventions. No explanation is possible why, under such circumstances, his efforts should have left no mark upon the annals of inventive progress, and given no evidence of life beyond the idle curiosity his talking machine excited in the circle of his admirers during all these years. His conduct is more persuasive to show that he did not have a practical, operative telephone, than the testimony of a multitude of witnesses who may have seen and heard talking machines at his shop during this period. But the complainant has given evidence of his declarations, made by him, before he had any interest to pervert the truth, which afford a reasonable explanation of his conduct, and go far to explain how the testimony of the corroborative witnesses may be reconciled with the truth.

In 1874-6 Drawbaugh issued a business card, advertising himself as "Inventor, designer, and solicitor of patents." On the back of this card is printed a list of his inventions, as follows: "Stave heading and shingle cutter; barrel machinery; stave "jointing machine; tram and red staff for levelling face of mill "stones; rine and driver for running mill stone; nail machinery "for feeding nail plates; pumps, rotary and others; hydraulic "ram; the Drawbaugh rotary measuring faucet; carpet rag "looper; electric clock and magneto-electric machine for short-"line telegraphing and fire alarm, and propelling electric clocks." He takes pains to say of this magneto machine on his card that it "can be applied to any form of electric movement, and dispenses with a galvanic battery." He had obtained patents for some of these inventions, but had not for others. He was then experimenting with his electric clock, and with his magneto-machine for short-line telegraphing, fire alarms, etc., and included them in the list of his inventions. The omission to mention the most important one of all his inventions, one respecting which, according to his present testimony, there had not been a week from the time he made his first cup machine that he had not been engaged with it, one which was complete before his electric clock was complete, is a significant statement by implication that he had no such invention to advertise.

It is to be remembered that when he chronicled his achievements in the autobiographical sketch of 1878, the Bell telephone had been introduced into commercial use at Harrisburg, three miles from Drawbaugh's shop and the local newspapers had been full of the subject. The cursory allusion in that autobiography to "several kinds of telephones," is in striking contrast with the elaborate description of the electric clock, and wholly inconsistent with the theory that he deemed himself to be the originator of the telephone which, at that particular time, was a topic of universal interest.

In his testimony given in 1879, in the interference proceeding with Hauck, although he did not include the talking machine in the category of his successful inventions in the course of his testimony, he produced a sketch of his faucet, and stated that he made it "about 1874 to 1876, when I was experimenting on telephones or phonographs." He represented himself not as an inventor of that which he is now claimed to have perfected, but as an experimenter with a "telephone or phonograph." It is instructive to read this statement in juxtaposition with a statement made by him to Mr. Matthews in the preceding year. Mr. Matthews was the managing editor of the *Baltimore American*, and in April, 1878, made a visit to Drawbaugh at his shop to see Drawbaugh's magnetic clock, in consequence of information received from a correspondent. He was a careful observer, who went there obviously for the purpose of writing an article for his paper. That his memory is unusually retentive and accurate, and that he is a careful and conscientious man, is apparent from a letter written by him in December, 1883, after the proofs in the case had been closed, and in which he manifests a desire to correct certain errors of detail in his deposition. Upon that visit his attention was chiefly directed to the clock, but he examined Drawbaugh's other inventions, and conversed with him about them; and, among other things, conversed about the telephone. Drawbaugh's statement to him on that occasion was, that he had invented apparatus to send messages by means of an alphabet founded upon difference of sounds. He did not profess to be the inventor of the speaking telephone, or assert that he had ever transmitted speech successfully with his apparatus. He said that the idea of transmitting sounds in this manner was not new, and that he had read of it some years before in a publication translated from the French; and he denied Bell's right to claim the invention of the telephone, because of that publication.

In the article founded on that interview which Mr. Matthews subsequently wrote for publication in the *Baltimore American*, he adverts to the several useful agricultural, and mechanical devices patented by Drawbaugh, and adds: "It may be mentioned that Mr. Drawbaugh constructed a rude telephone long before Mr. Edison loomed up as the 'boss' inventor. He never expected to send articulate sounds over a magnetized wire, but he believed that an alphabet could be arranged after the manner of the musical scale, and that messages could be transmitted and understood by the variations of tone and pitch. This unlettered mechanic came very near anticipating Edison and Bell in the invention of the telephone, and nothing but his poverty prevented him from conducting his experiments to a successful issue."

His advertising card, his testimony before the Patent Office, his autobiography, and his statement to Matthews, authenticated in writing, were all made when he had no pecuniary interest to color the facts, and upon occasions when he was anxious to present himself in the most favorable light as an inventor; and they were all made after his talking machine, according to the theory of the defendants, was a perfect invention and known to be such by many of his friends and neighbors.

These are declarations evidenced in writing, and one of them made under oath, which point in but one direction. They are consistent with his conduct. They show that he understood himself to be an experimenter with telephones or phonographs, but not the inventor of the speaking telephone.

EVIDENCE OF COMPLAINANT'S WITNESSES CONSIDERED.

The complainant has supplemented this evidence by the testimony of other substantial witnesses who had favorable opportunities to know what Drawbaugh had invented, and who describe what they saw and did not see at his shop, and narrate what he said about his talking machines on various occasions. This testimony indicates that, at as late a period as in 1878-9, Drawbaugh was an experimenter, but not the author of the parent invention, nor one who had perfected any valuable improvement upon it; and is in substantial accord with his statement to Mr. Matthews and his testimony in the interference proceedings. What gives point and force to this testimony and parries the ordinary objections to the reliability of verbal declarations, is that these witnesses are persons who would have been forcibly impressed, because of their interest in the particular subject, by any assertion by Drawbaugh that he was an inventor of the telephone. During the time in question Drawbaugh had friendly relations with the newspapers of the vicinity; his friends were frequently communicating laudatory notices of his mechanical and inventive efforts to the press; and he himself visited one of the newspaper offices in the spring of 1878, to show a telephone he had made. These newspapers had published articles about the Bell telephone; but up to the spring of 1878, while many notices had been published in them about his electric clock and other inventions, describing him as a man of extraordinary genius, there had been no mention of the telephone; and when, in the spring of 1878, the subject was mentioned, he was referred to as one who was "inventing a telephone on a different plan from that now occupying the attention of the scientists," and as about completing "the new telephone he is now constructing."

