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CONTAINS A SYNOPTICAL INDEX TO CURRENT ELECTRICAL LITERATURE.

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World's Fair Electrical Engineering

THE UNDERGROUND WORK.

BY FRED DE LAND.

Of the million visitors who have already inspected that wonderful World's Fair city, that will stand as the embodiment of the progress of civilization and of the arts and sciences in these closing years of the nineteenth century, the majority were impressed with the grandeur and the immensity of the work already accomplished, though seeing only the visible fruits of thought and skill and labor there displayed. For so broad does the scope of the enterprise appear, so inspiring the wonderful tasks thus far completed, that every fair-minded visitor becomes thoroughly imbued with a feeling of confidence that when the gates are thrown open this coming May he can share in an exposition, complete in every detail ; a national affair that will not only add to the dignity and the honor of our country, but also advance its material prosperity through the interest that will be awakened among the other nations of the earth, when they, too, see what has been wrought by concentrated energy, intelligence and the skillful handling of the resources of this glorious Republic.

But talent and thought and skill have not only been expended in that which gratifies the vision of the superficial observer, or on that which instantly appeals to and satisfies the artistic sensibilities and critical taste of the thoughtful throngs who there find unsurpassed educational advantages. For beneath the greensward, the foot-paths, the roadways, and the buildings, there is a work, broad in scope, skillfully planned, modern in construction, that, though buried from sight, yet plays a most important part in the success of this grand exposition. A system of pipes and conduits more complete than can be found in any but the largest cities in the world, a sanitary system devised and planned to protect the comfort and the health of no less an aggregate number of visitors than 750,000, who may congregate within the gates at one time; a system that includes water, light, heat, power, sewerage and the other details that, unless properly projected, perfectly planned and honestly executed, would not only affect the financial prosperity of the enterprise, but, what is of far greater moment, seriously impair the health of the hundred thousand exhibitors and employés and interfere with the enjoyment of the crowds of visitors that are expected this year.

The sanitary engineer may find this portion of the exhibit the more attractive from his point of view, than much that is above the surface. The municipal engineers will here find food for profitable study, while to the electrical engineer the big subway and its connecting ducts will prove a most interesting sight. And yet this electrical subway forms but a small part of the vast network of piping extending in every direction, the ramifications of which are simply bewildering to the uninitiated, but forming a grand and instructive object lesson to the local engineers of modern cities.

For there are pipes from the city water system, the pipes for the system of fountains, and the Waukesha (drinking) water system. The storm-water sewer system, the pavement sewer system, and the Shone ejector, or main sewerage, system of piping. The pipes for compressed air, for gas, fuel, oil, steam heating, and for steam power; in fact whatever a modern city of 500,000 inhabitants would deem absolutely necessary to maintain a perfect sanitary condition, with every modern convenience, can be found at Jackson Park.

Water is the first element generally considered in laying out a city, and at Jackson Park there is a mile and a half of lake frontage; a body of water grand and sublime in its extent and its purity, inexhaustible in quantity; the one redeeming feature in an abandoned tract, a feature that proved to be the factor that solved the problem of how best to utilize this waste space. Lake Michigan thus became the basis of the fundamental idea in the general design of improvement over which the leading architects and landscape artists labored so effectually.

As one-third of this park area was below the level of the lake at high water, it was decided to form in the more depressed portions a system of lagoons or waterways having four outlets to the lake, and to use the material dredged up in elevating the adjacent ground and affording handsome terraces at comparatively slight expense, thus overcoming the preliminary obstacles to proper drainage. An inland water area of more than fifty acres was thus provided, over two million cubic yards of earth removed and placed where it would prove far more serviceable, and, within the short space of a few months, an ideal stretch of seemingly natural landscape formed, including a long, narrow island sixteen acres in extent, occupying the center of the lagoon, on which special trees and shrubbery have obtained a fine footing, and the shores of which are fringed with aquatic plants. To appreciate how perfectly the landscape artist has here performed his work it is only necessary to seek the pleasure of a trip in one of the electric launches that smoothly glides through these quiet waters and enjoy the restful repose that is inseparable from this exquisite scene.

The next step was to secure the requisite supply of drinking water that could be furnished free to all thirsty tourists. This was obtained under contract from the city, and from the Sixty-eighth street waterworks enters the grounds in a 36-inch main. Arrangements were also perfected for securing 50,000 gallons of Hygeia water daily, from the springs at Waukesha, Wisconsin, 102 miles distance, and supplying same to visitors at the slight expense of a cent for half a pint. The engineering features of this bit of enterprise are worthy of notice, for the water will be pumped from the overflow basin at the springs to a reservoir 8 miles distant from and 200 feet higher than the springs, and 416 feet above the level of the Exposition grounds, to which point it is expected to flow by gravity through a 6-inch steel pipe.

The water required for the fountains is taken from the lagoons and the necessary pressure obtained from the Worthington pumping station.

For carrying away the rainwater there is a system of piping leading from the roofs of the various buildings to the lagoons, while by another system of piping the surface water is drained from walks and roadways into catch basins and piped thence to wells from whence it is pumped into the lake.

The main sewerage system is an odorless one that includes the chemical treatment of the discharges which leave the fluids inert while the solids are pressed into cakes and burned under furnaces.

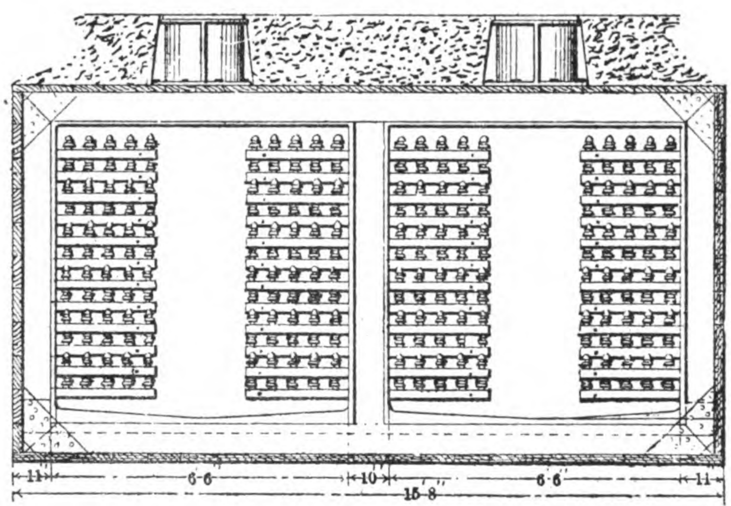
Fuel oil is piped from Lima, Ohio, to a relay station at Whitings, Indiana, and flows thence into a big reservoir on the grounds. And natural gas will be piped into the grounds from the gas wells near Greentown, Indiana, a distance of about 150 miles.

Then there is the big electric subway, through which one can walk from Machinery hall to the Electricity building, or the Mines and Mining building, and from the bridge to the Manufactures, the Government and the Fisheries buildings. It is like a very long tunnel only in being beneath the surface. It is unlike a tunnel in that the top is at an average depth of only 20 inches below the surface; in having cemented walls, flooring and ceiling, in being nearly square, with no sign of arched ceiling, and above all in being perfectly lighted from one end to the other with 16 candle-power, 100-volt incandescent lamps placed in series across a section of the 500 volt-power circuit wires that are attached by glass insulators to the ceiling.

While this great underground wire container is always referred to as one subway, it really consists of five sections, each distinguished by the nature of service required of the electric conductors supported therein. Thus it starts from the power plant as a double subway and so continues nearly to the Electricity building, where one section branches off to the bridge connecting the main end of the Electricity building with the Manufactures building. Each section of this double subway is the same in size and appearance, being 6 feet 6 inches square, built of 2-inch tarred planking spiked to 3 by 8 inch timbers set twelve inches apart, and rendered fireproof by an inch coating of cement held in position by expanded metal lathing. The section of the double subway extending to the Electricity building is about sixteen hundred feet in length, and that extending to the bridge is about the same length. Then there is a section about half the width of the main subway that branches off from the latter near the Electricity building and passes to the Mines and Mining building, a distance of about three hundred and twenty feet to the west.

The carrying capacity of the subway is far in excess of any possible demand, and 240 large wires can be supported on glass insulators in either of the main sections, while provision is made for supporting telephone and fire alarm service cables containing innumerable circuits, these cables being laid against the wall. Bolted to the walls at the distance of every thirty feet are upright cast-iron frames with supporting sockets into which five-pin oak cross arms, 2¼ by 4 inches, are driven to a depth of seven inches and wedged therein. Each frame supports twelve cross-arms, each holding five locust pins to which are screwed a special form of double petticoated glass insulator, arranged to hold two wires each. By this arrangement 120 wires are placed on each set of cross arms, and as these cross arms face each other in the double subway, there is an insulator supporting capacity for 240 wires. In the branches and laterals this arrangement is gradually lessened from 120 wires to 40 wires.

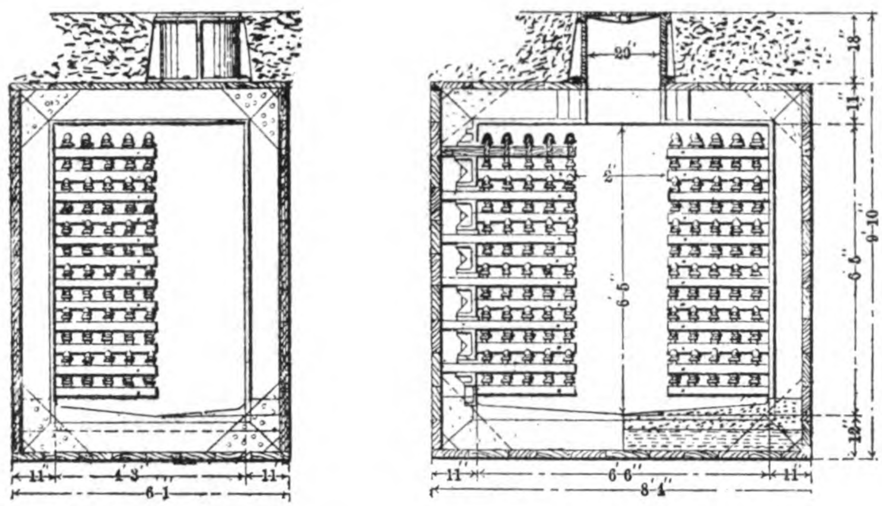
This subway does not pass under the waterways, but on approaching the two bridges is expanded out to a width corresponding to that of the bridge, underneath which the wires pass



on twelve ten-pin cross arms supported on the bridge trusses. Here the wires are protected from mechanical injury, are but slightly exposed to the weather, are in a position where they can be seen by all visitors passing in electric launches, and the openings at the bridges afford a free access of air that insures good ventilation in the subway at all times.

From the bridge above mentioned the subway extends some three hundred feet to the portico of the Manufactures building, underneath which it is built in a straight line for the entire length of the west side of that building, a distance of 1,700 feet; then it passes under the north portico and over the United States Government building, a total distance of about seven hundred feet, then to the bridge connecting the Fisheries building, where it ends. The total length of these sections is about two thousand nine hundred feet, and, while starting with 240 insulators, ends with but 40.

The total length of all sections of the subway is about seven thousand feet, and entrances are effected through trap doors in



the several buildings to which they are connected, and also through 1,500 manholes.

Connecting directly or indirectly with this subway are nearly sixty miles of 6-inch pump logs, placed in trenches. The first ducts laid were assigned to the telephone, telegraph and fire alarm and police signal service wires, and it was then planned to utilize the superstructure of the elevated roadway for some of the arc, incandescent and power circuits, but later on this plan was abandoned and thirty-three miles more of pump logs utilized.

From the accompanying illustrations can be gained a fair idea of the appearance of this subway, and also how the many conductors will appear when all are in position.

CONDUCTORS FOR THE SUBWAY.—The contract for the circuit wires for the electric power circuits has not yet been given out, but it is estimated that conductors approximating in carrying capacity 200,000 feet of 4-0 B. & S. wire will be required.

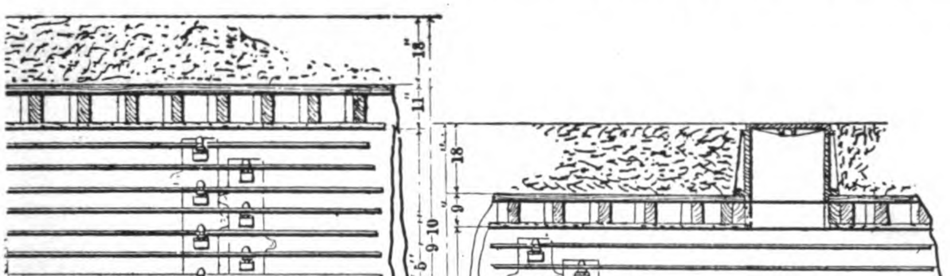
For fire alarm and police signal service the first contract was secured by the Okonite company, and called for 75,000 feet of a rubber-covered and braided No. 14 B. S. copper conductor, having an outside diameter of $\frac{6}{32}$-inch ; also 75,000 feet of double twisted

No. 14 B. S. conductors, braided in two colors. Later the Safety Wire Company secured a contract for similar conductors for the fire alarm and police signal service, which included 200,000 feet of each of the two specified above.

For the telephone circuits, the New York Safety Insulated Wire Company have furnished telephone cables for main distributors equivalent to 750,000 feet of metallic circuit. These wires, of No. 14 B. S. gauge, have an outside diameter of $\frac{4}{32}$-inch, are double-twisted, made up into cables and covered with one layer of jute and two layers of tape. For branch conductors about 100,000 feet of the same size wire and insulation, each wire being separately braided and the two then twisted together, have been furnished by the Safety Wire Company.

For the arc light circuits about 264 miles of No. 8 stranded (B. W. G.) copper conductor is being supplied by the Safety company. That portion used in the ducts has a lead-covered rubber insulation, making the total diameter ¾ of an inch and the portion strung in the subway will have a ½-inch outside rubber insulation.

For the incandescent circuits the New York Insulated Wire Company are supplying several hundred miles of Grimshaw wires



of various sizes that will be used in connection with the Westinghouse installation. Of smaller sizes of Grimshaw wire there will be several million feet used in the buildings, while for main feeder wires about half a million feet of larger sizes will be required.

In conclusion let me add that it must not be assumed that the engineers who placed this vast network of piping underground encountered no difficulties, or that it was merely a question of digging a hole anywhere in a great park. On the contrary, almost as much care had to be exercised as is necessary when doing similar work in a great city. For even after the main buildings were located there were reassignments in state and foreign locations, there were roadways and footpaths to be changed, and small but snaky tree roots to be pulled out. And then the stormy weather that prevailed during the first half of the year seriously interfered with all outdoor work. And though this long, triangular stretch of ground that is located but seven miles south of the down-town district is officially known as Jackson Park, yet two years ago, excepting the few acres at the northern extremity that gave promise of becoming an attractive pleasure ground, this so-called park was practically a flat, dreary waste of loose sand, with no picturesque elevations of surface, but here and there marshy spots of stagnant water, sloughs dangerous to cross, bordered with coarse underbrush, rank vegetation and stubby, shapeless trees. A section bounded on the east by a great expanse of water, which for ages past had washed up the cold and cruel coating of dull, pitiless sand that was shifted hither and thither by every wind, and under its remorseless weight burying all tender vegetation ; successive waves of sand that formed the only irregularity in the low, marshy tract. Such was the condition of affairs when the engineering staff planned the work that today is simply "out of sight."

THE POWER PLANT.

BY FRED DE LAND.

To the daily visitor at Jackson Park interested in electrical and mechanical engineering a section full of interest is the big power plant fast assuming shape in Machinery hall, for the different parts are being rapidly dovetailed one into the other as planned on paper months ago, and each found to be a perfect part of a practical harmonious whole. Not an ideal power plant in the accepted sense of that term, but a model power plant successfully installed after the buildings were planned and ironclad conditions had been erected on every side; a power plant that bids fair to be a lasting credit to its designer, Mr. Frederick Sargent, and as a working exhibit to show the most approved methods employed in the generation of steam and its utilization in driving electrical machinery.

This power plant occupies about one-fourth of the entire floor space of Machinery Hall, a building said to be more architecturally beautiful and greater in size than any exposition building heretofore erected, and is officially known as the Palace of Mechanic Arts. The total floor space in this building and the annex, both being practically under one roof, is about twenty-six acres, all of which is ground floor space, the slight amount of space open in the galleries being reserved for observation purposes, and for some light exhibits. Of these twenty-six acres, nearly seven acres in the form of a space 100 feet wide by 1,000 feet long has been allotted to the power plant proper, which occupies nearly the entire southern side of the building, and in this space will be exhibited the principal makes of engines and dynamos, ranging in size from units of 100 horse-power to 2,000 horse-power.

In addition to and adjoining the section of Machinery hall is the boiler house, which is 627 feet long and 86 feet wide, with an addition of the same width, but only 200 feet in length. There is an 18-inch wall at each end, while the sides and the gabled roof are of corrugated iron. Herein are the leading types of boilers, feed-water heaters, condensers, feed pumps and the other appliances found in all well-regulated boiler plants.

MACHINERY HALL.

The entire floor area of this boiler room will be of granitoid, affording clean and easy access to every portion of each battery of boilers and will be nine feet lower than the floor of Machinery hall, while extending the entire length of the room will be a gallery 20 feet in width and on the same level as the floor of Machinery hall, where the power plant is located, and the front half space, ten feet in width, of this gallery will be devoted to a promenade from whence visitors can inspect the boiler room. This gallery is supported by heavy brick walls rising nine feet above the boiler room floor, and that half nearest the wall of Machinery hall will contain the feed-water heaters, while underneath the heaters, on the ground floor and immediately in front of the center line of the boilers are placed the feed pumps that supply the boilers from the feed-water heaters, through an overhead system of piping. The water being converted into steam passes from the boilers at a pressure of 125 pounds through overhead pipes into a main header 800 feet long and 36 inches in diameter, that is supported under the gallery, and divided into seven sections, each adjoining section being connected by a 10-inch steam equalizing loop arranged to take up the expansion. From the top of this main header the steam passes through pipes laid beneath the aisles of Machinery hall to the engines in the respective blocks. From the steam chest of the engines the exhaust passes through pipes supported beneath the flooring to the feed-water heaters on the "visitors' gallery."

The equivalent of about 25,000 horse-power in steam will be generated in this boiler plant in water-tube boilers of the following well-known types, the capacity of each boiler being rated on a consumption of thirty pounds of water per hour per commercial horse-power, though the Exposition Company rented the boilers for the term of the Exposition at a term rental of $177.75 per 1,000 pounds of water evaporated each hour; the manufacturers to install and operate the boilers, but the Exposition Company to supply the requisite amount of fuel.

Extending from east to west the boilers are placed in the following order: Two batteries of two Root boilers, installed by the Abendroth & Root Company, New York, to supply 45,000 pounds evaporation per hour; two batteries of two Gill boilers, installed by the Stearns Manufacturing Company, Erie, Pennsylvania, to evaporate 45,000 pounds; eight Heine boilers (3,750 horse-power) installed in two batteries by the Heine Safety Boiler Company, St. Louis, to evaporate 112,500 pounds; two batteries of four National water-tube boilers (1,500 horse-power) by the National Company, New Brunswick, New Jersey, to evaporate 45,000 pounds; nine Zell boilers (3,750 horse-power) arranged in five batteries, to evaporate 112,500 pounds, and installed by the Campbell & Zell Company, Baltimore, Maryland; ten Babcock & Wilcox boilers (3,000 horse-power) arranged in five batteries, to evaporate 90,000 pounds; two Stirling boilers, manufactured by the Stirling Company, Pullman building, Chicago.

While all these boilers are of the water-tube pattern, each has its distinguishing features and form, and contain certain essential points that, in the estimation of their respective makers, insure successful and economical operation.

Underneath the visitors' gallery and on the same level with the boilers are the feed-water pumps assigned to the respective boilers, consisting of two Dean pumps, 7½ by 4½ by 10, for the Root boilers; two Barr pumps, 9 by 5¼ by 10, for the Gill; two Knowles, 10 by 5 by 10; one Gould, 10 by 12, and two Blake, 8 by 5 by 12, for the Heine; two Davidson, 12 and 20 by 10½ by 20, for the National; one each, Cameron, Laidlaw, 7½ by 4½ by 10, Wilson & Snyder, 14 by 8 by 18, and Canton pumps for the Campbell & Zell, and three Snow pumps, 8 by 12 by 7 by 12, 10 by 6 by 10, and 8 by 5 by 10, for the Babcock & Wilcox boilers. In order to give each boiler a fair chance to show its working capacity and to form a correct estimate of the amount of steam supplied, a water meter may be placed above the pumps, thus showing the actual amount of water evaporated by each boiler.

In planning how best to place the engines so that the greatest amount of work may be secured by the Exposition and at the same time afford the makers an exhibit that would prove attractive to prospective buyers, Mr. Frederick Sargent consulted with the different builders of engines and evolved the present plan that is highly spoken of by the interested parties, as it affords each exhibitor the opportunities desired for showing a working exhibit under advantageous circumstances.

The space allotted to the power plant in Machinery hall, 100 by 1,000 feet, was divided into fourteen blocks ninety-five feet in width, and each separated from the other by spacious aisles, and if the building is entered through the main portal, the first block will be found on the left of the south main aisle, the ground floor of Machinery hall being divided into three aisles extending from east to west, so wide as to be aptly termed grand boulevards.

Within the first block are the seven Worthington circulating pumps that form a part of this power plant and which are an independent exhibit from the Worthington station to the east of the boiler house. Four of these pumps have a capacity of seven and one-half, ten, twelve and fifteen million gallons per day capacity, while the size of cylinders are: 18½ and 29 by 17 by 8; 16 and 25 by 15 by 15; 14 by 22 by 15; 12 by 14 by 10; 14 by 19 by 15; 29 by 20 by 18; 14 and 24½ by 20 by 18.

All these pumps are leased to the Exposition Company on practically the same terms as the engines are, namely, free of charge during the exposition term, the Exposition Company to build all foundations, furnish and connect all piping and supply the necessary skilled attendance required in operation.

In the second block are four air compressors used in operating the Shone sewerage system; a cross compound Erie Ball engine, having cylinders 18 and 36 by 18 inches, and a driving pulley 86 inches in diameter, running at a speed of 225 revolutions a minute and driving two Edison 175-kilowatt generators; an Armington & Sims simple horizontal high speed engine, with 18 by 21 cylinders, a driving pulley 84 inches in diameter and 25-inch face, running at 225 revolutions, that also drives two 175-kilowatt Edison generators; and two of these four generators are expected to supply the current for the two electric fountains. There will also be two Edison multipolar generators directly connected to the shaft of a 1,000 horse-power vertical Edison engine in this block.

In the third block are three Phœnix engines from Meadville, Pennsylvania, driving four Eddy 450 horse-power generators. The first is a horizontal tandem compound condensing engine, having cylinders 13 and 24 by 18 inches and a driving pulley 108 inches in diameter and a 26-inch face, speeded to 200 revolutions a minute. The second engine is a simple high-speed horizontal with 18½ by 18-inch cylinders and a 98 by 26-inch driving pulley. The third is a 500 horse-power four-cylinder, triple-expansion, condensing Phœnix horizontal engine, having cylinders 15 and 24 and two 26 by 18 inches, and three pulleys 108 inches in diameter, two having a 26-inch face and one a 38-inch face, the normal speed being 200 revolutions a minute. An E. P. Allis cross compound condensing, having a driving pulley 16 feet in diameter, running at ninety revolutions, will be belted to a Westinghouse railway generator of 500 horse-power.

The fourth block contains two of the Woodbury type of engines, one of 375 horse-power, the other of 600 horse-power, built by the Stearns Manufacturing Company, at Erie, Pennsylvania, both being tandem compound condensing, the larger having cylinders 19 and 31 by 24, the smaller 15 and 25 by 20, with driving pulleys 102 and 31 inches and 88 by 23 inches, the larger being speeded at 165 revolutions a minute, the smaller at 200 revolutions. The larger engine will be belted to two Mather generators of 225 kilowatts, and the smaller to two Mather generators of 120 kilowatts capacity. There will also be a tandem compound condensing Ideal and a simple high speed Ideal engine in this block, built by A. L. Ide & Son, of Springfield, Illinois, the former having cylinders 13 by 22 by 16 and the latter 16 by 16, each with 72 by 16½-inch driving pulleys and both running at 245 revolutions a minute. Each of these engines are belted to two 100 horse-power "C. & C." generators.

The current generated in these four blocks will probably be utilized in operating the motors connected to the power circuits, and for the electric fountains.

The fifth block contains five Ball & Wood engines, a cross compound, 14 and 22 by 12 with a 66-inch driving pulley; two tandem compound engines, 13 and 20 by 16, and two simple engines 16 by 16. The four latter have driving pulleys 78 inches in diameter, and are rated at 150 nominal horse-power at 226 revolutions. These engines drive sixteen 60-light Brush arc dynamos and this block is a complete central station in itself with independent switchboard and other equipment.

The sixth block is the center block and the largest of all, occupying space over 150 feet in length by 95 feet in width. Here will be found the mammoth 2,000 horse-power Reynolds-Corliss engine built by the E. P. Allis Company, of Milwaukee, and a 1,000 horse-power Corliss engine built by Fraser & Chalmers, of Chicago. The Allis will be a quadruple expansion condensing engine, having cylinders 24 and 40 and 60 and 70 by 72 inches, a maximum load indicated capacity of 3,000 horse-power; a driving pulley 30 feet in height with a 76-inch face turning at the slow speed of 60 revolutions a minute; while the total weight of engine will exceed 650,000 pounds. Belted to this engine will be two of the mammoth new type of Westinghouse alternating incandescent dynamos of 10,000 lights capacity each, supplying current for the lamps in some of the main buildings. These two dynamos will be driven in tandem, both belts being 72 inches in width, the lower one 149 feet long while the upper one is 186 feet in length, both being loaned to the Exposition by the Page Belting Company. The F. & C. engine is a four-cylinder triple expansion condensing engine of 1,000 nominal horse-power and 1,250 indicated maximum horse-power, with a driving pulley 28 feet in diameter with 68-inch face and running at 65 revolutions a minute. This engine will drive one 10,000-light Westinghouse incandescent dynamo of the same type as the other two, with a Page belt. A noticeable feature in this block is the raising of the platform about two and a half feet above the floor level, a change found necessary owing to the enormous size of these engines. Westinghouse, Church, Kerr & Co. will place three vertical Westinghouse engines directly connected to exciter dynamos within this space, and the McEwen Manufacturing Company, of Ridgway, Pennsylvania, will have a tandem compound condensing engine with cylinders 14 and 23 by 20, running at 200 revolutions a minute, driving two "C. and C." 100 horse-power generators.

In the seventh block will be four 1,000 horse-power Westinghouse compound condensing engines of the vertical type, each directly connected to a 10,000-light alternating incandescent Westinghouse dynamo.

The eighth block will contain the four-cylinder tripel-expansion condensing engine of 1,000 horse-power built by the Buckeye Engine Company, of Salem, Ohio, with a driving pulley 20 feet in diameter, having a 75-inch face, running at 85 revolutions a minute; a 1,000 horse-power compound condensing engine, built by the Atlas Engine Works, of Indianapolis, with cylinders 14 and 24 by 30, and having a driving pulley 12 feet in diameter and 75-inch face, running at 150 revolutions a minute; and a McIntosh & Seymour double tandem compound condensing engine of 1,000 nominal horse-power, 18 and 32 by 36 double cylinders, having an indicated horse-power with maximum load of 1,500 horse-power, and a driving pulley 16 feet in diameter with 78-inch face. These three engines will be placed side by side, and will each drive one of the Westinghouse 10,000-light incandescent generators. The required belting for the Buckeye will be supplied by W. D. Allen & Co., and that for the McIntosh & Seymour by C. A. Schieren & Co.

The ninth block will contain two more of the 1,000 horse-power Westinghouse engines and direct connected 10,000-light dynamos. And these four blocks constitute what is known as the incandescent section of the power plant.

In the tenth block five Buckeye engines from Salem, Ohio, will be utilized in driving fourteen 50-light Wood arc dynamos manufactured by the Fort Wayne Electric Company. Three of the engines are simple high speed, having cylinders 16½ by 30, 13 by 16 and 13 by 21, and rated at 190 horse-power and 125 horse-power respectively; a tandem compound Buckeye with cylinders 11 and 21 by 16, and a 76-inch driving pulley with 26-inch face, running at 215 revolutions, the total weight of engine being 25,000 pounds; and a cross compound condensing Buckeye with 14 and 28 by 24 inch cylinders, belted to a Falls Rivet clutch pulley on a line of shafting to which six of the fourteen dynamos are belted. The larger of the three simple engines also drives a line of shafting to which four dynamos are connected.

In the eleventh block there will be twenty 50-light Standard arc dynamos, manufactured by the Standard Electric Company, Chicago, sixteen of which will be driven by line shafting belted to a double and a single tandem compound Russell engine, the larger having cylinders 15 and 24 by 24, and the smaller 13 and 20½ by 20, with driving pulleys 120 by 60 inches and 84 by 30 inches respectively, running at 125 and 180 revolutions. Directly belted to a third engine yet to be selected will be the four remaining Standard dynamos.

In the twelfth block air compressors may be placed.

The thirteenth block will contain sixteen 50-light Thomson-Houston arc dynamos belted to a line of Falls Rivet pulleys on line shafting driven by three engines manufactured by the Lane & Bodley Company, Cincinnati, a cross compound condensing having cylinders 16 and 30 by 42, with a pulley 16 feet in diameter with 43-inch face, turning 70 revolutions a minute; a tandem compound condensing with cylinders 16 and 28 by 42 and a pulley 18 feet by 36 inches, and a simple high-speed engine 18 by 42, both the former running at 80 revolutions a minute.

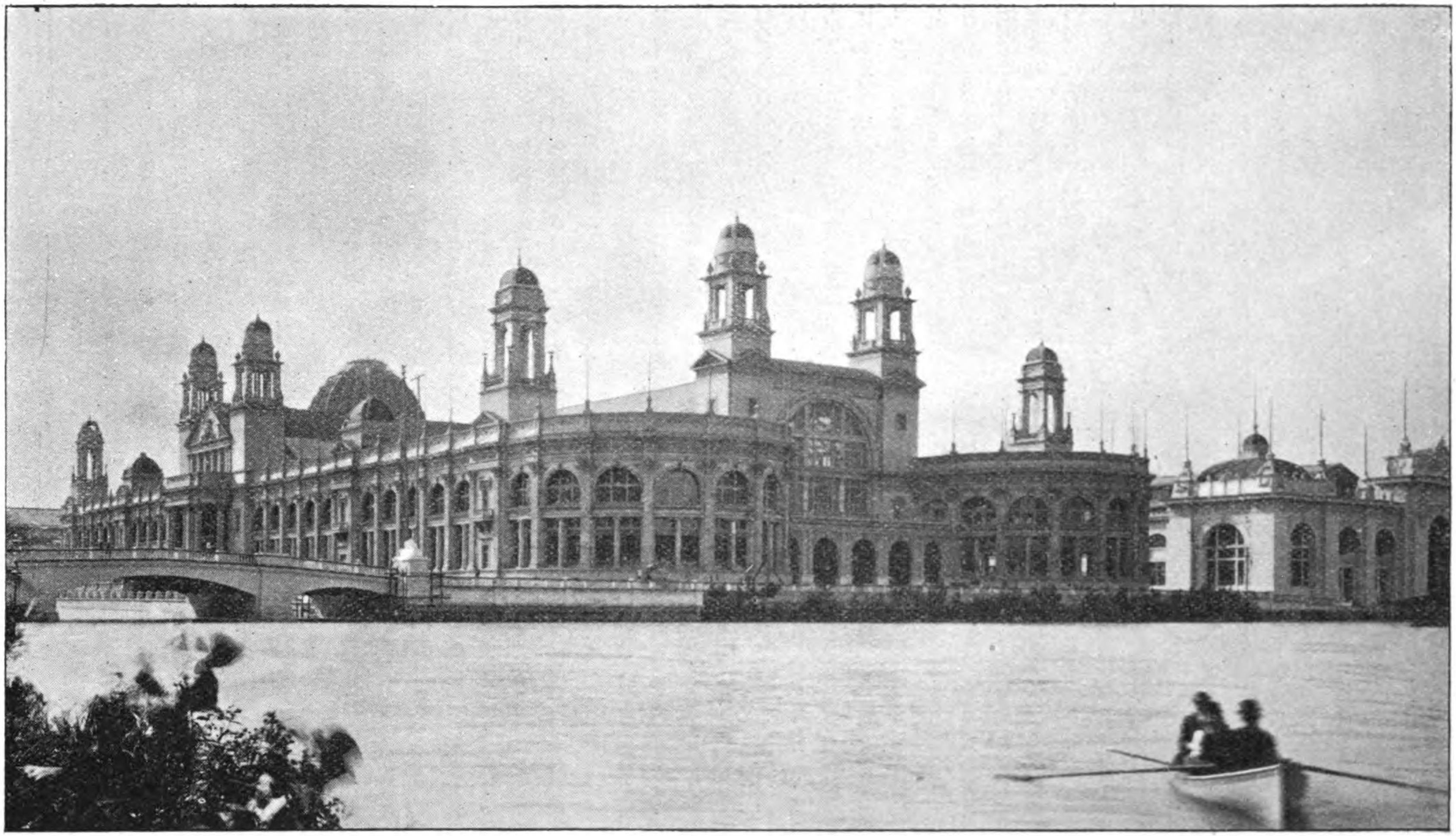
The fourteenth block will contain ten 50-light Thomson-Houston arc, and six 50-light Excelsior dynamos belted to two sections of line shafting, one driven by a tandem compound condensing Atlas engine, 14 and 24 by 30, having a driving pulley 12 feet in diameter with a 36-inch face, running at 150 revolutions a minute, and the other by a Bass cross compound condensing engine built by the Bass Foundry and Machine Works, Fort Wayne, Indiana, having cylinders 16 and 30 by 42, with a driving pulley 16 feet in diameter and a 43-inch face.

The fifteenth block, the last one laid out at present, will have ten 50-light Western Electric arc light dynamos. These machines will be directly belted to a double tandem compound condensing Watertown engine built by the Watertown Engine Company, Watertown, New York, having cylinders 9 and 16 by 24 inches and a driving pulley 72 inches in diameter and a 12-inch face; and to two Skinner engines built by the Skinner Engine Company, of Erie, Pennsylvania, both being simple high-speed engines with 16 by 18 cylinders.

These fifteen blocks constitute what is known as the power plant proper, including the arc lighting section, the incandescent section and the power section, and the total indicated horse-power of the forty engines employed is about 18,000 at the maximum economical load.

Then, in addition, there will be several other well-known engines installed as working exhibits in Machinery hall, and belted to line shafting, notably a tandem compound from the Sioux City Engine Works, Sioux City, Iowa, a simple high-speed engine from Cooper, Roberts & Company, Mt. Vernon, Ohio, a tandem compound from the Gold, Steel & Mineral Iron Works, of San Francisco, California; a tandem compound condensing from the Hooven, Owens & Rentschler Company, Hamilton, Ohio; a simple 20 by 48 from the Bates Machine Works, Joliet, Illinois; and two tandem compounds having cylinders 17 and 28 by 18 and 15 and 28 by 18, with pulleys 102 inches in diameter and 30-inch face, from the Harrisburg Foundry & Machine Works, Harrisburg, Pennsylvania. Then there will be a few foreign engines, so that the economical total capacity of the working exhibits will be about 23,000 horse-power.

(*To be continued.*)



ELECTRICITY BUILDING.