In this connection it is to be noted that soon after telephones were introduced in Harrisburg, late in 1877, or early in 1878, Drawbaugh visited the offices where they were used, examined the inside of the instruments, and borrowed one to take home, which he kept for several days; and the instrument which he borrowed bears a close resemblance in appearance to Exhibit "A," which it is asserted he had made in 1873 or 1874.

No extended reference will be made to the testimony of other witnesses, such as Mr. Weaver and Mr. Grissinger, showing declarations of Drawbaugh made after the Bell Telephone was in commercial use to the effect that, although he had experimented on the telephone years before Bell, he had obtained no satisfactory results.

EFFECT OF TESTIMONY FOR DEFENCE DISCUSSED.

It remains to consider what effect is to be given to the testimony of the multitude of witnesses who have been produced to substantiate the defense. Disregarding the testimony which is merely hearsay, and therefore incompetent as evidence of the main fact, the testimony of many other witnesses is overthrown by the palpable improbability of their statements, or by the contradictions between their statements and those of other witnesses for the defendants upon substantiative points, or by successful attacks upon their accuracy in the rebutting testimony of the complainant.

There still remains a formidable number of witnesses who testify to seeing or using Drawbaugh's talking machine, and some of whom identify particular exhibits as the instruments which they saw or tried.

No doubt is entertained that Drawbaugh was experimenting at an early period with telephones or phonographs. He knew about the phonographs or phonautograph of Scott as early as in 1863. The membrane diaphragm excited by sonorous waves, and the mechanism of the phonograph were not novelties, and, among the diversity of inventive possibilities had probably attracted his interest. Prior to the issue of Bell's patent, Dr. Van DeWeyde had made public experiments with the Reis telephone at the City of New York, and others had made like experiments elsewhere. In May, 1869, a full description of the instrument and of the experiments was published in the newspaper, "*The Manufacturer and Builder*," treating it as a highly interesting curiosity, which contained the germ of great practical purposes. Whether other newspapers noticed the experiments or not is not shown, nor is it shown that Drawbaugh saw the article in "*The Manufacturer and Builder*." It would be difficult to prove the circumstances if he did see it. Some such publication probably stimulated him to experiment. If he made a sketch of the mechanism at the start the material for it was at hand. As is stated by Mr. Benjamin, it has been asserted of the Reis instrument, that certain sounds of the human voice can be transmitted by it, but in truth these are merely fragmentary reproductions of vocal sounds, and the transmission of articulate speech could not be effected because it was constructed on the make and break principle, instead of on that of the undulatory unbroken current.

It is not strange to any reader of the autobiography that Drawbaugh should have taken up the telephone. That he and those about him should have treated it as a talking machine is entirely natural. That his talking machine as late as in 1876 bore a striking resemblance to the Reis telephone is shown by Mr. Shapley's testimony, a witness who noticed the resemblance and loaned Drawbaugh a copy of the *Scientific American* describing it.

There is enough here to explain Drawbaugh's declarations to his neighbors about the talking machine he was inventing, and to excite the curiosity of the community. A careful reading of the proofs renders it easy of belief that the witnesses who testify about casual visits to his shop, which occurred many years before their testimony was delivered, and to cursory tests of his instruments on those occasions, have confused the fragmentary and incoherent articulation of such an apparatus with the hearing of distinct words and sentences. When witnesses undertake (as many of them do), to give the exact words or sentence heard in the instrument five or ten years before, when their attention was not called to the subject afterwards, no hesitation is felt in rejecting such statements as utterly incredible. It may be charitably inferred that such a witness has confused his recollection with more recent impressions. As will hereafter be shown, the proofs demonstrate that most of the witnesses who testify to having heard distinctly and coherently through the talking machine, all those who indicate the Exhibits "B," "F," and "C" as the instruments, are mistaken if they are truthful. If Drawbaugh was a charlatan, he may have assisted in deluding them; and the proofs show, that between 1873 and 1874, a string telephone was in his brother's shop, in the village. The fact that he never attempted to exhibit his machine outside of his shop where it could be used between points some considerable distance apart, and where its real capacity could be readily observed, is significant in this connection.

The more important testimony is that by which it is sought to identify the several exhibits, and show their existence at times consistent with the theory of the natural evolution of the invention. The identification of particular exhibits as seen by the witnesses among the various objects of curiosity at Drawbaugh's shop several years before they testify, is necessarily unreliable when it is attempted by observers who had no knowledge of the mode of operation or of the internal organization of the instruments. Such witnesses could not appreciate what they saw even if they examined the instruments. Most of the witnesses belong to this class. Indeed, the greater proportion of them do not profess to identify the exhibits positively. Some are more certain than others that particular exhibits are the instruments they saw. Exhibits "F," "B," and "C," are fragmentary remains of instruments, and their value depends upon Drawbaugh's description of the operative parts that no longer exist. Scores of witnesses testify to seeing the tumbler device resembling Exhibit "F," and the tin can device resembling Exhibit "B," but the identification of the other exhibits prior to the date of Bell's patent is comparatively feeble.

The appearance of Exhibits "F," "B," and "C" is sufficiently peculiar and distinctive to impress the memory of those who saw them. On the other hand, the other exhibits are not of this character, and all that ordinarily the witnesses can safely say of them is, that five years or more before testifying they think they saw or used a small walnut box externally resembling "I," or "A," or "E," or "D."