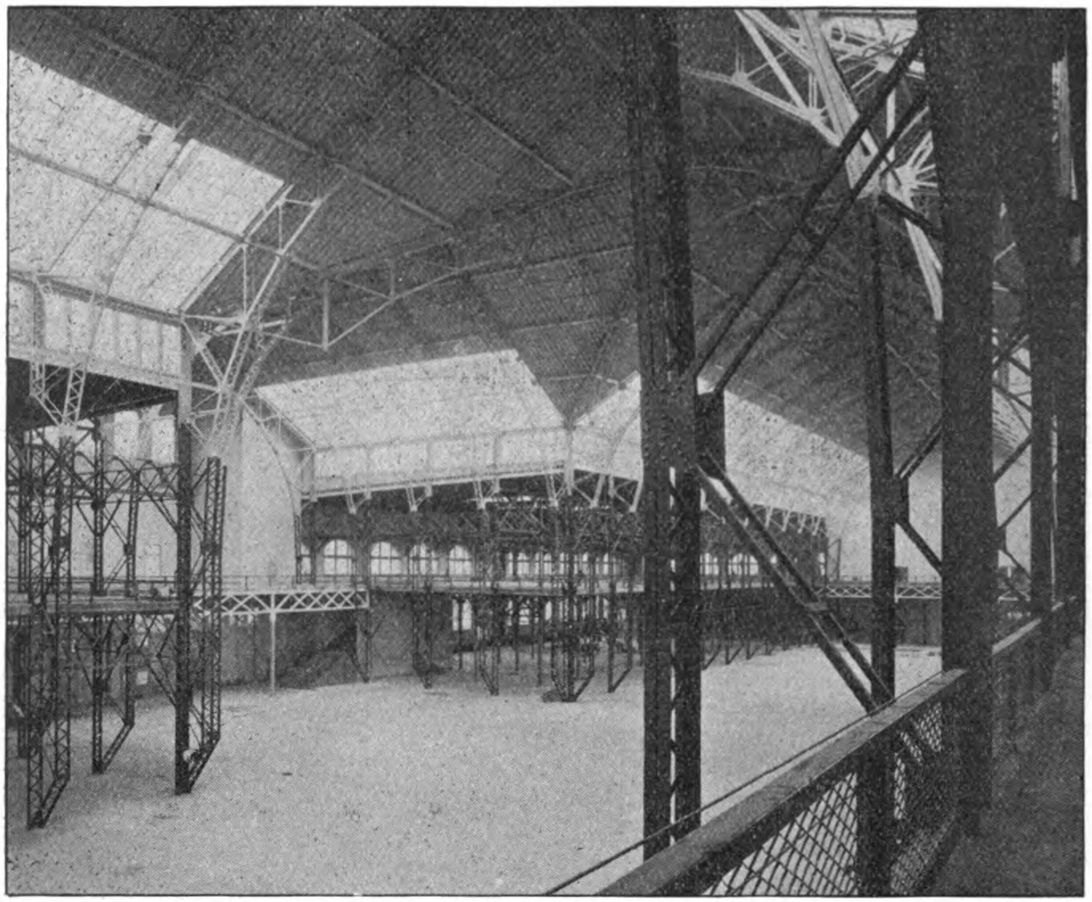
THE ELECTRICITY BUILDING.

Across the canal, with its long façade toward the canal, and its shorter ends facing the Administration building and the lagoon, stands the Electricity building of Messrs. Van Brunt & Howe, measuring 700 by 350 feet. Being smaller than either of the other structures around the main plaza, its designers seem to have thought that it should be more self-assertive in outline, and that verticality should be strongly emphasized. One cannot think the idea mistaken, but one wishes it had been somewhat differently carried out. There is no central dome, and the roofs cross at right angles, after the manner of the roofs of nave and transept in a cathedral which has no central tower or flèche. Yet the outline of the building is very much broken. The porch, which forms the middle feature toward the plaza, rises far above the main roofs, with a lofty open portal in its center marking the height of ceilings beyond it; above this is a pediment, and then a great plain attic. The angle pavilions are unsymmetrically treated with gables of different sizes, and from each springs a turret with open sides and a small conical dome. Similar turrets and domes flank the entrance pavilion toward the canal, with a windowed story and a gable between them, and below a projecting columned porch, and entrance toward the lagoon is treated in still another equally elaborate way. Moreover each of the arcaded longer walls between the central and the angle pavilions is divided half way by a broad, solid pier, which, carried up above the roofs and finished with a domical roof, makes the effect of an intermediate pavilion. The walls themselves show two stories, included in the round-arched arcade, the lower openings being divided rather unfortunately, a single column in the middle of each. In so diversified a structure some breaking of these openings was doubtless desirable, but if each had been cut into three instead of two parts, it seems as though the effect would have been better. A single supporting member in the axis of a large opening is not conventionally correct, I think, and there is usually a good artistic reason for architectural conventions, of which many generations of great builders have approved. Nor is the composition of the pavilions as successful as it is in neighboring structures, nor are the outlines of the turrets either very dignified or very graceful.

It should be remembered, however, that the standard by which these great Fair buildings must be judged is very high. So lofty a degree of excellence has been achieved in some of them that work which is even a little less good incites to criticism. Had this Electricity building stood, for instance, in the grounds of the Philadelphia exhibition, it would have seemed a very distinct and marked success.

In treatment it is less nearly classic, more decidedly Renaissance, than either of the others we have seen, and Corinthian, Ionic and composite orders are all introduced into the design, while a modern and appropriate character is given the details by the constant introduction of electrical tools and symbols. Some of this purely architectural ornamentation is very good, but, once more, the figure sculpture does not promise to be as fine as one would like to see it. Under the vast archway in the portal which faces the court, and which admits to a great semicircular porch with a domical ceiling, will stand a statue of Benjamin Franklin, fifteen feet in height, and mounted on a lofty pedestal. The station is a superb one, and the subject unsurpassed, among all American subjects, for historical interest and dramatic suggestiveness. But in trying for dramatic effect the sculptor, Mr. Carl Rohl-Smith, who, I am told, is a Danish-American, has fallen into melodramatic over-emphasis, although of a more robust and masculine sort than that which marks the work of the Viennese sculptor, Mr. Bitter. Franklin holds in one hand his kite, which rests upon the ground, and in the other uplifted hand the historical key. But his body and head are thrown back, and he is gazing into the air in a pose which makes us feel that he is trying to play the rôle of Ajax rather than his own. He seems not to be searching the heavens, but to be defying them, and also to be less intent upon mastering his problem than upon impressing spectators with the fact that he is equal to mastering any problem.

In the pediment over the portal which faces the canal is a sculptured group designed by Mr. Richard Bock. But this group does not fill the pediment, either in its width or in its height. Between the group and the apex of the triangle is a wide, vacant space, while on each side of the group stands an ornate pilaster, and beyond this the ends of the triangle are occupied by a scroll-work of acanthus leaves. The effect is distinctly unfortunate. Contemplating it, we feel how wise is the traditional rule that the boundaries of such a space should be regarded as the frame of a picture, and that the sculptures should be so conceived as to fill, without crowding, the frame — accommodating themselves to its area, yet not seeming cramped thereby. This pediment does not look at all as though its decoration had been designed for it. It recalls a thing we often see in the south of Europe — a pediment on an early Christian church into which have been fitted, for their own sakes rather than for the sake of architecture, fragments of classic sculpture originally designed for some different situation.—*Mrs. Margaret G. Van Rensselaer in the New York World, September, 1892.*



INTERIOR VIEW IN ELECTRICITY BUILDING.

THE ELECTRICAL EXHIBITS.

There was a legend among the ancient Phœnicians that the pieces of amber that were occasionally washed up by the sea were the petrified tears of maidens, who, disappointed in love had cast themselves into the arms of mother ocean and thus returned, like Galatea, to the source whence they had come. As such, they were highly prized and were the symbol of purity, and when used in barter were valued more highly than refined gold. They were worn as amulets, and to have one about the person was to obtain immunity from evil thoughts and the attacks of foul disease.

It is related of Thales, the earliest of Greek philosophers, who lived about 600 B. C., that when he discovered the electrical properties of amber, he thought he had called back to life the soul of a virgin, who in life had been so lovely, so pure, so perfect that even inanimate objects were attracted to her, and rushed to her pure caresses, and that he predicted that she would henceforth live forever to bless and to cast her benign radiance over the evil world.

Thales left no writings of his own, and what little we know of him and his philosophy is derived from the writings of his contemporaries, and the story is probably a myth, but it is such a pretty one, and in the light of the present day, seems so prophetic that we are loth to be so harsh with ourselves as to cast it from us.

The Greeks called it *electron*, whence our name electricity, and the peculiar property which Thales is credited with having first observed was supposed to be its soul, for the ancient Phœnicians and later the Greeks believed that even inanimate objects possessed souls, hence the negative electricity which it evoked by rubbing amber was known as amber-soul.

We would fain believe that amber has a soul, even in this day, for what without a soul could have wrought such wonders as has electricity during the last decade.

Standing in the great entrados of the south portal of the Electricity building, arching one hundred feet above our heads and spanning a gateway seventy-five feet wide, and glancing to the south we will see one of the applications of this ever-living amber-soul in the ever-changing hues of a living electric fountain, gorgeous beyond description, a fitting symbol of the voyage of discovery which this great exposition is designed to commemorate. Here, too, we see the bark of destiny, guided by hoary Time and urged on by maidens, but their tears are dried now and the light of expectancy of a new world fills their eyes. There is no more use for amber-soul; the genius of the nineteenth century, less poetical, more practical than that of Thales' time, has displaced the beautiful picture, and hung in its place the homely dynamo, which, if more prosaic, is still more useful.

But as we stand at the opened door, peculiar feelings fill our souls. To the layman, the Eleusinian mysteries lie beyond. To him all is strange, inexplicable, wonderful. He knows not the why nor the wherefore, but the one profound, unfathomable fact, It is.

To the electrician it is Aladdin's temple, for did not Thales by rubbing his wonderful lamp call up his good genius amber-soul, and by evoking this were not all these wonders called into being? His will be the enjoyment of the veteran actor, who sits in front of the curtain. An enjoyment no less keen because he knows that the bright interior but hides the grime of the machinery. His enjoyment is of another kind, that of the connoisseur, for he will see, as never before, the wares of rivals, the best their shops afford, side by side. To him there will be no mystery. He will see in each device a means, perhaps a different means to one common end. Not only can he compare the wares of American rivals, but these with those of foreign manufacture. The different temperaments, the different environments and local requirements in the different countries have resulted in radically different types of machinery, and now for the first time will he be offered the opportunity of making a close comparison of the old world and the brilliant ingenuity of his own.

Turning to the north (the points of the compass are readily found, for the lake lies to the east) and entering the central door the visitor looks upon a scene of bewildering splendor. A building 750 feet in length and 300 feet in breadth, divided by systems of arches 105 feet high, and 115 feet span into two naves crossing at right angles in the center, the whole interior tinted a delicate blue — just blue enough to correct the yellow of the myriads of incandescent lamps — comes before his eye.

The painting of this interior is worthy of note, from the fact that the major portion was done by electricity ; the first time in the history of the world that such a job has been done in such a manner. An electric motor pumps the calcimine and air through a hose, and the same issues from the nozzle in a fine spray, which being directed against the undressed beams penetrates every nook and cranny in a manner that it would be very difficult to accomplish with the brush, and with much greater rapidity. In fact it is claimed that one nozzle thus used will accomplish the work of twenty men with brushes, and do the work as well, or better. By this means it has been possible to tint the interiors of all the buildings, and this is said to be the first instance where the temporary exposition buildings have been painted on the inside. The effect in the Electricity building is exceedingly pleasant. The delicate blue is restful to the eye in the day time, and at night it reflects white light so as to add to the brilliancy of the illumination.

As a basis for the illumination of the building, the Exposition authorities have provided 450 2-thousand candle-power arc lamps, or one to every thirty feet radius of floor space, but this is only a drop in the bucket in the vast amount of light to be furnished by individual exhibitors who each for himself may try to outdo his neighbor in brilliancy of effects.

Entering the main portal, it is planned to have the eye of the visitor at once attracted by a colossal structure of glass rising seventy feet above the floor and situated directly beneath the center of the groined arch formed by the intersection of the north and south and east and west naves. This will be the exhibit of the Phœnix Glass Works, and with its interior illumination from many colored lights and the kaleidoscopic change of its prismatic colors with each change of position of the observer, crowned with its tiara of arc lamps suspended from the lofty dome above, will form a fitting centerpiece for the magnificent setting from which it seems to spring. Probably nothing more brilliant, nothing more gorgeous has ever been attempted before. It may be likened to an electric fountain, immobile crystal — petrified, as it were, in the midst of its play.

Can it be that the living fountain without was intended to typify the flowing tears of Astarte weeping for her lover, and that this is symbolic of those same tears petrified, whence came originally our electricity, or is it merely a fortuitous accident? The former thought is so pretty that we are inclined to believe that this arrangement is the result of design, and shall so regard it.

If we choose the left-hand (west) aisle, we have the Bell Telephone and Detroit Electrical Works on our right, and the Brush Electric Company, the Swan Lamp Company, the Short system of electric railways and the Fort Wayne Electric Company on our left. In the former exhibits will be seen the peculiar Brush machinery with the ring or Pacinnoti armatures — the only ones of the kind now manufactured in this country — and a profusion of arc and incandescent lamps, and we remember that Brush was a pioneer in this work and that it was he who made arc lighting a commercial success.

(*To be continued.*)

WORLD'S FAIR LITERATURE.

Among the original articles on World's Fair topics that have appeared during the past year none were more interesting than Mrs. Schuyler Van Rensselaer's weekly letters in the New York *Sunday World*, and the late article on "The Artistic Triumph of the Fair Builders," appearing over her signature in the December *Forum*.

Scribner's had three articles worthy of perusal: "The Making of the White City," by H. C. Bunner, in the October number; "Chicago's Part in the World's Fair," by Franklin MacVeagh, in the November number; and in the December number an extremely interesting article by F. D. Millet on "The Decoration of the Exposition."

The *Century* magazine during the summer published a series of high-class papers prepared by Henry Van Brunt, of the firm of Van Brunt & Howe, of Kansas City, the architects who designed the Electricity building. The papers were five in number, and appeared under the title of "Architecture at the World's Fair."

Harper's Weekly has supplied many columns of World's Fair matter, much of which was carefully prepared, interesting and instructive, and especially entertaining was the description of the dedication ceremonies given by Richard Harding Davis.

In *Harper's Monthly*, Mr. F. D. Millet tells us all about the "Designers of the Fair," and adds to the value of his very readable paper by a fine collection of portraits. Earlier in the year Julian Ralph supplied one of his picturesque sketches of the Fair under the title of "Our Exposition at Chicago."

Mr. W. H. De Young wrote a comparative description of the Columbian World's Fair, which was published in the *Cosmopolitan*.

THE WORLD'S FAIR.

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Of course, big as it is, our Fair is a small place compared to imperial Rome ; and fine though its structures are, some of them show conspicuous faults. But taken as a whole, considered as a great complex yet single work of art, viewed as a vast panorama of stately architectural and natural features, I believe that no place of its extent in the modern world has been so impressive, so magnificent, so imperial in its beauty. It seems an astounding fact that it can really exist. It seems a miracle that it can have come to life within the space of two years. It is impossible to think that a spectacle of equal beauty will again be created in our lifetime ; for in no other city will the designers of an exhibition have at command the shores and waters of a veritable ocean, and from the admirable use made of these shores and waters a large part of the beauty as well as the originality of the Chicago Exhibition has sprung. Man had here to conquer Nature in one of her most recalcitrant moods. But having conquered her, the result is more admirable as well as more individual than could have been any result won by a less desperate struggle. If among my readers there is any American who despairs or even doubts of our Republic as fertile soil for intellectual and spiritual progress, let him go to Chicago next summer and come back with a new heart in his bosom. And if there is any who thinks he could not be more full of hope and faith than he is today, let him also go for the sanctioning and exalting of his present confidence. Above all, it is the children who should be taken — that young generation upon which the future of the Republic rests, and the sons of which, if it develops as we have a right to expect, will, I firmly believe, head the world's advance in those intellectual paths where progress in art should run parallel with progress in general knowledge, in science, in literature, in the betterment of social conditions, and in morality. A lesson like the one Chicago will teach, received in impressionable years, will be the best gift that any American parent can bestow upon a daughter or a son. A trip to Chicago will be a pleasure trip truly. But it will also be a voyage of discovery, opening routes which will lead the Nation to the fountains of intellectual power, to those green meadows and pleasant waters which encompass lives open to the enlightening, sanctifying inspirations of beauty and the attractions of unselfish intellectual endeavor. And it will likewise be a journey fruitful in the influences which go to make good citizens, true patriots, wise and public-spirited Americans.—*Mrs. M. G. Van Rensselaer, in the Forum for December.*

WORLD'S FAIR ARCHITECTURE.

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The main group of buildings at the Philadelphia Centennial surpassed but slightly the housings of an ordinary county fair. They looked lank, flimsy, provisional. They prompted one to an immediate search for the biggest pumpkin and the loudest log-cabin quilt.

The principal group of buildings just finishing at Jackson Park offers a spectacle that, in its spaciousness, homogeneousness and splendor might almost be compared with that presented by the Palatine Hill in the days of the early Roman emperors.

This advance has been made in only seventeen years. It should be sufficient to show that artistic America is moving along at an equal pace with industrial America.

The Spanish style of the Renaissance is most apparent in the Machinery building. Its towers are modeled on the familiar Giralda tower at Seville, and domes similar to those that cover its corner pavilions are met with, in a modified form, in the cathedrals of Toledo and Segovia. This building aims at the fusing and harmonizing of a larger variety of architectural features than any other building on the grounds, its peculiarities of picturesqueness and freedom convey a powerful address to the American imagination, and are likely to give an impetus to the fancy of our younger architects throughout the coming decade or longer.

The Electrical building may be properly included in the academic group, whose members have been referred to more or less in detail, though it has peculiarities that give it a transitorial character — transitorial toward the freer play of style that prevails in the buildings around the wooded island and beyond. It is not all that might have been expected from its gifted author, the writer of the present series of World's Fair articles in the *Century* magazine and the clever translator of Viollet-Leduc's "Discourses on Architecture." The façade toward the grand plaza is hardly as successful as the double-apsed back turned toward the lagoon, and the whole effect of the composition is that of an air by Meyerbeer — rather labored, mechanical, self-conscious, without the real up-lift that comes from spontaneous creation. But it is obviously an "after-dark" building; its numerous towers do not rise for nothing, and under illumination it will doubtless justify itself.—*Henry B. Fuller in the Chicago News Record.*

BY BRUSH AND CHISEL.

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It is a difficult undertaking in a single article to know what to describe where the collection is such as one finds on the grounds occupied by the White City. An entire week does not suffice to give the visitor, even at this time, an idea of the work. As one wanders about one is reminded of the transformation scene in some great spectacular piece. One sight is surpassed by another, and the unfolding continues until one conjectures where the end is to be. Here there is much matter for all feeling, so long as the feeling is bounded by admiration, exultation and wonder.

If one goes into the Transportation building, or if one stands without its walls, it is the same. It is the golden entrance with its spacious arch, or it is the sculpture. One of the most striking figures is by Boyle. It is a woman standing on the cowcatcher of a locomotive. In her hands are sections of machinery symbolical of the power necessary in transportation. On either side of her, in sitting posture, are two other figures, on the face of each an expression indicating triumph. Another figure by the same sculptor is called "The Pilot." A youth stands at the wheel looking out to sea. Is it a storm in the distance, land, a sail, or what? No matter. The gaze is one of such intenseness that it follows the beholder long after he has passed from it.

There is not so much sculpture on the Electricity building as on some others. The statue of Franklin with his key to the elements is the most striking. One is so accustomed to see the great philosopher in that attitude that the figure is not as impressive as it would otherwise be. It will, however, bear study, and the longer one looks at it the more it grows. Some persons will say that such works last longest in the mind. It is too early to write anything about the Electricity building. Not until the doors swing open to admit the visitors to the workings of the coming motive power of the world will it be time to enlarge upon the building and all which it will then contain. When that is done those who thought the Manufactures Building Dedication Day too huge to describe will come to the conclusion that that occasion was a very trifling affair. When that day comes people will adopt the language of the Queen of Sheba when she stood before the glory and splendor of Solomon.

Crossing the bridge over the lagoon opposite the central pavilion of the west side of the Manufactures building, one finds a figure which will arrest the attention of the visitor, no matter how brave the visitor may feel. It is known as "The Still Hunt." It represents a huge panther in search of prey. The crouching attitude and the earnest look in the eyes are such as to make the beholder almost feel that the animal is a thing of life. There are few figures on the grounds which have received so much attention as this. It is something for the sculptor to have made a figure like this that stands out as prominently as it does in the face of such buildings as the Manufactures and Electricity. The dimensions of these buildings alone are sufficient to engross the attention. But before them this crouching beast of prey receives its share of admiration, and the visitor is puzzled to know where to center his gaze.

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The most imposing group of statuary in the Exposition grounds is the Columbian Fountain, designed by Frederick McMonnies, of New York. Placed as it is at the head of the grand basin, in the large open space in front of the Administration building, and near all of the more important buildings except the Art Palace, it is certain to be one of the features of the Fair. It will be a magnificent sight at the close of day when, against the dark background of the Administration building in shadow framed by the golden sky of sunset, the visitors will pause to gaze upon Columbia seated high upon a barque with Fame at the prow, propelled by the oars in the hands of eight female figures personifying the arts, sciences and industry, and guided by the governing hand of Time, while eight out-riders on sea-horses clear the way through the splashing foam.

The barque, which resembles somewhat the form of a Spanish caravel, is placed in the center of a basin 150 feet in diameter. The figures are fifteen feet in height. It may readily be imagined that the work of fitting the various parts of plaster together and setting them up is no small task. The plumbing required to conduct the water to the eighty or more jets and to direct it so that it shall fall in the desired lines is also an undertaking of magnitude.

The group is built up with plaster over a strong framework of wood and iron, with the exception of the oars, which are made of zinc that they may have the required strength.—*Extracts from an article in the Chicago Sunday Tribune, November 27.*

THE DECORATION OF THE EXPOSITION.

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The four grand central portals of the Manufactures and Liberal Arts building recall triumphant arches of Roman times. Each of these portals has a lofty central entrance with rich bas-reliefs by Mr. Bitter, and smaller side arches under pendentive domes. These eight domes have been filled with figure decorations, each by a different artist. * * *

In the north portal Mr. J. Carroll Beckwith has illustrated the subject of Electricity as applied to Commerce. Four female figures occupy the pendentives. The "Telephone" and the "Indicator" are personified by a woman standing holding a telephone to her ear and surrounded by tape issuing from the ticker; "The Arc Light" by a figure holding aloft an arc light; "The Morse Telegraph" by a woman in flying draperies seated at a table upon which is the operating machine, while she reads from a book; and "The Dynamo" by a woman of a type of the working class, seated upon the magnet with a revolving wheel and belt at her feet. Above, in the upper dome, is placed the "Spirit of Electricity," a figure of a boy at the top of the dome from which radiate rays of lightning, to which he points. * * *

Much has been said and much written about the proper color to be given to the exteriors of the great edifices. Experience shows, even if reason had not already dictated the decision, that the nearer they are kept to white the better for the architecture. Every experiment which has been made to produce æsthetic effects of texture suggested by the usual treatment of plaster objects has resulted in partial or in total failure, and every time the warm white of the staff has been meddled with, its glory has departed. But the conditions imposed by the climate, by the impossibility of securing a homogeneous surface, and by the exposure and consequent discoloration of a certain portion of the work, have made it necessary to apply some sort of paint to all the buildings. Ordinary white lead and oil have been found to give the best results, for the irregular absorption of the staff and the weathering rapidly produce an agreeable, not too monotonous an effect, and the surface deteriorates less rapidly after this treatment. The single notable exception to this simple scale of color is found on the Transportation building, which has been given to Healy & Millet, of Chicago, to cover with a polychromatic decoration, carrying out the original intention of the architects, and making it unique and splendid in appearance. All the statuary of this building is to be treated with bronze and other metals, the great portal, commonly called the "Golden Door," will be exceedingly rich and gorgeous in effect, and the intricate ornamentation of the architectural relief decoration will have an echo in the flat surfaces covered with rich designs. — *F. D. Millet in the December Scribner's.*

THE DESIGNERS OF THE FAIR.

* * The general theme of the architecture of the buildings is on the lines of classic renaissance. The Administration building, stately, impressive, virile, standing as it does in a plaza inclosed by lofty façades, and facing the broad basin, beyond which the blue line of the lake horizon is seen through the noble columns of the Peristyle, needs no signature on its base to mark it as the work of Mr. Hunt, for it is as characteristic of his hand as a picture is of the touch of the artist who painted it. The same may be said of the dignified, scholarly and tasteful structure of the Agricultural building, by Mr. McKim, with its

well-studied proportions, the richness and choice quality of its ornamentation and its sympathetic style, if such a characterization may be permitted. The lofty porticos of the Manufactures and Liberal Arts building, leading the eye off to an interminable succession of arches, whence it wanders in amazement to the grand roof above, are no less illustrative of the skill, the energy and the rare attainments of Mr. Post, who has given us a series of great portals such as might have adorned a forum or spanned an imperial route of triumph, while the Peristyle of Mr. Atwood connects the two last named structures by a fitting screen of great nobility and grandeur.

In this manner we may wander about through the whole group of buildings, admiring in turn the Machinery hall, by Peabody & Stearns, of Boston, with its grand arcades, shapely domes and extensive colonnades; the grand hemicycle of the Electricity building, by Mr. Van Brunt; the sturdy Mining building, by Mr. Beman, suggesting monumental strength; the appropriately modern and novel Transportation building, by Mr. Sullivan, with characteristic, rich and cyclonic ornament — I hope he will pardon me the last adjective; the graceful and charming Choral hall, by Mr. Whitehouse; the impressive dome of the Horticultural building, by Mr. Jenney; the dainty but tasteful Woman's building, by Miss Hayden; the rich, effective and fanciful Fisheries building, by Mr. Cobb, with its interesting and ingenious ornamentation and satisfactory pile; and at last the grand, perfectly proportioned Art building, by Mr. Atwood, with its exquisitely beautiful Ionic columns, its choice details and its pure style, echoing perfectly the charms of the Erechtheum. Modern man has never before been permitted to enjoy a ramble so full of delights to the eye and so satisfying and instructive. Noticeable defects become trivial in the presence of so much that is grand and fine and noble. The perfect but varied adaptation of each building to its proposed use, the significant differences disclosed in the individual interpretation of this condition — in short, the handwriting of each architect on the great sketch he has contributed to the Exposition is one of the most interesting and suggestive points of the whole work. The only building in the list of large structures which breaks the harmony is the one I have omitted to speak of above, whose architect worked on independent lines and has produced a discordant note. I refer to the

Government building, which I can characterize no better than by paraphrasing the school girl's composition on pins, "Pins have saved the lives of a great many people by their not having swallowed them": the style of its architecture has saved the reputations of a great many architects by their not having adopted it.—*F. D. Millet in Harper's Monthly*.

THE EVENING CLOSING RULE.

Following the publication in the Chicago *News Record* of an abstract of the rules governing the Exposition, the writer called on the Exposition authorities, and was informed that while one of the rules read: "The gates shall be open to all exhibitors and all employés at 6 A.M. and to the public at 8 o'clock A.M., and closed at 7 o'clock P.M., except in such cases as the management shall direct for special evening entertainments, and in such instances the gates shall close at an hour not later than 11 o'clock P.M," yet there was no intention of closing the gates on any number of evenings; the 7 o'clock clause being merely added to enable the Exposition to close early should the attendance be light when disagreeable weather prevailed. Moreover, an average of four evenings each week have already been allotted for "special evening entertainments," so that but two nights in each week remain when the gates could be closed if so desired. Owing to the sensational articles that have appeared on the subject of the evening closing rule the following note from President Higinbotham is interesting:

WORLD'S COLUMBIAN EXPOSITION,
EXECUTIVE DEPARTMENT.

HARLOW N. HIGINBOTHAM, President.
FERDINAND W. PECK, Vice-President.
ROBERT A. WALLER, Second Vice-President.
HOWARD O. EDMONDS, Secretary.

Fred De Land, Esq., City: CHICAGO, November 26, 1892.

DEAR SIR,—Replying to your favor of the 19th inst., I beg to thank you for your prompt and intelligent action relative to the evening sessions of the World's Columbian Exposition. It was never intended that the grounds should be closed on all evenings, but only on such evenings as the management were disposed to think that it would not be practicable to open the gates.

Again thanking you for your interest in the matter, I am, with respect,

Very truly yours,

(Signed) H. N. HIGINBOTHAM, President.

THE TELEPHONE INTERESTS.

The critical condition of telephone affairs in Chicago, in view of the approach of the rush of business which will be attendant upon the opening of the World's Fair, is commanding the best attention of the highest talent engaged in this field of electrical engineering. That the authorities of the American Bell Telephone Company are fully alive to the importance of the situation in the World's Fair city, is evidenced by the fact that within a short time the president of that company has spent some time in Chicago making a personal investigation, and he was accompanied by the chief engineer of the Bell Company, Mr. Davis. Subsequently Mr. Lockwood, electrician of the American Bell Telephone Company, spent some time in Chicago investigating the conditions and problems which confront the local company, as did also Mr. A. S. Hibbard, general superintendent of the American Bell Telephone and Telegraph Company, otherwise called the Long Distance Company. The opening of telephonic communication with Boston and New York enables the experts and authorities residing in those cities to keep in touch with the local representation and experts in Chicago, and great use of these facilities is made for the purpose of preparing, as well as money and the best talent obtainable can prepare, for the approaching crisis. Several changes in the Chicago Telephone Company staff have been made.

The crisis in Chicago has a twofold importance, resulting from the enormous growth of the business in the past and the prospect of abnormal growth during the year 1893, and from the fact that just at this juncture the original Bell patent will expire. It would seem that the most important point, telephonically considered, in the world just now is Chicago, and it is toward this city that all eyes will be turned for the next year for interesting news in this line. It is the purpose of WORLD'S FAIR ELECTRICAL ENGINEERING to give special attention to this branch of electrical work.

A BRIEF REVIEW OF SOME LEADING ARTICLES IN THE ELECTRICAL JOURNALS.

In some recent tests made by Professor Ewing on an improved Parson's steam turbine an efficiency on a par with usual steam engines was obtained ; and according to Professor Ewing it is now well fitted for central station work.

A paper read before the Chicago Electric Club by Mr. Willis, on the use of compound wound generators, elicited considerable discussion as to the best means of compensating for the rise of voltage when the load of a number of over-compounded dynamos, working through a long feeder, in multiple, is transferred to one machine. A number of methods were suggested.

Professor Ewing recently gave an exhibition of his perfected instrument for tracing magnetic curves. The curves are traced by the operation of a delicately suspended mirror, acted on by variations in a special arrangement of electro-magnets. The changes of magnetization are produced by a continuous commutator, arranged to make the variations very gradually, thereby insuring smooth action and preventing jerking.

Mr. H. L. Tyler describes, in the *Electrical Engineer*, a type of non-commutating direct current dynamo. The machine is of the stationary armature type with an inner revolving field. The currents are supplied to the field by means of brushes in contact with a revolving pole changer, in place of the ordinary commutator. The advantages claimed being high efficiency and low cost of construction with the absence of sparking.

M. Giulio M. Appolonj, in an article in the *Electrical World*, describes a universal transformer, arranged to transform a continuous current into any desired voltage, a simple alternate current into a continuous one, or vice versa, and a polyphrase alternate current into a continuous one, or vice versa. The apparatus consists of a specially constructed Pacinotti ring, wound with double bobbins, connected to a commutator, the transformation being accomplished by rotating the contact brushes.

Mr. F. S. Pearson, of the West End Street Railway Company, of Boston, in the course of the discussion at the recent meeting of the Street Railway Association, at Cleveland, made some very pertinent remarks on the use of the ground returns. Mr. Pearson thinks that for small roads and where the distance is not great, the use of the rails and ordinary supplemental wire is sufficient; but on roads where the traffic is heavy, more grounds than heretofore used will have to be installed. Electrolytic action and corrosion seriously affect the underground returns, and in Boston a large amount of overhead copper for returns is being put up by the West End Company.

Mr. Rankin Kennedy, in a recent article on the induction motor and its inventor, gives a number of plain diagrams illustrating the action of his motor and of the Tesla motor, and considers the rotary polar theory a fiction upon which the action of induction motors has been built by mathematical processes. Mr. Kennedy's motor contains two coils, while the Tesla motor has but one, which acts, alternately, as a generator and motor coil. One coil in the Kennedy motor acts as a motor coil continually, having currents circulating in it generated by the second coil, which acts as a generator continually. Mr. Kennedy believes the induction motor to be in its infancy, and as now made not fit for introduction into practical work.

Mr. Joseph Wetzler, in an article in the *Electrical Engineer*, gives some engineering details of the New York-Chicago long distance telephone line. Thorough construction characterizes the line throughout, and many novel methods have been resorted to. The line marks a new era in the telephone operation; and the calculation of the size wire required to make the transmission of speech possible and yet to prevent the cost of the line from becoming prohibitory, presented many difficulties. The results obtained are totally at variance with the hitherto most commonly accepted rules regarding the capacity-resistance constant; which were, however, entirely empirical. Mr. Preece, a few years since, placed the amount of this constant at 15,000 as the point where speech became impossible. The new line to Chicago has practically a K. R. constant of 32,000.

Professor Rowland gives some notes on the effect of harmonics on the transmission of power by alternate currents, and its measurement, in the *Electrical World*. He believes they are the explanation of many seeming mysteries in the operation of alternating current motors and may be responsible for considerable loss in efficiency. He suggests that most calculations on the efficiency of power transmission by alternating currents are seemingly at fault, unless they include the action of harmonics, and that their presence will modify many of the results hitherto obtained by observers and theorists. In the present calculations he thinks that while there is too much assumption to warrant full belief, the loss of efficiency is a certainty; the amount must be determined by further experiment and mathematical investigation.

In a recent electric road constructed in England, a radical departure from American methods has been made. The trolley wire is suspended from arms, projecting from steel columns; no guy wires are employed, as the steel columns are especially designed to withstand severe strains. At the corners the trolley wire, instead of following a curve of the same radius as the track, as in the American systems, is turned on an angle; the whole system depending on the flexibility of the trolley arm, or side collector, as it is called, which automatically engages the trolley wire in any position from two to twelve feet from the side of the car. Another change from American practice is the adoption of a pressure of only 350 volts. The cars are twenty-two feet long, and are equipped with two motors of 15-brake horse-power, running at 400 revolutions.

A recent article in the *Street Railway Journal* for December contains a number of extracts from papers and works of prominent engineers, on the expansion of continuous rails. The results of a number of experiments tend to prove that when lengths of over 100 yards have been perfectly welded or riveted together and spiked to the ties in the usual manner, no elongation or contraction by heat or cold can be detected. The fact does not seem to be satisfactorily accounted for. It is suggested that the rail should be laid in warm weather, as the tendency to contract would strengthen the metal. So many favorable arguments have been advanced that a St. Louis railway company proposes to construct four miles of track in this manner as soon as welding machinery can be obtained. It would seem that the material in which the rail was imbedded would play an important part, as the facility with which the heat was conducted or radiated would tend to effect the expansion.

Mr. H. Franklin Watts, in a series of articles in the *Electrical World*, on the subject of the "Electrical Needs of the Times," strongly advocates a reduction in alternating frequencies to about one-fourth of what is generally used. This would allow the dynamo to be connected direct to engines of low speed, and allow the alternators to be operated in multiple. The low number of alternations required would insure the necessary low speed and would require fewer pole pieces; giving the machine a wider neutral point for the brushes, thus allowing it to be more easily self-excited and compounded. The lower frequency, while reducing the rate of cutting in the converter, would give the alternations more time to act on the iron and would create more lines of force; the amount depending on the iron in the converter. Mr. Watts believes the practice of the day is to operate the station under great disadvantages solely for the purpose of obtaining a smaller and cheaper converter. He does not consider the increased size of the machinery a serious disadvantage, and believes the question of increased cost open to discussion. As one of the greatest needs of the times and most desired inventions, he mentions a system of converting alternate, into direct currents suitable for arc lamps and electrolytic operations, which would allow one type of dynamo to satisfy all possible conditions of service. Further suggestions are: the use of carbon brushes throughout and the employment of higher voltages.

In an editorial comment it is suggested that Mr. Watts may be going to the opposite extreme; and that desirable as low frequencies and lower speeds may seem, so long as people prefer cheaper apparatus, though less reliable and satisfactory, so long will high frequencies and speeds be preferred by the manufacturer.

ALTERNATING CURRENT APPARATUS.

PART I.

Among the various electrical machines now in use for the production of light, heat or power, the alternating current dynamo with its accessories, such as transformers, etc., occupies a prominent position. It goes without saying, that in the operation of alternating current machines, as well as direct current apparatus, the best results can only be obtained where the machinery is handled by men thoroughly familiar with the construction and working of the machinery under their control. Too often, however, the apparatus is shipped and set up by the maker, and started by one of his so-called "experts," who, after a few hasty and generally rather indefinite instructions, takes his departure, leaving the bewildered engineer or dynamo tender to "wrestle" with the "new-fangled" machines as well as he may. As long as everything operates under normal conditions, all is well, but very often, should anything unusual occur, the attendant in charge is more or less at sea.

Nearly all, if not all, modern alternators, such as the Westinghouse, Thomson-Houston, Slattery, National, etc., are built after the same general design, and consist of a multi-polar field magnet of from eight to fourteen or more poles, in which the armature revolves. In one or two systems this arrangement is reversed, i. e., the armature is stationary and the field revolves.

The field magnets are, as a rule, "excited" or magnetized by means of a small direct current dynamo, called the exciter. This exciter may be a separate machine driven from a countershaft, or from a pulley on the alternator shaft, but is often combined with the alternator by mounting the exciter armature on an extension of the main shaft. Such machines are sometimes, although erroneously, called self-exciting.

In one well-known system the exciter armature coils are wound parallel with and on the same core as the alternator coils, the current being collected by means of a special commutator, but even such an arrangement cannot be properly called self-exciting. Another arrangement consists in connecting the terminals of one of the main armature coils to a special two-part commutator, so as to transform the alternating impulses into a continuous current, suitable for exciting the fields. The field magnets with their exciter being entirely separate and distinct from the main or alternating current, it follows that any trouble or disturbance of the main circuit can only be due to causes existing on the circuit or armature, and need never be looked for in the field magnet coils or the exciter.