It may be said generally of all the testimony of the witnesses who attempt to identify exhibits, that it is mainly valuable when it proceeds from those who used the instruments which they think they remember and obtained results. They must remember the results obtained much better than the minor differences of appearance presented by the instruments. Granting that Exhibits "F," "B" and "C" would be likely to be remembered, what shall be said of the value of the testimony of scores of witnesses who state that they tested these instruments, or saw others test them, and they articulated perfectly, when it appears by the most authentic test that these instruments were incapable of such articulation?

RESULTS OF TESTS OF DRAWBAUGH'S APPARATUS.

In March, 1882, after most of the proofs in the case had been taken, a test was made of the capacity of the exhibits to transmit speech in the presence of the counsel and the experts for the respective parties. It is not accurate to say a test was made of the exhibits; but reproductions of "F," "B," and "C," were made by Drawbaugh and as rehabilitated by him, were used for the test. Whether these were honest reproductions, no one can tell; but such as they were, they were experimented with by Drawbaugh before they were subjected to the test. Whatever else that test demonstrated, it proved that articulate speech could not have been practically communicated through Exhibits "F," "B," and "C," at Drawbaugh's shop under similar conditions; and that only fragmentary or incoherent speech could be occasionally and exceptionally rendered by the reproduced instruments which had been experimented with privately before the public test. The proofs show that all along to 1878 Drawbaugh exhibited his earlier instruments, "F" and "B," to spectators and used them as his talking machine, sometimes showing or using both together, and sometimes one of them. The testimony of the defendant's witnesses,—Springer, Moore, Musser, and Bayler, is pertinent upon this point, and has been referred to. How is it to be explained that he used these crude instruments in 1875 and 1876, as his talking machine, if he had the better instruments, especially such instruments as "E" and "D"? But in view of the fact now shown that these earlier exhibits are incapable of satisfactory articulation, what confidence can be placed in the rest of the testimony produced to identify exhibits? If the witnesses are mistaken in identifying these very characteristic instruments, and in recalling the results obtained through them, little reliance can be placed upon the identification of the other instruments, or upon the statement of the results which the witnesses think were obtained through them. If these witnesses are mistaken in the dates which they fix for the occasions they speak of, their testimony can be reconciled with all the probabilities of the case. And the reasonable explanation of their testimony is, that those witnesses who really saw or used the later exhibits, did so in 1876, 1877, 1878, and later, instead of on earlier occasions.

DRAWBAUGH AN EXPERIMENTER, NOT AN ORIGINAL INVENTOR.

The proofs on both sides lead to the general conclusion that Drawbaugh was not an original inventor of the speaking telephone, but had been an experimenter without obtaining practical results until the introduction of the instruments into Harrisburg. It is very probable that after reading in the *Scientific American*, loaned to him by Mr. Shapley in October, 1876, the article purporting to describe Bell's telephone, but which really describes better the Reis apparatus, he undertook to improve his old devices. At that time, or after he had examined the telephone instruments at Harrisburg, and carried one of them home to study, he may have altered the organization of his instrument, and made the intermediate exhibits between "F" and "B." If he exhibited them at his shop, and was able to transmit speech through them, this fact will account for the testimony of the witnesses who identify these exhibits, and may be mistaken as to the time they saw them. The real history of his talking machine is known only to himself, and it will not be profitable to conjecture when he made the advanced instruments which he claims to have made in February, 1875, and the later instruments.

It may be, that in discrediting his narrative, and rejecting the theory of the facts which rest upon it, the value of the corroborative testimony has been underestimated. However this may be, no doubt is entertained as to the conclusion which should be reached upon the proofs.

SUMMARY OF DEFENDANT'S CASE.

Succinctly stated, most favorably for the defendants, the case is this: One hundred witnesses, more or less, testify that on one or more occasions, which took place from five to ten years before, they think they saw this or that device used as a talking machine; they are ignorant of the principle and of the mechanical construction of the instruments, but they heard speech through them perfectly well, and through one set of instruments as well as the other. This case is met on the part of the complainants by proof that the instruments, which most of the witnesses think they saw and heard through, were incapable of being heard through in the manner described by them, and further that the man who knew all about the capacity of his instruments never attempted to use them in a manner which would demonstrate their efficiency and commercial value, but on the contrary for ten years after he could have patented them, and for five years after they were mechanically perfect, knowing all the time that a fortune awaited the patentee, and with no obstacles in his way, did not move, but calmly saw another obtain a patent and reap the fame and profit of the invention.

TRUTH OF THE DEFENCE OPEN TO FATAL DOUBT.

Without regard to other features of the case, it is sufficient to say that the defence is not established so as to remove a fair doubt of its truth, and such doubt is fatal.

The observation of an eminent commentator may be quoted as apposite to the case: "No form of judicial evidence is infallible, however strong in itself; the degree of assurance resulting from it amounts only to an indefinitely high degree of probability; and, perhaps, as many erroneous judgments have taken place on false or mistaken direct testimony, as on presumptive proof." Best's Ev. Sec. 408.

A decree is ordered for complainant.

REVERBERATIONS FROM THE TELEPHONE DECISION.

The motion for an injunction made by the Bell Telephone Co., against the People's Telephone Co., was renewed in the United States Circuit Court at Trenton, N. J., Dec. 15. When it was originally made several months ago, the court refused it, but gave permission for it to be renewed at any future time. It was urged that the recent decision of the main question justified the granting of the desired injunction. The counsel for the opposing company declared that this was not a final decision of the matter. This is a distinct company from the one which has been engaged in exploiting Drawbaugh, and employs the Hopkins telephone. Judge Nixon reserved his decision.