The armature, until recently, was usually of the drum type, with a number of coils corresponding to the number of field magnets wound or laid on the surface of the core, and held in position by means of binding wires of steel or some other suitable material. In some of the latest forms, however, the core is of the Pacinotti type, and has as many teeth or projections as there are field cores. The armature coils are wound on separate forms of paper, asbestos or the like, and slipped over the armature teeth, where they are held in position by means of wooden wedges or some other suitable device. This arrangement is quite an improvement over the older type of armature, as it enables us to readily exchange or repair an injured coil without the necessity of removing any bands or binding wires. It also enables us to better insulate the coils, which is of great importance in machines of high voltage.

The armature coils, being wound alternately right and left-handed, are either connected in series or joined in multiple, according to the voltage and carrying capacity desired, the terminals in either case being led to a pair of collector rings. Some makers arrange the armature connections so that they can be readily changed from series to multiple, and vice versa. An armature giving a current of say 1,000 volts and 50 ampères can thus be easily changed so as to deliver a 25-ampère current at a pressure of 2,000 volts.

The armature with its coils revolving past the magnetized field cores produces a current of rapidly changing polarity. The number of alternations depends upon the number of field magnets or armature coils and the speed of the machine. A ten-pole machine, for instance, running at a speed of 1,500 revolutions per minute would give 15,000 alternations, or 250 per second.

The voltage, pressure or electro-motive force of an alternator depends upon three things: the speed, number of armature conductors and intensity of the magnetism of the field cores. Varying either of these factors will therefore produce a corresponding change in the electro-motive force or voltage of the dynamo. Given an alternator running at a constant speed, a most convenient way of changing or regulating its voltage consists in varying the exciting current. This can be done by putting resistance either in the exciter or alternator fields, the effect being the same in either case. From this we deduce another fundamental principle: Any change in the exciting current will cause a corresponding change in the armature current.

In the operation of dynamos and other electrical machinery, constant vigilance is the price of safety. Do not assume that because a machine ran successfully last night, it will do so again today. Before starting, see that the dynamo, exciter and all their parts are scrupulously clean, free from all dirt, grease or accumulation of copper or carbon dust. Carefully examine all binding posts, connections or screws, and make sure that they are clean and tight. The constant vibration of a machine will sooner or later loosen screws or connectors, and very often an open circuit is the result.

(*To be continued.*)

A SYNOPTICAL INDEX OF CURRENT ELECTRICAL LITERATURE.

AGRICULTURE.

"Applications of Electricity to Agricultural Work." A series of illustrated articles in *Electrical World*, Dec. 3, 10 and 17. Refers to W. M. Black's articles in *Electrical World*, Aug. 6 and 20, and Sept. 10, and in *Engineering Magazine* for Nov.

BATTERIES, PRIMARY.

"Experimental Studies of the Difference of Potential Generated Through Contact of Metals, Liquids and Dry Electrolytes." By Dr. Walter Negbaur. A series of articles based upon papers published in "Wiedmann's Annalen," 1891 and 1892. *Electrical World*, Nov. 26, Dec. 3 and 10.

"A New Carbon Electrode." *Electrical World*, Nov. 26.

BATTERIES, STORAGE.

"Storage Battery Cars in Paris." (Laurent Cely type.) From *La Nature*. *Electrical Engineer*, Nov. 30.

"Successful Storage-Battery Traction." (Epstein Accumulators on Birmingham Tramways.) *Street Railway Gazette*, Dec. 19.

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"A Biographical Sketch of the Khotinsky Accumulator," VIII. (Concluded.) By Capt. A. de Khotinsky, *Electrical Engineer*, Nov. 30.

"The Life Work of Werner von Siemens." *Electrical Engineer*, Dec. 14.

CENTRAL STATION, THE.

"Increased Commercial Efficiency and Higher Economy in Central Stations." By J. H. Vail. *Electrical Engineer*, Nov. 30, Dec. 7.

"Electrical Needs of the Times." By J. F. Watts. A plea for improved generating apparatus. *Electrical World*, Dec. 3 and 10.

"Cost of Electric Supply." By Dr. John Hopkinson, F.R.S. Presidential address delivered before the Junior Engineering Society, London. *Electrical World*, Dec. 3.

"The Cost of Electric Supply." Editorial review of Dr. Hopkinson's paper. *Electrical Engineer*, Nov. 30.

DECORATIVE LIGHTING.

"Christmas Electricity." An illustrated account of the incandescent decorations in show windows, house fronts, theaters and churches in New York. *Electricity*, Dec. 21.

DYNAMO ELECTRIC MACHINERY.

"Theoretical Elements of Electrodynamic Machinery." Part XIII. By A. E. Kennelly. *Electrical Engineer*, Nov. 30.

"Ball Dynamos, and How They are Made." By Leslie W. Collins. *Electrical Engineer*, Nov. 30.

"On a Method for Balancing Armature Reactions." By Harris J. Ryan. From *Sibley Journal of Engineering*, Oct.; *Electrical Engineer*, Dec. 7.

"The Use of Compound Wound Generators from a Practical Point of View." A paper read before the Chicago Electric Club. By M. Willis.

"A Curve for Ascertaining the Ampère-Turns Required for Magnetic Saturation." By Charles Steinmetz. *Electrical Engineer*, Dec. 14.

"On a Novel Type of Unipolar Machine." By W. A. Carey. *Electrical Engineer*, Dec. 14.

"The Mather Generator for Electric Railways." By Prof. Wm. A. Anthony. *Street Railway Gazette*, Dec. 19.

"Some Fallacies in Dynamo and Motor Design." By F. B. Crocker. *Electrical World*, Dec. 17. Reply to "Some Anomalies in Motor Design," copied from London *Industries*, in *Electrical World*, Nov. 12.

"A New Method of Field Excitation." By H. L. Tyler. *Electrical Engineer*, Dec. 7.

ELECTROLYSIS.

"Commercial Electrolysis." By Emile Andreoli. A series of papers copied from London *Electrical Review* in *Electrical World*, Nov 26, Dec. 10.

ELECTROPLATING.

"Letters from a Laboratory." By Julian A. Moses. *Electrical Review*, Dec. 3 and 10.

EXPOSITIONS.

"The Massachusetts Fair." (An illustrated account of exhibits.) By W. S. Key. *Electricity*, Nov. 30, Dec. 7, 14 and 21.

FRANCHISES.

"Canadian Street Railway Franchises." *Street Railway Gazette*, Dec. 26.

HEATING AND COOKING.

"Electric Heating." (The elementary principles of electric heating with a comparison of its commercial value to that of coal. A paper read before the Buffalo Electrical Society.) By P. K. Stern. (And editorial comment). *Electricity*, Dec. 21.

HISTORICAL.

"Chronological History of Electricity." By P. F. Mottelay. *Electrical World*, Nov., Dec.

"Galvani. The First Electrical Treatise of." By Park Benjamin. *Electrical Review*, Dec. 17.

"Moses G. Farmer and the Electric Car of 1847." By W. S. Key. *Electricity*, Dec. 21.

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"Alphabetical Index by Subjects for Practical Men." By F. G. Bolles. Gives details of card index. *Electrical World*, Dec. 3.

LIBRARY.

"Laboratory and Library." By Prof. C. Wellman Parks. A plea for well-equipped libraries as well as laboratories at educational institutions. *Electrical World*, Dec. 3.

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"Arc Lamps for Optical Projection." By R. S. Dobbie. *Electrical Engineer*, Dec. 7.

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"Separable or Detachable Incandescent Lamps." An illustrated description of various separable lamps. By Dr. L. K. Bohm. *Electrical World*, Dec. 3.

"Life and Efficiency Tests of Incandescent Lamps." By P. Feldmann. Copied from London *Electrician* by *Electrical World*, Dec. 17.

"Edison Lamp Suit." Chronological statement, defendants' points, and argument for complainants. *Electrical World*, Dec. 17. Opinion. *Electrical World*, Dec. 24.

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Light Company and Edison General Electric Company against the Sawyer-Man Electric Company, filed Dec. 15, 1892. *Electrical Review*, Dec. 24.

"The Life of Incandescent Lamps in its Relation to Mercury and Metallic Vacuum Pumps." A. A. Frei.

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Decisions under the Sherman Law. *Electricity*, Dec. 7.

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"Tank Lightning Arrester." *Street Railway Gazette*, Dec. 19.

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"Transactions of the American Electro-Therapeutical Association." Abstract of. By Dr. J. M. Bleyer. *Electrical Review*, Dec. 3 and 17.

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"Lighting Parade Floats, by Street Railway Current." By John H. Barnard. *Electrical Engineer*, Dec. 14.

PARK LIGHTING.

"The Lighting of Washington Park, Chicago." By F. A. Scheffler. *Electrical Engineer*, Nov. 30.

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"The Sheridan Electric Power and Office Building, Denver, Colo." *Electrical Engineer*, Dec. 14.

"Electric Motors in Factories." (A paper read before the Mason College Engineering Society of England.) By R. H. Hausman. *Electricity*, Dec. 14 and 21.

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"The Ground Return." Remarks of F. D. Pearson, at Cleveland meeting American Street Railway Association. *Electrical World*, Dec. 3.

"Brain Electric Conduit." In use on experimental track in England. *Street Railway Journal*, Dec.

"Series Electric Traction." Criticism by Dr. Cary T. Hutchinson on Nelson W. Perry's American Institute paper and resulting controversy, *Electrical World*. Nov. 19, Dec. 3, 10 and 24.

"Construction of Circuits." A series of articles on construction work. By T. J. McTighe. *Electrical Review*, Dec. 3, 10 and 17.

"Siemens & Halske Electric Conduit." *Street Railway Journal*, Dec.

"Some Possible Uses of 500-volt Street Railway Circuits." C. K. MacFadden, *Street Railway Review*, Dec.

"Lake Roland Elevated Railway, Baltimore, Md." By A. V. Abbott. *Electrical Engineer*, Dec. 7.

"Binghamton, N. Y., Electric Railroad Company." *Electrical Engineer*, Dec. 14.

"The First English Trolley Road." *Street Railway Gazette*, Dec. 12.

"Chicago City Railway and its Adoption of Electricity." *Street Railway Gazette*, Dec. 5.

"An Ideal Railway Power Station." By C. J. Field, E. J. Cook and F. Bourne. A paper read before the Chicago Electric Club, Dec. 19, by C. J. Field. (And editorial comment.) *Street Railway Gazette*, Dec. 26.

"Pruyn Elevated Railway." *Street Railway Gazette*, Dec. 19.

"Cost of European Street Railway Traction." Abstract of tables, prepared by Emile Dieudonné for *L'Electricien*. *Street Railway Gazette*, Dec. 19.

"Through by Lightning." (Editorial comment on prospectus of Chicago and St. Louis Electric Railway.) *Electricity*, Dec. 7.

"The New Rae Car Motor Equipment." By Frank B. Rae. *Electrical Engineer*, Nov. 30.

"Rail Bonding and Measuring Ground Resistance." By Franklin Sheble. *Electrical Engineer*, Nov. 30.

TELEGRAPH.

"Burke Cable Relay and Transmitter." *Electrical Engineer*, Dec. 7.

TELEPHONE.

"Hudson River Telephone Exchange." (With portraits of officers.) *Electrical Review*, Dec. 10.

"The Engineering Details of the New York-Chicago Long-Distance Telephone Line." By Joseph Wetzler. (And editorial.) *Electrical Engineer*, Dec. 14.

TRANSFORMERS.

"Test of a 17,500-watt Stanley Transformer." By Harris J. Ryan. *Electric Spark*, Nov., 1892.

"Open and Closed Magnetic Circuit Transformers." Review of a paper read by Profs. W. E. Ayrton and W. E. Sumpner before the British Association. *Electrical World*, Dec. 17.

TURBINES, STEAM.

"The Parsons Condensing Steam Turbine." Prof. Ewing's test of same. *Electrical Engineer*, Nov. 30.

WAR.

"Electricity in the Art of War." By Lieut. C. D. Parkhurst. Reprint from *Journal U. S. Artillery* in *Electrical Review*, Dec. 3, 17 and 24.

WORLD'S FAIR.

"$1,472,244.46." (Editorial comment on lighting contracts.) *Electricity*, Dec. 7.

NEW PUBLICATIONS.

STANDARD ELECTRICAL DICTIONARY. By Prof. T. O'Conor Sloane. Published by Norman W. Henley & Co., 150 Nassau street, New York. 5½ by 7¼. Price, $3.

An indispensable work to everyone interested in electricity, serviceable alike to the beginner and the engineer, the inventor and the electrician, for the definitions are clear, complete and concise, and have, though alphabetically arranged, their value increased by a very complete index. The book is nicely printed, well bound, and contains some 350 illustrations.

ORIGINAL PAPERS ON DYNAMO MACHINERY AND ALLIED SUBJECTS. By John Hopkinson, F.R.S. Published by The W. J. Johnston Company, Limited, Times Building, New York. 5 by 7. Price, $1.

A collection of eleven papers prepared by Dr. Hopkinson and published since 1886, and now republished in book form, as several of the papers were out of print. The titles of the papers are: On Electric Lighting, 1879; On Electric Lighting, 1880; Some Points in Electric Lighting, 1883; Dynamo-Electric Machinery, 1886; Dynamo-Electric Machinery, 1892; Theory of Alternating Currents, 1884; An Unnoticed Danger in Certain Apparatus for Distribution of Electricity, 1885; Induction Coils or Transformers, 1887; Report to the Westinghouse Company of the Test of Two 6,500-watt Transformers, May 31, 1892; Theory of the Alternating Current Dynamo, 1887; The Electric Light-houses of Macquarie and of Tino, 1886.

ELECTRICITY AND MAGNETISM, A SERIES OF ADVANCED PRIMERS. By Prof. Edwin J. Houston. Published by The W. J. Johnston Company, Limited, Times Building, New York. 5 by 7. Price, $1.

A new series, instructive and interesting to the general reader, the student and the electrician, and convenient in size for ready reference or perusal during odd minutes. At the end of various chapters extracts from standard works are inserted, giving the views held by other authors on the respective subject.

DAVIS STANDARD TABLES FOR ELECTRIC WIREMEN: With underwriters' rules, instructions for wiremen and linemen, plates of circuits and useful data. By Charles M. Davis. Third edition, thoroughly revised and edited by W. D. Weaver. New York: The W. J. Johnston Company, Limited, 41 Park Row. Price, $1.

The author makes the following statement: "The wiring tables have all been calculated on a basis of 55-watt lamps, and it is believed that this is the first uniform set of tables published. A valuable table here appears for the first time by means of which the tables of the three standard voltage can be used for any other voltage and also for other drops than those in the tables." A valuable feature in the book is the complete, revised instructions issued by Mr. James I. Ayer, president of the National Electric Light Association, for the use of the linemen in the central station of the Municipal Electric Lighting and Power Company of St. Louis.

ELECTRICAL PATENTS.

ISSUED NOVEMBER 22, NOVEMBER 29, DECEMBER 6 AND DECEMBER 13.

This list is intended to include all electrical patents which are noteworthy. It is not a complete list of all patents.

486,498.—*Lightning Arrester.* Harry G. Osborne.

A permanent connection to ground in front of the machine is provided with a non-inductive device adapted to produce an electro-motive force which just balances the electro-motive force of the machine, so that normally no current passes to ground by the ground connection. When, however, a high potential discharge traverses the line it will pass through the non-inductive ground connection to ground.

486,524.—*Dynamo Electric Machine.* G. Baehr.

The armature is provided with a spider in the form of a disk supporting the ring armature core, and plugs of metal are inserted in the disk with their ends exposed on both faces of the disk, one end of each serving as a contact surface for the brushes and the other end having attached to it the ends of the armature coils.

486,624.—*Electrical Method for Forming Tubes.* George D. Burton and Edwin E. Angell.

The method consists in heating a bar electrically to a higher degree at its core or internal part than upon its exterior, coiling the bar in its heated state upon a mandrel with its successive turns abutting against each other, and permitting the coils to expand under the action of the internal heat, whereby their abutting edges are fused together and a tube is formed.

486,689.—*Electrical Measuring Instrument.* Edward Weston.

The instrument is designed for measuring differences of potential. A coil, traversed by the current to be measured, is disposed in a magnetic field, and, while a current is passing through it, has a tendency to take a new position in the field depending upon the difference of potential between the instrument terminals. The motion of the coil is opposed by an initial torque given to a spring which acts upon the coil and prevents any motion of the coil until the torque of the magnetic force urging the coil overbalances the initial torque of the spring and permits a movement of the coil, and, consequently, of the indicating needle attached to it. The object of the invention is to cause the index of the instrument for a given change in electrical pressure to sweep over a long interval of arc.

486,916.—*Electrical Transformer.* Elihu Thomson.

The object of the invention is to automatically adjust the potential of the secondary circuit of a transformer as the demand for current in the working circuit increases or decreases. A conductor spirally wound around a rotatable drum forms a portion of the secondary circuit, and the drum is adapted to be rotated as necessity requires to cut in or out of the circuit the proper amount of resistance, thus automatically changing the resistance of the secondary circuit and, consequently, the potential. When applied to lamps in multiple arc in which a constant potential is required, the rotating drum acts to maintain the total resistance in the secondary circuit constant so that the potential will also remain constant, irrespective of the number of lamps burning.

487,049.—*Incandescent Lamp.* J. H. F. Görges.

The lamp is designed for polyphasal currents, three leading-in wires being provided, to each of which are secured the ends of two filaments, the lamp being thus provided with three filaments which are alternately brought to the condition of maximum brilliancy by the passage of the phase-differing currents.

487,092.—*Electric Switch.* John J. Nate.

The switch is designed for controlling electrically propelled elevators, and a rheostat with duplex contact points is placed in circuit with the armature circuit of the motor, so that motion of the hand-rope in either direction will serve to properly alter the resistance in the armature circuit. A switch is provided in the field circuit adapted to close the circuit through the field coils before the circuit is closed through the armature.

487,098.—*Telephone Switch-Board Apparatus.* C. E. Scribner.

The operator's testing-plug when not in use rests on a spring-pressed lever attached to a dash-pot that prevents the immediate rise of the lever when the plug is removed. A switch is controlled by the lever which throws the operator's testing set out of operation when the lever has ascended to its uppermost position, the gradual ascent of the lever, due to the dash-pot, giving the operator time to make the test before the testing set is cut out of circuit.

487,219.—*Telephone.* H. V. Hayes and W. L. Richards.