The United States Telephone Manufacturing company, of New York, and the McDonough Telephone and Telegraph company, of New Jersey, filed a bill in the United States Circuit court at Trenton, Dec. 22, asking for an injunction against the American Bell Telephone company, of Boston, and the Domestic Telegraph and Telephone company, of Newark, for an infringement of certain patents of James W. McDonough of Chicago, Ill., for electric speaking telephones.

THE ELECTRIC RAILWAY SYNDICATE.

The fifth of the series of meetings for the purpose of uniting the different electric railway interests was held in this city December 16. It was decided that all the parties who are to come into the American Electric Railway Co., must agree to transfer to that company all their patents and inventions for electrical propulsion on railways in the United States, as a condition precedent to participating in the advantages of this arrangement, they to be compensated by participation in the stock reserved for patents and inventions, in the proportion fixed by the arbitrators.

Sir William Thomson, of Glasgow University; Prof. Charles R. Cross, of the Massachusetts Institute of Technology, and President Harris, of the Northern Pacific Railway, have accepted invitations to be members of the Expert Commission to test the rival electric motors on the Second avenue elevated railway, and apportion the stock of the new company among the companies consolidating, according to the value of their respective motor patents; and it is believed that President Roberts, of the Pennsylvania Railway, and President Rutter, of the New York Central Railway, will also accept. It is understood that the commission will be empowered to employ expert electricians and practical mechanical engineers to conduct the test, under its direction, and its members will render a verdict upon the results of the experiments.

At a subsequent meeting held Dec. 22, it was decided to issue an invitation to all reputable holders of patents relating to the subject of electric railroad propulsion, to assign the exclusive rights under their several patents for electric railroad purposes to the new company, and to receive from the board of arbitration their proportionate share of the stock according to the value of such patents. Those who do not avail themselves of the offer before December 31 are to be excluded from the advantages of the arrangement.

STATE TAXATION OF TELEGRAPH COMPANIES.

Under the corporation law of New York state passed in 1881, the Controller desires to levy a tax on the entire capital stock of the Western Union, the Gold and Stock, and other telegraph companies. The companies are resisting the payment of the tax, arguing that only that proportion of their property represented by stock in this state should be taxed. The Gold and Stock Telegraph Co., makes the point that the State has no right to tax property not within its limits, as it would do if it taxed the entire capital stock of the company. In the lower courts the judges have decided against the companies. Nearly $500,000 is involved in the two cases.

General Wager Swayne and Matthew Hale appeared for the telegraph companies and Attorney-General O'Brien for the people. General Swayne claimed that by a law passed in 1853 telegraph companies should be taxed only on that part of their capital covering property in this state. This law was not repealed by the corporation tax law of 1881. In his brief he quoted from many authorities. The Attorney General in his reply argued that the law of 1881 already gave the State the right to tax all the capital stock and that the act of 1853 was repealed by that of 1881. The judges, as usual, took the briefs and reserved their decision.

DISSOLUTION OF THE TELEGRAPH POOL.

The pooling arrangement under which the Bankers and Merchants' and the Postal Telegraph companies have been doing business since the retirement of the Baltimore and Ohio Telegraph Co. from the celebrated tripartite agreement, was dissolved December 11 by mutual consent as well as by necessity. The Bankers and Merchants', although in a receiver's hands, has been in great financial distress. It is stated that a complete separation of business interests at stations where the offices of the two companies have been mutually conducted will be arranged within a few days.

The receipts of the Bankers and Merchants' Co. have not been sufficient to enable the receivers to meet the interest due on the large bonded debt. While the employés have waited months for their pay, business has been falling off, until the hopelessness of struggling to maintain the united lines was apparent.

PRINTING TELEGRAPH PATENT SUIT.

Before the U. S. Circuit Court at Hartford, Dec. 28, Judge Shipman on the bench, a hearing was had on a motion for a preliminary injunction in the case of the Gold and Stock Telegraph Co. against the Commercial Telegram Co., in a suit concerning the right to use the Field printing instrument, it being claimed that this is an infringement upon the patents of E. A. Calahan, owned by the complainant company. Dickerson, Thurston and Dickerson appear for the plaintiff, and Roscoe Conkling and General S. A. Duncan for the defendant.

AUTHORIZED TO ISSUE RECEIVERS' CERTIFICATES.

Counsel for the Receivers of the Bankers and Merchants' Telegraph Co., made application to the United States Circuit Court to have confirmed an order made by the Supreme Court of New York permitting the Receivers of that company to make a settlement with the Receivers of a construction company which had constructed property for the telegraph company. Under the arrangement the Bankers and Merchants will receive the property so constructed, and issue Receivers' certificates in payment therefor, which will be secured by a lien on the property in question. Judge Butler confirmed the order on Dec. 9th, so far as issuing Receivers' certificates to the amount of $130,000, but refused permission for the issuance of $20,000 worth additional which had been asked for.

ELECTRIC LIGHT AND POWER.

Domestic.

Easton, Penn., is lighting its streets with electricity.

At a recent public meeting at Toronto, Mr. James French said that "the electric light which we were promised would be cheaper than gas, was about three times as expensive."

For some weeks Delaware avenue, between Market and Vine streets, Philadelphia, was in almost total darkness, as the electric lights were not lighted. The cable is laid underground, and it is said the insulation was burned off in places. Finally Mayor Smith instructed the police to light the gas lamps, which was done, and it is said will be continued until further orders.

The electric lighting apparatus on the dome of the court house, at Wabash, Indiana, was wrecked on the night of October 22d, by a flock of wild geese.

The prospects are that Laconia, N. H., will soon be furnished with electric lights. A preliminary meeting has been held and $1,500 in stock subscribed, and upwards of 100 lights engaged by merchants and others. Local parties are interested in the enterprise. They have secured excellent power and expected to have the lights in operation December 20.