The telephone is adapted to be connected with two lines at the same time, and to receive messages from either without introducing inductive effects between the circuits. Each circuit is provided with a double-pole magnet, the magnets being so arranged that one set is perpendicular to the other, inductive effects being thus prevented.

487,220.—*Electrode for Arc Lamps.* C. W. Hazeltine.

Ordinary arc-lamp carbons are given a coating of copper and a coating of zinc exterior to the copper, the copper serving to increase the conductivity of the electrode, and the zinc to protect the copper from the oxydizing influence of the air and to seal the pores of the copper near the arc to prevent the access of cold air to the heated part of the carbon.

487,703.—*Electric Meter.* C. W. Ayrton.

A number of circuit terminals are arranged in arcs of circles concentric with the pivot of the needle, and above which the needle is adapted to swing. An electro-magnet is placed beneath the needle, and at certain equal periods of time, determined by a clock mechanism, is energized to attract the needle against the concentric circuit terminals. The circuit terminals are thus closed together, and the number of circuits closed depends upon the strength of the current actuating the electro-magnet, and consequently the force with which the flexible needle is drawn against the terminals. In each of the circuits are contained devices whose added effects operate a rachet wheel and counting devices.

487,795.—*Multiple Switch Board.* Giles Taintor.

A high auxiliary resistance is placed in circuit with the call annunciator, and the insertion of the plug in the answering jack serves to short-circuit the resistance, thus enabling the disconnecting signal to be received on and indicated by the calling drop of that one of two connected lines which initiated the call.

487,796.—*System of Electrical Transmission of Power.* N. Tesla.

The invention relates to means of adapting multipolar alternating current machines for the generation of currents having a phase difference, and it consists in winding the armature with overlapping coils so that the electro-motive force generated by one set of coils will rise to its maximum value at a different time from that of the other set of coils. The invention further relates to means for causing motors to make a greater number of revolutions than the generator, and consists in providing the motor with a less number of pole pieces than the generator; thus, if the generator be provided with eight poles, and the motor with four, the motor will make twice the number of revolutions of the generator.

487,816.—*Automatic Safety Device for Dynamo-Electric Machines.* Francis B. Badt.

The invention is adapted for shunt wound machines, and a device, responsive to changes in the working circuit, closes the field magnet circuit through an auxiliary resistance when the current in the working circuit rises above a predetermined amount, thus decreasing the current through the field magnets, and consequently the electro-motive force of the machine and the current supplied to the working circuit.

487,834.—*Manufacture of Secondary Battery Electrode.* W. W. Griscom.

The process of manufacture consists in subjecting a plate to the action of an alkaline solution, thereby first producing honeycombs in the surface of the plate, and, subsequently, depositing upon it active material or material adapted to become active.

487,890.—*Manufacture of Incandescent Electric Lamps.* C. Panthonier.

The leading-in wires are first sealed to the bulb, after which the filament is inserted from the opposite end and its ends clamped to the leading-in wires by temporary clamps; the lamp is then immersed in a hydro-carbon and an electric current passed through the leading-in wires and filament, whereby the joints are heated to such a temperature that the hydro-carbon is decomposed, and finely divided carbon is deposited at the joint, forming a perfect contact.

487,981.—*Printing Telegraph.* C. L. Buckingham.

The characters are carried upon the periphery of a disc and electro-magnetic devices controlled by the operator are adapted to rotate the disc, each through a different angle, so that any character may be brought in position by the actuation of the proper electro-magnetic device.

488,002.—*Lightning Arrester.* W. R. Garton.

A pair of serrated plates are placed in parallel positions, the lower one being connected to ground. Upon the upper plate rests a carbon rod attached to the core of a solenoid. When an abnormal current traverses the device, it passes through the solenoid, thence through its core and the carbon rod to the upper serrated plate, and across the air gap to the other serrated plate and earth. The passage of the current through the solenoid lifts the carbon rod from the upper plate and forms an arc which is extinguished when all of the oxygen contained in the nearly air-tight vessel in which the carbon rests is consumed.

488,121.—*Automatic Regulator.* E. J. Houghton and W. White.

The regulator embodies a resistance placed in the circuit and adapted to be varied in response to changes in the strength of the current. A bare conducting wire is wound into a spiral of cone shape and supported upon a metallic plate, the apex of the spiral being attached to the core of the solenoid, excited by the current to be regulated. The wire and the plate are included in the circuit, and as the current varies the core of the solenoid is moved to cause a greater or less number of turns of the spirally wound wire to bear against the metallic plate, all wires thus bearing against the plate cut out of the circuit.

Mr. James I. Ayer is supplying current from his St. Louis station to some of the adjacent suburban towns on a long distance system of lighting. The center of distribution is in Webster Grove, Missouri, nearly ten miles from his plant, and 500 lamps are already connected in circuit, while 700 more are contracted for. The current passes over a pair of 0000 stranded feeders at a pressure of 1,000 volts, and as the load increases it is planned to increase the pressure to 2,000 volts, and then transform down to 1,000 volts at center of distribution. By switching out the step-up transformers as the load decreases the loss will not be excessive by direct transmission at 1,000 volts, and a large number of lights carried with fair economy.

THE PRIZE ESSAY.

"How Can the Department of Electricity of the World's Columbian Exposition Best Serve the Electrical Interests?"

WORLD'S FAIR ELECTRICAL ENGINEERING has offered the following three prizes for the best answers to the above question:

$100 for the best answer.

$50 for the second best answer.

$25 for the third best answer.

Thus the following correspondence relating thereto will be of interest to those who may be preparing an answer. Should any who have already sent in an answer desire so to do they are at liberty to send in a second answer:

WORLD'S COLUMBIAN EXPOSITION.

DEPARTMENT OF ELECTRICITY,
CHICAGO, December 10, 1892.

Mr. Fred De Land, Editor WORLD'S FAIR ELECTRICAL ENGINEERING,
"The Rookery," Chicago:

MY DEAR SIR,—In acknowledging receipt of the three certified checks, amounting to $175, which I undertake to hold subject to the order of the committee of award for the prize essay contest, permit me to express my appreciation and indorsement of your undertaking as regards this competition, and also in the publication of a periodical to be devoted largely to electrical engineering at the World's Fair. Few recognize the importance to electrical interests of the work in this line at the World's Fair, both in the application of electricity to the lighting, power transmission and other uses of the Exposition and in the electric exhibition itself, which will be the greatest and most complete ever made.

We are glad to welcome so competent an aid as your magazine promises to be in the direction of educating those who ought to be interested to full recognition of their opportunities.

The scope of the electrical and mechanical work at the World's Fair is so wide and the means and processes employed are so completely abreast of the time that an exponent of this department of work at the World's Fair can hardly fail to present something new, interesting and instructive in each of its issues. Yours truly,

JOHN P. BARRETT,
Chief of Department of Electricity.

Editor WORLD'S FAIR ELECTRICAL ENGINEERING,
"The Rookery," Chicago:

DEAR SIR,—I am one of the many who will enter the competition for the prize for the best essay on "How Can the Department of Electricity of the World's Columbian Exposition Best Serve Electrical Interests?" and for our common guidance, as well as for the assistance of the committee who will have the task of deciding between the various contestants, I will ask a few questions, which, if you will answer, will have the result of preventing an unnecessarily wide divergence of ideas among the contestants.

(1) I take it that the service of the Department of Electricity is confined to the exhibition at the World's Fair. Am I right?

(2) I assume that the Department of Electricity is acting under certain rules which limit the scope of its freedom of action. Is this so?

(3) Then, I understand that suggestions to be pertinent must apply to matters within the scope of the authority of the Department of Electricity. Is this correct?

(4) I understand the authority of the Department of Electricity so far as pertains to our present subject is limited to assigning space in the Electricity building and inspecting and approving plans made by the various exhibitors for their exhibitions. This naturally includes the privilege of making suggestions to exhibitors, which suggestions, if they are reasonable, will naturally be accepted and acted upon by the exhibitors. Am I correct in this?

(5) Then am I right in thinking that suggestions made thus in competing essays will reach the Department of Electricity, and may in that way be made useful in the way of suggestions to exhibitors with the sanction of the Department? Yours truly, INQUIRER.

ANSWERS.

(1) Practically, yes. But suggestions as to the best way of making use for general benefit of the electrical service in practical use at the World's Fair will be appropriate.

(2) Yes.

(3) Yes, with the exception noted in answer to question one.

(4) Yes.

(5) You are right in respect to the suggestions of essayists reaching exhibitors through and with the sanction of the Department of Electricity, but as the prize essays, or some of them, will be published in WORLD'S FAIR ELECTRICAL ENGINEERING, they will reach exhibitors in that way also, and will have likewise their effect upon those who do not exhibit, but visit the World's Fair to observe and learn.

ED. WORLD'S FAIR ELECTRICAL ENGINEERING.

WORLD'S FAIR
Electrical Engineering

JOHN P. BARRETT,

CHIEF OF THE DEPARTMENT OF ELECTRICITY,
WORLD'S COLUMBIAN EXPOSITION.

JOHN P. BARRETT.

Seldom has a neater, more truthful or more prophetic editorial been written than the following, which appeared in the Chicago *News* one Christmas eve :

> Chicago has a modest man in its employ, who deserves a very merry Christmas. He is City-electrician Barrett, and to him this community owes a great deal. The new system of electric lights which shone in a number of the streets last night for the first time was created by him. He it was, who a year ago strung boquets of electric lights along the river and by the bridges. He has put miles of hideous wire underground. He has perfected the police and fire-alarm systems. In short he has made himself immensely useful to this community. There is more work yet for Professor Barrett. We want him to light the entire city by means of his underground wires and tall electric lamps. Then, perhaps, he can give us rapid transit by means of electricity, and after that a telephone system, which the city shall own. After he has accomplished these things no doubt something else will turn up which will give him other opportunities to please us. We hope that Professor Barrett will live a century at least to harness lightning for our uses.

Later, the Hon. George Bowen, beloved by all electric light men for his earnest work in their behalf, in referring to Mr. Barrett during a session of the National Electric Light Association at Cape May, said :

> Professor Barrett enjoys the confidence of every man in Chicago, whether he is a republican or a democrat. * * * I congratulate him and I congratulate the city, because he is a man of great capacity as an electrician, and is an honest and square man.

Then came the suggestion that Mr. Barrett be nominated as chief of the Department of Electricity of the World's Columbian Exposition, and from the four corners of the republic came the indorsements that are treasured as highly as the fitting honor that was conferred in deference to these thousand and one requests.

Above the medium height, with a rugged and closely-knit frame, in the prime of life and possessing a generous, happy temperament, John P. Barrett, as Chief of the Department of Electricity, has planned an exhibit for the electrical section that will prove a fitting tribute to the genius and the business sagacity of the men who have made the electrical industry unequaled in its rapid growth and financial prosperity, and in its kinship to the advancement of civilization.

THE $100 PRIZE ESSAY.

How Can the Department of Electricity of the World's Columbian Exposition Best Serve the Electrical Interests?

BY HERBERT LAWS WEBB.

It is unquestionable that the Department of Electricity of the World's Columbian Exposition will contain the most complete and elaborate manifestation of the capabilities of electrical engineering that has been seen since electricity first became a factor in the commercial world. How this great exhibit can best serve the interests of those who give it being is a rather broad problem.

I think the safest way to attack the question is from the popular side. Electricity is undoubtedly the science of the day. Every man, woman and child is more or less affected by the numerous services that electricity performs today, and in popular interest the Department of Electricity will almost certainly be the chief attraction of the World's Columbian Exposition. Many people gather from the newspapers and the periodical literature of the day more or less vague ideas of how the various applications of electricity are carried out. At the Exposition they will be able to see all of these multifarious applications in all their details, and their natural curiosity as to a subject of which they hear and read so much in every-day life will give added interest to an intelligent inspection of the agencies by which so much of the world's every-day business is now carried on.

It is the general experience of manufacturers who exhibit at the great expositions that are held in various parts of the world that the direct returns traceable to their enterprise do not repay the great cost of making a suitable and representative exhibit. They rely more on the general and indirect effect produced on hundreds of thousands of people who view their exhibits more or less carefully. Of these hundreds of thousands, or millions, of persons, a certain percentage will be interested in particular exhibits, will examine them carefully and will acquire certain knowledge that afterward will guide them in their purchases or in their advice to others to purchase. The actual sales made at great expositions, or even the orders booked, are comparatively few and are chiefly confined to artistic wares manufactured expressly for the occasion.

In electrical matters this question of exhibits not giving direct returns is especially obvious. Electrical engineers do not as a rule require to go to exhibitions to learn what each other is doing. Through their business relations, their technical journals and their regular conventions, they know, each in his own branch, what progress is being made in the various lines of electrical manufacture, and where a given machine or piece of apparatus can be made best and cheapest. Few electrical men are likely to visit the Department of Electricity of the World's Columbian Exposition with a view to placing orders for electrical machinery.

The important point, then, in connection with the Department of Electricity — the way in which it can best serve the electrical interests — is, it seems to me, that it should be popular and educational and that it should cultivate the interest and attention of the general public. The general public is, after all, the eventual customer of the electrical manufacturer and of the electrical engineer. Dynamos and motors, batteries and wires, switch-boards and steam-engines are all built and put in place and operated in order to supply the general public with some kind of electric service — light, power or communication. And the price that the general public pays for these various kinds of service is what keeps the electrical manufacturer and the electrical engineer going.

Therefore, it is decidedly to the interest of the electrical industries that the general public should be impressed with the variety of services that electricity is capable of rendering, and with the safety, economy, efficiency and reliability of the appliances and systems by which these services are carried on. No better opportunity could possibly be offered for doing this than that which the Department of Electricity of the World's Columbian Exposition will give.

Very little consideration of the question is required to reach the conviction that the Department of Electricity can best serve the electrical interests by interesting the general public in the electrical exhibits. Among the visitors to the Exposition those without technical knowledge or experience will outnumber those who possess either by a thousand to one, and all of these are possible customers for the electrical man. Many of them are prevented from becoming customers owing to prejudices which a little intelligent explanation and ocular demonstration would soon overcome and dispel. I know of people who would not have an incandescent lamp in their houses because they believe it is "dangerous," and of others who are prejudiced against all electrical appliances because they have had unfortunate experiences with cheaply made and badly arranged electric bell installations. No doubt every electrical engineer has among his acquaintances several who are thus prejudiced, and we all know how sensational newspapers fan the general belief in the danger and insecurity of electric light and power. It is difficult to combat these impressions by arguments; but actual demonstration, intelligently planned and assisted by descriptions in plain language, should go a long way toward removing them altogether, or at least modifying them and giving people a basis on which to think for themselves.

The Department of Electricity, then, should appeal to the general public. Every exhibit should be arranged, as far as may be practicable, so that popular demonstrations may be given to those unversed in electrical matters of the operativeness, usefulness, safety and economy of the particular system or appliance represented. Those in charge of the exhibits should be ready with explanations, couched in untechnical language, so as to be able to give every inquirer of reasonable intelligence a fairly clear idea of the *modus operandi* of the exhibit, what it effects, how it does it, and what it saves, or what it can add to the conveniences, luxuries, or economics of life. Pamphlets, printed in attractive form, and containing well written popular descriptions of exhibits and what they represent should be provided for those whose interest is sufficiently aroused to give them a desire for information in permanent form. Wherever possible, simple demonstrations should be made of some particular point in the operation of an appliance or system that will appeal to the popular mind and attract attention. Such a demonstration may be merely an experiment that would claim notice on account of its beauty or novelty, or it may be an illustration of some point of safety, usefulness, or special service, particular to an appliance or system;

but it should be capable of quick performance and frequent repetition, so as to serve as a start, as it were, for a more detailed inspection and explanation.

The old proverb says that it is "the first step that costs." Some art and ingenuity will be necessary to arouse interest in many of the electrical exhibits, and special effort should be directed to this point, because, once interest is aroused, even the most apparently forbidding array of technical appliances or materials will often have features that will impress the visitor more or less directly. Attention should be given, then, to including in verbal and printed descriptions and explanations some special details, whether they refer to personal, historical, scientific or the commonest of every-day matters, that will connect the subject with some fact of common knowledge. Such a reference will often prove the starting point for further investigation; and by an exercise of ingenuity in establishing a connection with a matter within the understanding of everyone, even a showcase of wires or an exhibit of some extremely technical appliance may sow seed on fruitful soil.

By keeping in view the special object of demonstrating to the public at large in the most intelligent and impressive way the great field which the practical applications of electricity now cover, and of emphasizing in a popular manner the safety, economy and usefulness of electrical appliances, the exhibitors will run no risk of neglecting their professional confrères. Indeed, they will probably aid many of them in their inspection of systems which lie outside of the usual course of their own work. Those electrical men who visit the Exposition with a view to business will take care of themselves; they will investigate and question as their needs direct. But many electrical engineers will seize the opportunity to familiarize themselves with the working of apparatus and systems with which they are not often brought in contact. In a very few years electrical engineering has become specialized into several distinct branches, and those occupied in one branch seldom are able to keep up more than a slight acquaintance with what is doing in the others. The Department of Electricity of the World's Columbian Exposition will enable every electrical engineer who can get to Chicago to survey the whole field, and the popular explanations and descriptions of the various exhibits will be of positive aid to him in investigating those appliances with which he is unfamiliar. One of the best known electricians today living makes a practice, when shown anything new in electricity, to ask to have it explained to him as if he knew nothing whatever of the subject. It is an excellent plan, as such an explanation would naturally start with the fundamental principles utilized, and everything would be made clear in natural progression. The popular descriptions and explanations I have suggested would be drawn up in a similar way, and would be of considerable service even to a technical man who might be inquiring into the working of a system that had not previously come within his experience.

It is obvious also that this method of popularizing exhibits will be of advantage in other ways by stimulating inventiveness in finding new applications for electrical appliances and in suggesting modifications in apparatus and methods. It does no necessarily need a technically trained mind to discover new applications for existing electrical machinery or to see where improvements may be made in mechanical details, and if the principles and operation of the various exhibits are made clear to all, no doubt much benefit will redound to the electrical interests by the ideas that will occur to those visitors possessed of inventive ability.

To sum up, the Department of Electricity can best serve the electrical interests by giving the general public an object lesson in the commercial applications of electricity; by showing in a manner intelligible to all who can see, hear and read, the numerous services that electricity can perform today for the benefit of mankind; and by emphasizing, to the removal of prejudices due to ignorance and inexperience, the safety, economy and trustworthiness of the machinery and appliances used in the generation, distribution and utilization of electrical energy for all purposes.

PIERRE QUIRONLE.

THE POWER PLANT.

(CONCLUDED.)

The observant foreigner who crosses "the pond" in the new Cunard liner Campania may recall the fact that she has a total indicated engine capacity of 30,000 horse-power, and in length and breadth is only about two-thirds the size of the area allotted to this plant, being 620 feet long and 65 feet in breadth. Then there is the City of Paris, which carries 20,000 horse-power, and even the notorious Normania has 16,500 horse-power in engines, while the proposed new steamer of the White Star Line may have an engine capacity of 36,000 horse-power. And in this connection it is worthy of note that these engines may be taxed to their full capacity, as it is reported that more than 100,000 orders for cabin passage are already entered on the books of the various steamship lines.

Among the largest stationary power plants in this country there are several having from thirty to seventy boilers installed, and where the total equals that at the Exposition.

But in all these cases there are but one or two types of engines or boilers used in each installation, while in the power plant at the World's Fair there are many different makes and all the different types.

A plan of the complete installation showing the location of all the engines and dynamos will be found in this magazine, and is the first complete plan sent out.

When discussing the question of what fuel should be used in the power plant, the general sentiment appeared to be in favor of oil, as there would be no vexed problems of coal delivery and ash removal to work out, or self-constituted smoke committees to pacify. So it was assumed that three barrels of oil of forty-two gallons each would equal a ton of the best lump bituminous coal, and that if an inferior grade of coal was used that two barrels of oil would afford as many heat units. Then in the item of labor, one fireman would probably do the work ordinarily required of five or six.

Finally a contract was entered into with the Standard Oil Company to deliver all the fuel oil required for generating steam within the grounds at the market price, not to exceed 72½ cents per barrel of forty-two gallons, this oil to be delivered into the receiving tanks on the Exposition grounds through the six-inch main that connects with the relay station of the Standard Oil Company at Whiting, Indiana, and which is practically an extension of the great pipe line, 240 miles long, extending from Lima, Ohio, and having a daily delivering capacity exceeding a million gallons of oil.

As this fuel oil plant will be inspected by thousands of visitors, among whom will be many electrical engineers, the details of construction and operation are worthy of record.

The storage reservoir and necessary pump house is located near the shore of the lake, some 3,200 feet to the southeast of the power plant. The reservoir consists of eight cylindrical tanks made of $\frac{5}{16}$-inch steel throughout, and are nominally 25 feet in length and 8 feet in diameter, and the actual average capacity of each is 9,370 gallons, making a total containing capacity of 112,144 gallons of oil, an amount of fuel sufficient to develop 393,400 horse-power hours when consumed under the type of boilers installed in the power plant.

These receiving tanks rest within an air-tight vault having a fifteen-inch floor of concrete, side walls of sewer brick laid in cement, and a roof of heavy "I" beams, with brick arches laid in cement springing from one beam to the adjoining one. The structure is placed on a level with the datum line, five feet below grade, and rises from thence to a height of twelve feet, while over all a foot of rich loam has been placed and the whole embanked and sodded, giving it the appearance of a symmetrical grass-covered mound. The interior of the vault is divided into six separate compartments, having division walls of sewer brick laid in cement, each compartment holding two tanks supported on brick saddle walls, and beneath each compartment is a sump three feet in depth containing a steam syphon for ejecting any water that may accumulate therein. Separating each pair of tanks by an eighteen-inch wall is a preventative against total loss should the oil in any one compartment become ignited through accident or carelessness, a contingency not liable to occur in an air-tight vault. With the aid of flanges pipes were joined to each tank and then connected to suitable headers that extend through the vault, pass underground and into the pumping station located thirty feet distant. These pipes include a six-inch "outflow" line in head of tank near bottom, a six-inch "overflow" pipe in head near top, a four-inch "inflow" pipe in top of tank near head, a two-inch pipe required in connection with the indicating apparatus that shows the amount of oil in the tanks, and two pipes of one inch diameter connected to steam coils extending six times the entire length of tank provided, for heating the oil in cold weather. The connecting headers are respectively: two of six inches each for the "inflow," one of six inches for the "outflow," two of nine inches for the "overflow," and two of two inches each for steam supply.

The machinery for the distribution of the oil to the various batteries of boilers is located in the solidly constructed brick pumping station thirty feet to the east of the oil vault and was specially designed and built for this plant, the successful installation and operation of which is looked upon as an excellent piece of engineering and one that reflects great credit upon Mr. C. O. Billow, secretary of the National Supply Company, Manhattan building, Chicago, who planned and personally supervised the entire undertaking. Within this pumping station are two brass-fitted 8 by 8½ by 10 duplex oil pumps, each having a total pumping capacity of 400 gallons a minute, that are operated by steam supplied from two forty horse-power vertical boilers equipped with oil burners; a vertical feed-water heater; a 4 by 6 duplex feed-water pump; and a Jenney incandescent dynamo, the current from which illuminates the station, and having portable lamps for inspection services; while above the station rises a standpipe, 30 inches in diameter and 35 feet in height, built of seven 60-inch rings of $\frac{3}{16}$-inch steel, erected with the object of maintaining a uniform pressure on the boiler supply lines. And as a precautionary measure, a 9-inch pipe extends outward for two feet from near the top of this standpipe and thence to the ground, and is designed to serve as an overflow pipe.

The big pumps draw the oil from the tanks and force it upward till it flows into the standpipe, from whence it passes into a 5-inch pipe that is joined to the standpipe near its base. This 5-inch pipe is boxed in with and paralleled by a 2-inch steam pipe, the heat from which will keep the oil limpid in cold weather. Both pipes are snugly packed in a casing made of 2-inch lumber, and box and pipes extend in a direct line to the center of the main boiler house, 3,200 feet distant, where branch and lateral piping conveys the oil to the boilers.

One feature in this interesting installation is that all the important valves are electric valves, and are so arranged that not one unit of energy will have to be unnecessarily expended. For instance, if the demand on the boiler line is only for 1,000 horse-power per hour the machinery in the pumping station will automatically adjust itself to delivering but the requisite quantity, while the starting up of a dozen additional boilers necessitating an increase to the extent of say 20,000 horse-power in oil, will be as quickly indicated at the pumping station and automatically responded to by an increased speed and pressure in the machinery and an increased flow of oil, the pumps automatically slacking or decreasing their oil circulating power as the demands require, in response to the action of an electric float in the standpipe, which opens or closes the valves on a variance of four inches in the height of the column of oil.

The burners under the boilers are also connected electrically with a pressure gauge located on the boiler, so that any rise or fall of the pressure will open and close the burner. The feed-water pump supplying the boilers with water is connected in the same way and the same impulse is felt throughout and responded to by all the machinery. Then, as an additional precautionary measure, each machine is provided with a high and low electric alarm that instantly notifies the engineer of changes in pressure.

The tanks will be filled whenever necessary, and as occasion arises a message will be sent to the relay station at Whiting, over a special wire, notifying the chief engineer to start the big pumps, when the oil will begin to flow. The quantity placed in each tank is shown by a steel tape indicator and the quantity of oil used determined by means of an outage table carefully prepared for this purpose, and calculated on a scale for each fall of one-fourth of an inch.

An important precautionary measure for use in the event of the Whiting pipe line being temporarily disabled, includes a line of five-inch pipe 150 feet in length that extends along the railroad siding 100 feet distant. This line of piping is provided with six 2½-inch nozzles to be connected with tank cars and the oil can then be pumped into the receiving tanks or the standpipe till the main line is again in order.

As previously mentioned the responsibility and the work of planning and installing the power plant fell on Mr. Frederick Sargent, the chief mechanical and electrical engineer of the Exposition, who displayed excellent judgment in the selection of his zealous and efficient staff, including:

R. H. Pierce, first assistant electrical engineer.

John Meaden, first assistant mechanical engineer.

S. G. Neiler, second assistant electrical engineer.

G. B. Foster, engineer in charge of arc lighting.

J. A. Lounsbury, engineer in charge of incandescent lighting.

G. M. Mayer, chief draftsman electrical department.

W. S. Monroe, chief draftsman mechanical department.

J. H. R. Ward, superintendent of electric plant.

T. P. Gaylord, electrical engineer in charge of subway.

J. F. Gray, secretary mechanical and electrical department.

O. G. Dodge, inspector electrical department.

L. S. Boggs, engineer in charge electric power.

Locke Etheridge, engineer in charge of telephone and fire police signal.

L. A. Scovil, superintendent of electric construction.

S. Bispham, engineer in charge of foundations.

A. J. Davis, engineer in charge of steam heating plants.

Harry Jones, engineer in charge of erection of machinery.

G. R. Green, inspecting engineer.

Crawford Hutchinson, engineer in charge of erecting boiler foundations.

George E. C. Johnson, in charge of contracts.

Luther Stieringer, consulting electrical engineer.

THE ELECTRICITY BUILDING AND THE ELECTRICAL EXHIBITS.

CONTINUED.

The block adjoining the Brush exhibit has been assigned to the Fort Wayne Electric Company, who are preparing a comprehensive exhibit showing the resultant advantages accruing to central station managers who operate the Wood arc and the Slattery incandescent systems. And in addition thereto they will display several important devices which they are about to place on the market.

Side by side with the Fort Wayne exhibit will be the representative electrical industry of the northwest, the National Electric Manufacturing Company, of Eau Claire, whose output is in operation in nearly every state and territory in the Union, and whose display will be characteristic of so progressive a company, judging from the remarks of General Manager Daigh, whose appreciation of the educational and financial benefits to be derived from the Exposition is unqualified.

In this vicinity are some of the rooms set aside for toilet conveniences, and which have been placed in easily accessible portions of the Electricity building, whether approaching from the interior or exterior, as all are near the main side entrances on both sides of the building. The rooms set apart for women being to the south and those for men to the north of these entrances. Each closet is partitioned off and will be thoroughly flushed and cleansed by an attendant before being occupied a second time. For the use of males there are 176 closets in the Electricity building and for females 108 closets. Of these closets 52 on the men's side are for use free of charge, while 124 are somewhat more handsomely finished, have more attendants in charge, and are termed "pay closets," the small fee of 5 cents being collected by one of the attendants from each occupant. On the female side there are 56 free and 108 "pay closets."

Then there are 42 lavatories in the rooms set apart for the men and 56 lavatories in the female section, where the use of running water in marble basins, with powdered soap, individual towels, comb and brush, may all be had for the slight fee of 5 cents. For the women the utmost privacy is secured by inclosing each lavatory in what might be termed a small cabinet finished in white enamel and containing a rug, chair, towels, brushes, comb, long plate-glass mirror and other conveniences, the use of which may be enjoyed for the trifling sum of 5 cents. And no room may be used a second time till thoroughly cleansed by an attendant. When the imperfect and thoroughly unsanitary toilet arrangements existing at previous expositions are recalled to mind, there is only praise of the highest character for the thoughtfulness and wisdom of the management in planning these systematic details that will add so largely to the comfort and to the maintenance of the health of visitors and exhibitors.

The discharges from the lavatories and closets in the Electricity building flow into a pair of Shone ejectors, each of 180 gallons capacity, placed under the building, in a cemented pit sunk to the depth of fourteen feet below the ground surface. Only one ejector is used at a time, except on extraordinary occasions, the second being held in reserve, but when the Exposition is well attended, it is expected that an ejector will fill and be emptied at the rate of about once a minute, and as the contents are ejected into the branch pipe the displacement of a similar quantity from the main discharge pipe flows into tanks, where it is treated with sulphate of aluminum or other chemicals, which throw down the solids and leave the water comparatively innoxious.

These ejectors are operated by compressed air supplied from the power plant in Machinery hall. Each ejector has an inlet and outlet pipe for sewage, and an automatic valve for the compressed air. Through the inlet pours the waste water and other matter from basins, closets and sinks, till the machine is full, when a float automatically opens the compressed air inlet, and the pressure of the inrushing air (50 pounds to the square inch) instantly closes the inlet flap valve and ejects the contents into a branch pipe directly connected with the main discharge pipe. As the last of the fluid passes out the compressed air valve is automatically closed, and the ejector expanded down to atmospheric pressure through a muffler box, then the back pressure in the branch pipes closes the flap valve on the outlet, and the pressure being released the inlet flap valve opens, allowing the liquid washes to again flow in.

The Gage Hotel Company has secured the concession for restaurants in each of the main buildings, and it is the intention to furnish a luncheon at a moderate price in certain rooms, and an unexcelled high-class service in the galleries. Especially in the Electricity building will the service be of a character to win the praise and admiration of all good livers, and each restaurant will sell light wines, beer and mineral water to customers ordering food whether it be a complete dinner or a "mere bite." No cooking will be allowed in any of the exhibit buildings, but several big kitchens will be located near the southern end of the grounds and the cooked food transferred in specially arranged vehicles to the restaurants where it will be kept warm, probably with the aid of the Burton electric heater. The view from the restaurant windows in the curved bays of the Electricity building is exquisitely picturesque in summer, and not altogether cheerless at this season even though the snow covers Wooded Island more than a foot in depth and the ice-bound lagoons and canals bear no resemblance to Graham's sketch enriched by the warmth of lithographic colors. But when the sunshine of spring comes again then island and inlet and bay will be fringed with a wealth of floral beauty entwined with water hyacinth, lotus, poppies and water lilies, bordered with sedge grass and guarded by bulrushes.

From the restaurant windows one can gain one of the best views of the grounds looking to the north and the west, for the vision is unobstructed for a long distance, and the Fisheries and the distant Illinois building all come within the range of eyesight. Then intuitively some appreciation of the great area covered by these buildings comes to the visitor. An area more than twice that occupied at Paris, where the total area of the grounds was but 238 acres, while here there are over 600 acres.

The Electricity building is insured for nearly eighty per cent of its cost at the rate of $2.75 per $1,000, the same as Machinery hall, the Manufactures, and other large buildings. About 130 home and foreign companies are carrying the insurance on the buildings and most of these companies will also insure the exhibits, a matter that will have to be attended to by the exhibitor. And in this connection it is well to remember that many of the exhibitors who have secured their allotment of space are already taking out policies to run for twelve months, a very wise precaution as insurance may be difficult to secure later on, should the total amount applied for approximate $100,000,000, which now appears quite probable. The insurance officials have not hesitated in accepting risks since the fire department at the Exposition grounds was placed in charge of Chief Swenie, in whom they have the utmost confidence, and the thoroughly organized department includes a fire-boat, having a pumping capacity of four first-class fire engines, that will be stationed near the island, seven fire steamers, four hook and ladder companies, twelve horse hose reels, thirty-two hand hose reels, and 1,000 fire extinguishers. Then there is the perfectly operating police and fire signal system, including 150 alarm boxes, and 150 patrol telephones, and in addition experienced firemen will patrol the Electricity and other buildings day and night ready to quench the slightest outburst.

(*To be continued.*)

THE TELEPHONE INTERESTS.

The Chicago Telephone Company has perfected elaborate plans for the complete installation of a working exchange and subsidiary lines at Jackson Park and the work is well under way.

The plans include the furnishing of 300 telephones for use between the different departments and as many public and private telephones as may be required by exhibitors in the various buildings. Each separate installation will include copper metallic circuits and the long distance equipment that is so popular, and with the public instruments will be provided the comfortable booths that shut out all sound. Then, to relieve the subscriber from the unpleasant features of retardation so noticeable in the city lines, and which is largely due to conditions existing in the down-town conduits, connection by means of a belt line will be made to the long distance circuits extending to the north and west as well as to the east, at some point near the city limits.

Then there will be at least 100 trunk lines directly connecting the exchange in Jackson Park with the Chicago exchange, thus affording easy telephonic communication to or from all parts of the city without interruption to main trunk lines or interference with the regular city calls. This cable is being placed in the subway.

These lines leave the Chicago exchange in the form of a single cable of 100 pairs that is laid in the telephone subway to Fifty-second street, where it is divided into two cables of 50 pairs each and carried on the handsome pole lines to Jackson Park.

The possibility of a demand not arising for this work has not prevented the preliminary wiring from being done, and telephone cables have been carried into every building and headed up so that when required service wires can readily be extended.

Mr. W. S. Ford, of the engineering staff of the American Bell Telephone Company, of Boston, is the genial and efficient engineer in charge of this work.

MR. F. H. BROWN'S TELEPHONE.

The Brown Telegraph and Telephone Company, of Chicago, is generously offering to sell treasury stock at fifty cents on the dollar after publicly stating "that the city paid a million dollars a year for telephone service, of which $750,000 was net profit." The newspaper reporter quotes Mr. Brown as saying: "We are not going to organize exchanges, as I have said, but shall sell our instruments at $50 a pair. The city could accept our proposition and rent telephones at the price we have specified and make a handsome profit." Mr. Brown is a truthful man, and he will be discreet enough not to organize and operate an exchange unless the American Bell Telephone Company and the Western Electric Company are first conferred with, for the patent Mr. Brown refers to as about to expire is the least important of many that interlace and form so necessary a part of the central exchange system that investors should look with distrust upon any schemes for introducing a new telephone system for some years to come.

IMPORTANT MEETING OF THE ADVISORY COUNCIL OF THE CHICAGO ELECTRICAL CONGRESS.

A meeting of the Advisory Council of the Chicago World's Congress of Electricians was held at the rooms of the American Institute of Electrical Engineers, New York, on January 17.

The following gentlemen were present: Dr. Elisha Gray, chairman, Prof. William A. Anthony, Prof. Charles R. Cross, Dr. Louis Duncan, Dr. William Geyer, Mr. Carl Hering, Mr. George A. Hamilton, Prof. F. B. Crocker, Mr. A. E. Kennelly, Mr. T. D. Lockwood, Mr. T. C. Martin, Mr. George M. Phelps, Dr. M. I. Pupin, Mr. R. W. Pope, Prof. H. A. Rowland, Mr. Herbert Laws Webb.

Mr. H. L. Webb was elected secretary of the meeting, in the absence of Professor Carhart, permanent secretary of the Council. The preliminary reports of the English and American Committees, already made public, were received.

It was resolved that the Electrical Congress of 1893 shall consist of two chambers, of which the legislative chamber shall decide on units, names of units, and standards, and shall consist solely of delegates named by their respective governments.

A committee was appointed to determine the total number of official delegates and their apportionment to the various countries to be represented.

The following apportionment of delegates was made by the committee whose report was adopted by the meeting: Great Britain 5, France 5, Germany 5, Austro-Hungary 5, United States 5, Belgium 3, Italy 3, Switzerland 3, Holland 2, Denmark 2, Norway and Sweden 2, Russia 2, Spain 2, Portugal 1, British North America 1, Australian Colonies 1, India 1, Japan 1, China 1, Mexico 1, Brazil 1, Chili 1, Peru 1, Argentine Republic 1; making a total of 55 official delegates.

It was resolved that a Committee on Invitations be appointed by the chairman, this committee to consist of five members who shall select and recommend to the chairman the names of electricians, electrical engineers and others who shall be members of the

Electrical Congress. Said committee to coöperate with the foreign committees.