The managers of the New Orleans Exposition have awarded the following contracts for lighting the buildings and grounds: The Leavitt-Mueller electric light, 800 arc lamps for the main buildings; the Brush electric light, 300 lamps for the Government and State exhibit building; the Jenney arc light, 100 lamps, with five iron towers for the grounds and the live stock department; Thomson-Houston, 100 arc lights for the machinery, extension and saw mill; Edison incandescent light, 4,800 lights for the Music Hall, Horticultural Hall, the Art Gallery, State head-quarters, and offices. Each principal entrance and wharf will be lighted by six Leavitt-Mueller lamps; altogether 1,500 h. p. is required for the electric lights which cost the Exposition over $100,000.

A corporation has been formed under the laws of Massachusetts, entitled the Holyoke Electric Light and Power Co., Wm. A. Chase, Pres., R. C. Winchester, Treas. Capital $10,000.

A company has been formed in Bangor, Maine, with a capital of $50,000 for establishing a central lighting station to supply the city and people there with arc and incandescent electric lights, as well as electric motors for transmission of power.

The Brush Electric Light works, at Toledo, O., were damaged by fire on November 19th to the extent of $10,000.

Foreign.

An Electric Lighting company has lately been formed in Madrid, with a capital of £102,000, for the purpose of establishing in that city a central station, from which 12,000 incandescent lamps may be supplied. The works, to be erected near the Puerta de Salamanca, will comprise 15 Belleville or de Naeyer 100 h. p. steam-boilers, and two Sulzer or Corliss engines of 1,000 h. p. The electric machines to be erected are two Gordon dynamos, which will supply 10,000 ampères with an electromotive power of 120 volts. The current is to be distributed by means of underground cables in accordance with Edison's system.

The British Gaslight Co. has given the Town Council notice of its intention to raise the price of gas in its Hull district on and after the 1st of January. This step, attributed to the discontinuance of the electric lighting, has given much dissatisfaction. A special committee has been appointed to consider it.

A meeting of the Edison and Swan United Electric Light Co. (Limited) was held, November 11, in London. Mr. J. S. Forbes presided, and in the course of his remarks said that, including the item of depreciation, £2,310, the loss on the year's operations had been £28,214. They had had, roughly, £300,000 locked up, to represent which they had their patents, a first-rate manufactory, and a trained establishment. For the first three months of the current year's operations there had been a balance of profit of £752, or at the rate of £3,000 a year. It was their intention to do no more speculative business, either street, house to house, or any other lighting, but only that which paid.

The status of electric lighting in Australia, is given by Mr. McLean of Melbourne as follows:

Of the electric light there is very little to be said. Some efforts have been made, especially in Elizabeth street, Melbourne, one of our principal streets, but it was not a success, and all efforts on a large scale have been abandoned. There are a few lights kept going in some of the theatres, but what it costs I cannot say, except that I believe that the managers will not pay more for it than they have to pay for gas, and so I presume it is kept on there as a kind of standing advertisement. The belief in the colony is the same as that in England, viz., that electricity as a light is only yet in its infancy, and with this conviction there does not seem a disposition to help the problem forward

The Great Eastern before leaving England for the New Orleans Exposition, is to be fitted up throughout with incandescent lamps.

MANUFACTURING AND TRADE NOTES.

The Westinghouse Machine Co., of Pittsburg, has received an order from Scotland for a steam-engine for use in one of the ironclads of the British Navy. It will operate the electro-dynamo on each ship from which light is obtained for incandescent lamps throughout the vessel, arc lights for signal or danger lights, and the enormous search light at the masthead.

The Electrical Supply Co., of Ansonia, Conn., has opened an office and wareroom at 175 Lake street, Chicago. A full line of electrical goods, such as electrical wire, carbons and general supplies, will be kept in stock.

MISCELLANEOUS.

The Underground Electric Co., with a capital of $25,000, has been incorporated in New York by Joseph B. White and Henry Franz.

The Sims Electric Torpedo Co. has been incorporated in New York with a capital of $1,000,000. The corporators are Oscar Marshall, Henry P. Butler and Richard C. McCormick. Their purpose is to manufacture torpedoes, torpedo boats, submarine vessels, war ships and other materials of war.

The following electrical companies have been incorporated in Illinois: The Illinois Pan-Electric Co., capital stock, $1,000,000; incorporators, Porter White, John Boyle, and L. M. Chipley. The Globe Electric Engineering Co., capital $200,000; incorporators, Herbert A. Streeter, proprietor of the Globe Iron Works; Henry Burkholder and George W. Wilbur.

The American representative of Marcus Ward & Co., British paper manufacturers says: "An experience of twenty-five years in the manufacture of paper has convinced me that climate has much to do with the quality of fine writing papers. You may have as good mills and workmen as England, but your climate changes so suddenly and violently that the greatest care in the process cannot provide, say, for the different amount of sizing that must be put in the pulp, and that varies with the weather. Every English workman in an American paper or cotton mill will tell you that the electricity in the air in this country is much more intense than it is over the water. So much so, indeed, that special apparatus is made to correct its influence about a machine. English writing paper is largely used in the United States. In Washington I supply the various departments and the White House with our paper."

PERSONAL MENTION.

Hon. George Walker, who was appointed Consul General to France under the Hayes administration, is now in this country. He was formerly a vice-president of the Western Union and more recently of the Gold and Stock Telegraph Co.

A press despatch from Washington says that "It is probable that Mr. H. D. Lyman, Second Assistant Postmaster General, will resign his office within a short time to accept a position with the Bell Telephone Co."

THE TELEGRAPH.

The war of rates was inaugurated in the interior of New York state last month by the Baltimore and Ohio company reducing from 25 to 20 cents to points within the state.

Minneapolis has a district telegraph system which has some peculiar features. It does a general parcel, package and trunk delivery business, keeping several wagons constantly employed. This began in a small way by employing boys to carry bundles. The business men in the retail line found them very useful in the delivery of purchases to customers, and at length the work became so large in volume that the use of teams was necessary.

A larger business is done by telegraph companies in the United States than in any other country in the world. Over 40,000,000 messages were sent last year. Great Britain sent nearly 33,000,000, France 26,000,000, and Germany 18,000,000. The total for the world was 153,000,000, fully one-half being sent in English-speaking countries. Germany has nearly as many telegraph offices as the United States, although so much smaller in area, and doing less than half the business. Great Britain, on the contrary, does a large business with comparatively few offices.

The Houston and Texas Central Railway Co., applied to Judge Hartley, of the Texas State Court, for an injunction against the Baltimore and Ohio Telegraph Co., to restrain that company from constructing its lines on the right of way of the railway company in Collin County. Judge Hartley refused the injunction, and the telegraph line upon the right of way of the railway company is completed.

The local telegraph service within the Paris fortifications was to be performed entirely by pneumatic tubes after December 15th.

In the United States Circuit Court at Norfolk, Va., Dec. 5th, Judge R. W. Hughes presiding, a bill was filed by William Mahone, suing for himself, and others similarly situated, as a bondholder and stockholder of the Southern Telegraph Co., charging fraud, waste, mismanagement, and insolvency on the part of the officers of said company, and praying for an injunction, the appointment of a receiver, and the winding up of the company. The litigation involves bonds amounting to $2,500,000. A temporary restraining order was granted by the court, the Marshal was ordered to take custody of the affairs of the company, and the case was set for further proceedings on Dec. 19. It is stated that the franchise of the company is a valuable one, and under proper management it could be made not only solvent but profitable. The company is in default for interest, and, it is said, in danger of irreparable bankruptcy.

FINANCIAL.

Sheriff Johnson sold at public auction, at Petersburg, Va., Dec. 19, $10,500 of the Southern Telegraph Company's bonds, of the denominations of $1,000, $500 and $250, at the rate of $17 per $100.

The Western Union directors met December 10 and adopted the following report of the Executive Committee:

The following statement will show the condition of the company at the close of the quarter ended September 30, 1884:

Surplus July 1, 1884, as per last quarterly report		$4,157,408 89
Net revenues quarter ended September 30, 1884		1,545,520 17
		$5,702,926 06
From which, deducting appropriations for—		
Dividend of 1¼ per cent., paid October 15	$1,330,807 40	
Interest on bonded debt	124,000 00	
Sinking fund	20,000 00	
		1,513,807 40
Leaves a surplus, October 1, of		$4,189,190 57
The net revenues of the quarter ending December 31, instant, based upon nearly completed returns for October, partial returns for November, and estimating the business for December, will be about		$1,500,000 00
Add surplus October 1, as above		4,189,190 57
		$5,689,190 57
From which, appropriating for—		
Interest on bonded debt	$124,000 00	
Sinking fund	20,000 00	
		$144,000 00
Leaves a balance of		$5,545,190 57
It requires for a dividend of 1¼ per cent. on the capital stock		1,199,897 00
Deducting which leaves a surplus, after paying dividend, of		$4,345,293 57

In view of the preceding statements, the committee recommend the adoption by the board of the following:

Resolved, That a dividend of 1¼ per cent. on the capital stock of this company be hereby declared, payable on and after the 15th of January next, to stockholders of record at the close of the transfer books on the 20th of December, instant.

Resolved, That for the purpose of the dividend hereby declared, the stock books of the company in New York and London be closed at 3 o'clock on the afternoon of the 20th of December, instant, and be reopened on the morning of the 2d of January next.

NORVIN GREEN, President.

INVENTORS' RECORD.

Prepared expressly for THE ELECTRICIAN AND ELECTRICAL ENGINEER *by* Pope & Edgecomb, *Solicitors of Patents for Electrical Inventions, 59 Wall Street, New York city.*

LEGAL NOTES.

Supreme Court of the United States.—The case of *Butterworth*, Commissioner of Patents *v. The United States ex rel. Hoe et al.*, decided November 3rd, 1884, involves important questions as to the right of appeal from the decision of the Commissioner of Patents to the Secretary of the Interior. The history of this case is briefly as follows:—A patent was granted to one Scott,

March 18th, 1881, for a printing machine. An application was filed by one Gill, March 12th, 1881, for a similar invention. An interference was declared between Gill and Scott, which was heard by the Examiner of Interferences and decided by him in favor of Scott, and on appeal to the Examiners in Chief, the decision was affirmed. An appeal was taken to the then Commissioner, Marble, who, after argument, decided the case in favor of Gill. No motion either for a new trial or a rehearing was made before the Commissioner, but an appeal was taken by Scott to the Secretary of the Interior. While the case was pending before the Secretary, counsel for Gill made a demand upon the present Commissioner, Butterworth, for a patent to issue, based upon the decision of Commissioner Marble that Gill was the first and sole inventor. Commissioner Butterworth refused so to issue the patent, whereupon Gill, through his counsel, filed a petition for a writ of mandamus against the Commissioner to compel him to issue a patent to Gill in accordance with the judgment of his predecessor.

A rule was made requiring the Commissioner to show cause why the writ should not issue against him as prayed for. In answer to the rule, the Commissioner reviewed the history of the case, admitted that a judgment in favor of Gill had been entered in the interference between him and Scott, which was unreversed, and that no motion or other proceeding was pending in the office to review or modify that finding. The Commissioner further stated that he did not desire to hear further argument in the case, nor to make any other or additional inquiry or investigation in that behalf; that he refused to issue the patent on the sole ground and for no other reason than that the case had been appealed to the Secretary of the Interior; that if the honorable Secretary had jurisdiction to hear and determine the case on appeal, refusing to issue the patent as demanded by Gill was proper, otherwise it was not, and Gill was entitled to have his patent issue to him as prayed. Upon this return issue was joined. The case was heard by the Supreme Court of the District of Columbia, and a writ of mandamus against the Commissioner awarded. The case was then taken on appeal to the Supreme Court of the United States. The Supreme Court held that mandamus will not lie to compel a public officer to do a particular thing which his superior in authority has lawfully ordered him not to do. The court also held that in all matters in which the action of the Commissioner is judicial or quasi-judicial, the fact that no appeal is expressly given to the Secretary is conclusive that none is to be implied, and this is equally true whether or not an appeal is allowed to the courts; that the supervision conferred upon the Secretary by the statute does not authorize him to substitute his discretion and judgment for that of the Commissioner when by law the latter is required to exercise his own, and when that judgment, unless reversed in the special mode pointed out by judicial process, is by law the condition on which the right of the claimant is declared to depend. *Morris et al.* v. *McMillin*. This was an appeal from the Circuit Court of the Western District of Pennsylvania. The original bill was filed to restrain appellants from infringement of patent dated April 16th, 1867, for an improvement in applying steam-power to the capstans of steamboats. The Supreme Court reversed the decree of the Circuit and remanded the case with directions to dismiss the bill, on the ground that the patent was void for want of patentable invention, the only field of invention left for the patent to cover being the application by the old and familiar arrangement of shafts and cog-wheels of the power of an auxiliary engine to a capstan instead of a windlass.

United States Circuit Courts.—*Odell et al. v. Stout et al.* Suit for infringement brought in the Southern District of Ohio, alleging infringement of reissued patent for roller-mills. SAGE, J., held, MATTHEWS, J., concurring, that the grant of a reissue is *prima facie*, but not conclusive evidence of inadvertence, accident or mistake. Claims in the reissue for patentable parts of the combination in the original, do not invalidate the reissue if the patentee is first inventor of the patentable parts claimed, although the original was for the combination alone; therefore a patentee may under proper circumstances extend his claims by reissue to the limits of his invention, but he may not enlarge the invention. Upon the authority of *James* v. *Campbell*, and other decisions of the Supreme Court, it is clear that the claim may be enlarged by reissue if the patentee moves promptly and no rights of others have intervened. What constitutes a reasonable time must be decided by the Court upon the case presented. The rule is equitable and therefore flexible and to be applied according to equity. The rule that an invention may be exhibited either in a drawing or model so as to lay the foundation of a claim for priority, is to be taken with the qualification that it must be followed up with reasonable diligence. Patents granted between the making of a drawing by complainant and his filing an application a year afterward, are not anticipated by such drawing. One claim in a reissue may be void without necessarily invalidating other claims, provided the latter were made in good faith. Where it appears that reissued claims were intended to broaden the invention and thereby cover intermediate inventions, the fraud may be sufficient to vitiate all the claims. *Hatch* v. *Adams*. This was a case in the Eastern District of Pennsylvania, involving a single question, viz.: Has a purchaser of patented articles from a grantee that has an exclusive right to manufacture and sell under the patent in a specified part of the United States, the right to sell the articles in the course of trade outside the designated limits of the grant? MCKENNAN, J., decides this question in the negative.

United States Patent Office.—In *Gill* v. *Scott*, a rehearing was asked for by counsel for Scott. The state of facts in this case is set forth in the report of the decision of the U. S. Supreme Court given above. After the rendition of the judgment of the Supreme Court of the District of Columbia, but possibly before the opinion of the Supreme Court of the United States was announced, counsel for Scott moved for a rehearing on the record. BUTTERWORTH, Commissioner, says that after a case has been heard and decided by the Commissioner it is competent for either party to move for a rehearing on the record. When, however, instead of making such motion the party prosecutes an appeal; Held, that the prosecution of such an appeal operates as a waiver of the right to subsequently make such motion. Also, the case having been decided by a former commissioner, it would be obnoxious to rule 130 for the present Commissioner to rehear it, no new facts having been presented to him. The motion was accordingly overruled. In *ex parte Wilkin*, which was an appeal from the primary examiner, who objected to the language of applicant's claim on the ground that it was vague and did not identify the construction which performed the result desired, referring to *ex parte Deming* (26 O. G., 1,207), and *ex parte Holt* (29 O. G., 171), Acting Commissioner DYRENFORTH held that a claim which mainly depends upon such language as "mechanism, substantially as described" to define the invention sought to be patented, is vague and indefinite and does not comply with the statute. In *ex parte Chapman*, it appeared that the last action of the Patent Office in applicant's case was made August 28th, 1882, which therefore became abandoned on August 28th, 1884. The applicant now petitions to be allowed to renew the application under the provisions of section 4,894 R. S. It appeared that applicant's attorneys, who reside in Chicago, put the case into the hands of their Washington associate on August 18th, and that an amendment was prepared by him before the two years expired, but was not filed in time because of his absence from the city. BUTTERWORTH, Commissioner, denied the petition, on the ground that the discretion vested in the Commissioner by the statute is judicial discretion and not mere complaisance, and hence satisfactory evidence must be adduced that the delay could not have been avoided, which in this case did not appear. *Ex parte Lassells*. This was an appeal from the action of an Examiner who refused to accept an amendment cancelling all the claims of an applicant without substituting others. The Examiner held that the cancellation of all the claims, being in effect an abandonment, should be framed in such manner as to make that intent clear. BUTTERWORTH, Commissioner, held that while the question is not free from doubt, claims would seem to be indispensable to the life of the application. The cancellation of all claims signifies intent to abandon. Whether the applicant shall be required to put that abandonment in set words is a matter within the discretion of the office. The Examiner's action was approved. *Ex parte Witty* and *Caffrey*. Appeal from the action of the Examiner, who required an applicant to amend his drawings so as to show a modification of the invention referred to as a mechanical equivalent. BUTTERWORTH, Commissioner, held that the requirement of the Examiner came within the rule of *ex parte Howe* (25 O. G., 1,189) and it was therefore approved.

CLASSIFIED LIST OF UNITED STATES ELECTRICAL PATENTS.

From November 25 to December 16, 1884 (inclusive).

Alarms and Signals:—*Time Detector*, A. Lasmoles, 308,416, Nov. 25. *Signaling Apparatus*, M. Touhuin, 308,533. *Call box*, C. Herrmann, 308,867, Dec. 9; W. B. Palmer, 308,922. *Low-water Detector*, J. M. Palmatier, 308,979; C. H. Wickersham, 309,425, Dec. 16.

Clocks:—C. H. Pond, 308,521, Nov. 25; same, 308,703, Dec. 2. *Synchronizing Device*, H. L. Bailey, 308,731; W. F. Weisgerber, 309,263, Dec. 16. *Apparatus for Setting Clocks Synchronously*, J. E. Smith, 309,000. Dec. 9, same, *Circuit Controller for Clocks*, 309,001.

Conductors, Insulators, Supports and Systems:—*Underground Conduit*, E. J. Houston, 308,612, Dec. 2. *Electric Light Conductor for Structures*, J. H. Vail, 308,713. *Brace for Telegraph and Telephone Lines*, A. H. Arnold, 308,818. *Insulating Compound and Application*, W. D. Grimshaw, 308,830, Dec. 9. *Wire Supporter*, O. M. Draper, 308,954; A. S. Weaver, 309,267, Dec. 16. *Accessible Underground Conduit*, W. K. Platt and G. A. Aldrich, 309,091. *Adjustable Resistance for Circuits*, F. J. Sprague, 309,-157. *Method of Making Cables*, W. R. Patterson, 309,244, Dec. 16. *Ventilating Underground Test Stations*, same, 309,245. *Electric Light Conductor*, same, 309,246. *Joint for Lead Pipes*, same, 309,247. *Apparatus for Maintaining Connection with a Moving Instrument*, C. W. Williams, G. S. Barnum and E. B. Ives, 309,274. *Compound Wire*, F. Chillingworth, 309,-439; W. Paul and T. J. Wood, 309,500. *Manufacture of*, I. A. Kilmer, 309,-408. *Insulating Wires*, M. D. Fenner, 309,450.

Dynamo Machines and Motors:—*Motor*, G. Trouve, 308,531, Nov. 25; A. D. Blodgett and J. P. Tirrell, 308,548. *Armature Core for Dynamo*, F. K. Fitch, 308,601, Dec. 2. *Dynamo*, E. B. Cutten, 308,832. *Armature for*, B. F. Orton, 308,851.

Galvanic Batteries:—I. L. Roberts, 308,992, Dec. 9.

Ignition:—*Fire Arm*, R. S. H. Thompson, 309,262, Dec. 16.

Lamps and Appurtenances:—*Double Carbon Lamp*, J. A. Dalzell, 308,595, Dec. 2. *Electric Light Fixture*, J. H. Vail, 308,712. *Arc Lamp*, N. McCarty, 308,620; S. F. Van Choate, 309,012, Dec. 9; T. L. Kay, 309,392, Dec. 16; H. A. Gorn, 309,454.

Measurement:—*Gage*, J. and H. M. Goodman, 308,487, Nov. 25; C. D. Warner, 309,114, Dec. 9.

Miscellaneous:—*Means for Locating Mineral Veins*, A. P. Lighthill, 308,908, Dec. 9. *Movement Cure Apparatus*, M. G. Farmer, 309,036. *Educational Apparatus*, I. S. Kinch, 309,064.

Railway Appliances:—*Car Uncoupler*, J. D. Reed, 308,432, Nov. 25. *Apparatus for Controlling Railway Signals*, J. T. Hanbay, 308,492. *Circuit Closer for Railway Switches*, same, 308,493. *Apparatus for Controlling Railway Appliances*, same, 308,494. *Railway Signal*, J. L. V. Tepes, 308,-845, Dec. 2.

Storage Batteries:—*Making Electrodes for*, W. E. Case, 309,203, Dec. 16.

Telephone Systems and Apparatus:—*Combined Telephone and Automatic Fire Alarm System*, T. D. Lockwood, 308,566, Nov. 25. *Mechanical Telephone*, I. F. Tucker, 308,582. *Arm Rest for Telephone Users*, J. M. Fitch, 308,600, Dec. 2. *Transmitter*, W. H. Eckert, 308,956, Dec. 9; G. T. Woods, 308,817, Dec. 2. *Spring-jack Switch*, R. V. Freeman, 309,218, Dec. 16. *Telephone Apparatus*, T. J. Perrin, 309,357. *Telephone*, J. Lowth, 309,474, 309,475, 309,476.

Telegraphs:—*Polarized Relay*, W. B. Harvey, 308,610, Dec. 2. *Reed for Harmonic*, F. W. Cushing, 308,754. *Dynamo Multiplex*, S. D. Field, 308,835. *Telegraphy*, R. K. Boyle, 309,126, Dec. 9. *Winding Telegraph Paper*, H. F. Clarke, 309,333. *Printing Telegraph*, F. L. Pope and T. A. Edison, 10,542, reissue, Dec. 9.

Expired Patents:—A list of the more important electrical patents which expire during the current month is subjoined:—J. L. Arman, *Submarine Cable*, 73,847, Jan. 21. J. H. Bunnell, *Telegraph Repeater*, 73,774, Jan. 28. F. Bean, *Electric Gas-Lighting Apparatus*, 73,868, Jan. 28. S. G. Cabell, *Preventing Incrustation of Steam Boilers*, 73,872, Jan. 28.