It was further resolved that in addition to invitations to deliberating and voting members of the congress, a general intimation shall be extended through the journals or otherwise that the meetings will be open to the public, for attending the proceedings, but not for taking part therein.

It was resolved that a Committee on Programme and Papers be appointed by the chairman. This committee shall consist of eight members, whose duty it shall be to invite, receive and consider papers and other documents relating to the work to be done by the congress. And it was further resolved that it shall be the duty of this committee to formulate a programme for the congress.

It was resolved that the reports of the English and American sub-committees which were received at the meeting should be referred to the Committee on Programme and Papers, and that the committee confer with the English Committee as fully as possible and with such other foreign committees as may be formed.

It was resolved that the Electrical Congress of 1893 shall last one week, beginning on August 21.

It was resolved that a committee of three be appointed by the chairman as a Finance Committee.

It was resolved that an Executive Committee of five shall be appointed by the chairman, said committee to have full power to act for the Advisory Council.

It was resolved that the question of charging a fee for membership of the congress, and fixing the amount of such fee be referred to the Executive Committee.

THE INTERNATIONAL ELECTRICAL CONGRESS OF 1893.

The General Congress Committee of the American Institute of Electrical Engineers has received the report of its sub-committee, embodying a provisional programme for the conduct and work of the Congress, to be held in Chicago during this year.

The sub-committee, consisting of Mr. Carl Hering, chairman; Prof. William A. Anthony and Mr. A. E. Kennelly, made the following recommendations:

(1.) Ratification of the adoption of units, terms, symbols and definitions by previous International Electrical Congresses.

(2.) Defining and adopting practical units for measuring and designating the measurements of the following quantities: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; electric conductivity; illumination.

It will be noticed that this refers only to the question of what the magnitude of the units shall be, or, in other words, what multiples or sub-multiples of the absolute units they are to be.

The value of the practical units to be: magneto-motive force, one-tenth of the absolute unit, that is, equal to $\frac{1}{4\pi}$ ampère turn; of magnetic flux, 10^8 absolute units or lines; of magnetic intensity, 10^8 absolute units, that is, 10^8 lines per square centimeter; of reluctance, 10^{-9} absolute units; of electrical conductivity, 10^{-9} absolute units, that is, to the reciprocal of the ohm; of illumination to be a violle, at the distance of one meter.

(3.) Adopting names for the following practical units: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; inductance; electrical conductivity; illumination.

The following names are suggested for these units: For magneto-motive force the name "gilbert"; magnetic flux, the name "weber"; magnetic intensity, the name "gauss"; magnetic reluctance, the name "oersted"; inductance, the name "henry"; electrical conductivity, equal to the reciprocal of the ohm, the name "mho." For the practical unit of illumination defined above, the name "lux."

(4.) Defining and adopting modes of embodying the following principal units of measurement in concrete standards capable of being readily reproduced, and adopting names for them or for the theoretical units, by which they can be distinguished from each other: Ampère, ohm, volt, watt, standard candle.

The following definitions of these units are recommended:

An ampère shall be that unvarying current which, when passed through a solution of nitrate of silver in water, in accordance with the specifications recommended in the recent report to the British Board of Trade, deposits silver at the rate of 0.001118 of a gramme per second.

An ohm shall be the resistance offered by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area, and of a length of 106.3 centimeters.

A volt shall be the product of this ampère and this ohm.

A watt shall be the product of the square of this ampère and this ohm.

The other units, such as the coulomb, the farad and the joule, shall be taken as derivatives in terms of this ampère and this ohm.

(5.) Adopting an international system of notation and conventional symbols for designating different quantities.

(6.) Defining the following terms: Impressed electro-motive force, inductivity, inductance, real activity, Matthiessen's standard, north and south pole.

(7.) Defining and adopting expressions: For alternating currents of more than one phase; for describing phenomena of alternating currents and of electro-magnetic waves.

It is recommended to adopt the following expressions: "Simple" alternating current for the usual alternating currents in which there is practically but a single phase; "diphase" alternating currents for two alternating currents whose phases differ in time by 90° or 270°; "triphase" alternating currents for three alternating currents whose phases differ in time by 60° or 120°; "polyphase" alternating currents for such as have more than three phases.

For expressions describing phenomena of alternating currents and electro-magnetic waves your committee solicits suggestions.

(8.) Recommending the more universal use:

Of the term "voltage" as synonymous with "difference of electrical potential" or P. D. in place of the terms "potential," "tension," or "pressure," the use of which in this sense it is recommended to abandon;

Of the term "transformer" instead of "converter";

Of the term "dynamotor" for a continuous current transformer;

Of the term "continuous current" instead of "direct current";

Of the term "kilowatt" instead of "horse-power."

Of the metric system of weights and measures, and suggesting means by which its introduction will be facilitated.

The following subjects of papers are offered as a suggestion to the Congress Auxiliary merely as a basis and not as a complete list:

The criterion of sensitiveness of galvanometers; or, on the theory of their construction.

The working of national or municipal laboratories for testing meters and instruments.

The practical results and economy of the employment of accumulators in central station systems of supply.

On the relation between weight of copper and iron in dynamos and their output.

Nomenclature and notation of magnetic circuit — or on standard and units of magnetism.

Magnetism.

On the economic use of transformers under various conditions of supply.

Electricity meters from a European standpoint.

Electricity meters from a British standpoint.

Electricity meters from an American standpoint.

Choice of materials for standard of electrical resistance.

Nomenclature of phenomena of electro-magnetic waves.

Standards for electrical measurement.

Alternating current transformers from an American standpoint.

High frequency and high potential phenomena.

Dynamo construction.

The committee suggest that papers should be solicited by the General Congress Committee of this Institute on the work of the early electricians of this and foreign countries, considered from a modern standpoint, and their importance in the development of the science of electricity, including descriptions and illustrations of models and apparatus used.

Regarding the meetings of the congress, the committee recommended that, as in the Paris Congress of 1889, the meetings be divided into (a) General Meetings, one at the opening and one at the closing of the congress, which are to be devoted to the consideration of general questions and those on which agreements are desired, and to the reading of papers of a general character; (b) Sectional Meetings for the reading of all other papers. The following division into sections is recommended:

1. Electrophysics, units, measurements, and all electrical matters of a purely scientific nature.
2. Dynamos, motors, transformers, etc.
3. Systems, central stations, installations, lamps, etc.
4. Electric telegraphy, telephony and signalling.
5. Electric railways.
6. Electrochemistry, batteries, electrometallurgy.
7. Electrophysiology and electrotherapeutics.
8. Legal questions.

ALTERNATING CURRENT APPARATUS.

PART II.—BY C. KAMMEYER.

See that the oil cups are filled with a good quality of lubricating oil and adjust them to feed properly. In a new machine supply the oil rather freely at first, until all bearings are running smoothly and cool.

The circuit or circuits should also be examined daily for grounds or escapes. Do not depend upon the behavior of a cheap magneto bell for this, but use a bell that will ring through at least 50,000 ohms; or better still, procure a suitable resistance set and measure the insulation resistance between line and ground daily. It will be found advisable to keep a record of these daily tests for future reference.

Before starting the machine it will be necessary to properly set the brushes. Specific directions on this point may vary with different systems, but the following general remarks are applicable to all kinds of machines.

The alternator brushes should be set so as to bear on the collector rings with a moderate pressure. The exact position or angle of contact on the rings is immaterial, as the brushes merely serve to collect or take off the current from the rings. To avoid cutting of the rings a very small quantity of oil should occasionally be applied by means of a small linen pad secured to the end of a stick. Do not use your finger for this, while the machine is generating current, as it would be needlessly exposing yourself to danger.

In the setting of the exciter brushes more care and precision are required. Always set the brushes so as to make contact with diametrically opposite segments of the commutator. Most makers mark two opposite sections with a dash or arrow. If they are not so marked, cut a strip of paper or tin and measure around the commutator; one-half of this distance will give the desired points. Before placing brushes on commutator, their ends must be given a proper bevel by filing or grinding. This bevel should be such as to cover not more than one commutator segment when all copper brushes are used. Carbon brushes or brushes having their outer layers or leaves composed of high resistance material (such as the "Wirt" brush) may be allowed to cover more than one section. The more sections thus covered, the hotter the armature will become, because more of the armature coils are short-circuited by the brushes, when passing the neutral point. See that the bevel of the brushes runs parallel with the commutator bars, so that the brush bears evenly on same and not merely on one corner or edge. It is of course of the utmost importance that the commutator itself be at all times kept perfectly round, true and smooth. This can only be accomplished by keeping the brushes from sparking at all times and adjusting their tension or pressure so that they will not cut or score the commutator. A very little vaseline should occasionally be applied with the tip of the finger to prevent excessive friction. Should any cutting or scoring take place, the defective spot should be immediately smoothed and polished by holding a pad of fine sandpaper against the commutator, while the latter is in motion. Never under any circumstances, use emery on a commutator, as the particles of emery are apt to embed themselves in the soft copper and remain there.

One of the most prolific and annoying troubles met with in alternators is sparking of the exciter brushes. This may be due to several causes. In the first place, the brushes may not be set at the neutral or non-sparking point. This should be remedied by carefully shifting the position of the brushes by means of moving the rocker arm, until the sparking is reduced to a minimum. If the brushes are set so as to touch exactly opposite points on the commutator and the latter is round and smooth, no perceptible sparking will occur in a properly designed machine. If, however, the commutator is rough or out of round or both, it will be impossible to prevent more or less sparking. In this case the commutator must be carefully trued up by means of a file and then polished with fine sandpaper. Wherever it is possible, the trueing up of commutators should be done in a lathe, as it is extremely difficult to get the commutator exactly round by filing it.

If the brushes make poor contact with the commutator, or the latter is covered with dirt or grease, sparking will invariably occur. Where any lubricant is used on the commutator, a very minute quantity will generally be found sufficient, and even this, with any dust or copper dust which may have accumulated, should occasionally be removed by means of a linen rag moistened with benzine, being very careful to not apply this when any current is on, as a spark may ignite the benzine.

Sparking may also be due to the exciter being overloaded, although this is of rare occurrence, and can only be caused by one or more of the alternator fields being short-circuited. This, of course, would prevent the proper working of the alternator itself.

It occasionally happens that an alternator fails to start or generate, when all the connections, etc., are apparently in good working order. The trouble will generally be found in the exciter or its connections. By carefully holding a piece of iron near any one of the alternator fields while the dynamo is running and all connnections properly made, we can readily determine whether or not the fields are being magnetized. If no magnetism can be detected, the trouble is in the exciter. See if the exciter fields are being magnetized, if so, the circuit of the alternator fields is open. This nearly always occurs at the terminals of the field coils; if these terminals are connected by means of couplings, these may have become loose from constant vibration, or the ends of the wire may even be broken off short where they leave the coil. Careful examination will generally disclose the faulty place.

(*To be continued.*)

Mr. Charles Steinmetz, in the *Electrical Engineer*, gives some data regarding the maximum possible speed of electric railways. Mr. Steinmetz points out that the speed is not limited by the capacity of the motor, but that when the point is reached where the resistance to the train's motion is greater than the adhesion between the wheel and rail, motion ceases, and any increase of power will simply cause the wheel to slip without producing any acceleration. He thinks that with the heavy rails and well-ballasted tracks in use on our steam railroads the electric motor can reach speeds up to 220 miles per hour, and that by using heavier rails and better tracks the train resistance can be still further reduced.

A BRIEF REVIEW OF SOME LEADING ARTICLES IN THE ELECTRICAL JOURNALS.

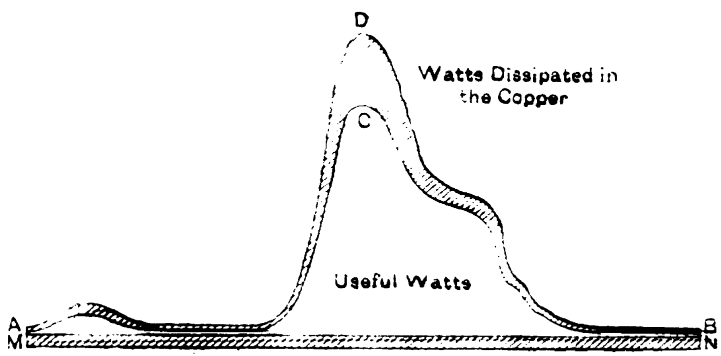
Mr. B. H. Thwaite recently read a paper before the Manchester Association of Engineers on "Economic Possibilities of the Generation of E. M. F. in the Coal Fields, and its Application to Industrial Centers," in which a plan is described for converting coal at the mines into gas and using this in gas engines to drive alternating current dynamos. It is claimed that this method will give the highest practical standard of efficiency, the ultimate possible results of a plant on a large scale being an indicated horse-power with an expenditure of from $\frac{5}{8}$ to 1 pound of solid fuel. It is also claimed that the nitrogenous value of the fuel can be abstracted and utilized for agricultural fertilization, the amount obtainable per ton being equivalent to that contained in twenty-two pounds to twenty-eight pounds of ammonia sulphate. The details have been worked out with the assistance of Mr. J. Swinburne, and estimates for the plant have been made by Messrs. Brown, Boveri & Co. and by the Maschinen-Fabriken Oerlikon. The figures show that 10,000 horse-power can be delivered and sold in London with 7 per cent profit for $1\frac{84}{100}$d. per supply unit.

Mr. Carl Hering in an interesting article in the *Electrical World* regarding the advantages of forcing lamps at the expense of their life, describes the method devised by Mr. O'Keenan for determining the most economical age of incandescent lamps. The results obtained would seem to indicate that it will be more economical to destroy lamps after burning them a few hundred hours than to continue to use them during their full term of life. Mr. O'Keenan's method is very simple and appears to be perfectly rational. He divides for each hour of its life the total cost of the light, including lamps and power, by the total amount of light obtained up to that hour, and finds that for the first few hundred hours the cost of the light diminishes, but after that it increases. This point of minimum cost Mr. O'Keenan terms the "smashing point," and is where he thinks it pays best to throw the lamps away and use new ones. It is reached in some lamps at the early age of 200 hours, and none exceeded 500 hours. The tests were of foreign lamps, but it is very probable that American lamps would give about the same results. It has long been known that the efficiency of an incandescent lamp increases when it is forced, that is, the number of watts required per candle-power decreases as the voltage is increased; also, that the life is thereby diminished. As the total cost of the light is increased by either of the extremes of long life and low efficiency on the one hand and high efficiency and short life on the other, there must be some intermediate value for the life and efficiency which will give the most economical results, when both the cost of the lamp and the power required are considered. This is Mr. O'Keenan's "smashing point." The results apply more directly to private installations where the greatest amount of light is desired for the least amount of money. Central station managers, as a rule, are not so particularly concerned about the candle-power of the lamps, and will run them until they die a natural death. They receive the same income per watt, regardless of the efficiency of the lamps, and where they furnish the lamps it is desirable to have them last as long as possible. The fact that the energy is not producing the amount of light paid for by the customer does not ordinarily affect them, nor does the fact that the lower efficiency of the lamps necessitates a greater consumption of energy on the part of the customer to get a given amount of light. The practice of burning lamps until they are black and dim, and of using low-efficiency lamps run below their voltage is certainly [redacted] to be deprecated. The aim of a large number of station managers is seemingly not so much to solve the scientific problem of getting the most light for the least amount of money possible, but rather that of getting the most money for the least amount of light possible, which, however, is at the expense of the consumer.

Dr. John Hopkinson's address, delivered before the Junior Engineering Society, in London, contains many points of interest to station managers. Doctor Hopkinson points out the advantages of using the differential method of charging suggested by him in 1883. To illustrate this method, which is intended to secure some approach to proportionality of charge to cost of supply, he has chosen an imaginary station designed to supply 40,000 16 candle-power lamps, or 2,500 kilowatts, first, on the hypothesis that it is always to be ready to supply the 40,000 lights at half an hour's notice, day or night, but that the lights are hardly ever actually required, and second, on the hypothesis that the 40,000 lights are steadily and continuously supplied day and night, these being the two extreme cases possible. The cost of supplying electricity is therefore divided into two parts, one part being incurred in simply being ready to furnish the supply, the other being the actual cost of supplying. It is assumed that with uniform and continuous load one kilowatt hour can be produced with less than three pounds of coal, but that with a load for twelve per cent of the time or a load factor of twelve per cent the consumption is about seven pounds, that is, to deliver a kilowatt for twenty-four hours would require seventy-two pounds of coal and to keep the boilers warm and turn the machinery round for twenty-four hours, but only supplying current for three hours would require twenty-one pounds of coal. The plant is assumed to cost £145,000, the fixed charges such as interest, taxes, depreciation, etc., would amount to £16,410 running light, and £18,750 when fully loaded, adding the coal account, the cost of running light and fully loaded would be £28,010 and £59,250 respectively. Thus the cost of simply being ready to supply the current for 40,000 lights at any moment throughout the year would be £28,010, whereas the cost of actually supplying the current would be £59,250. Based upon these figures Doctor Hopkinson has prepared a chart comparing the charges per kilowatt hour at a fixed rate of charge and at what he terms a compound rate, that is, a certain fixed charge whether the current is used or not, and an added small charge for the amount actually consumed. The chart shows that for anything over 500 kilowatt hours the compound charge is more economical to the consumer than the fixed charge, and this gain in his favor increases rapidly with an increased use of the current. The enormous decrease in the cost of production as the load on the stations is increased is also shown. In a number of American cities this is provided for by giving rebates proportional to the amount of current consumed. Doctor Hopkinson also considers a station equipped with accumulators, and he finds the cost of being ready to supply and to continue to supply is about the same whether accumulators are used or not; the additional cost of actually supplying current is about forty per cent more where accumulators are used than when they are not used. The station under consideration is, however, a large one, and Doctor Hopkinson points out that the certainty of improvements in accumulators and the possibility that the improvements may be considerable is a strong argument for the use of the direct current wherever it is not precluded by the distance of transmission being too great. He does not hesitate to say that in most small stations giving a continuous supply accumulators ought to be used notwithstanding their defects. Doctor Hopkinson concludes that to be ready to supply a customer with electricity at any moment he wants it will cost those giving the supply about £11 per annum for every kilowatt furnished per hour, and that afterward to actually give the supply will not cost much more than [illegible]/3d. per kilowatt. With selected customers electricity is cheaper than gas, but to compel those customers who are unremunerative to adopt other methods of illumination what is wanted is not so much an increased charge for those whose lights are used for a short time as such a special reduced charge for those whose lights are used long as will induce them to use the supply. Doctor Hopkinson's calculations do not take into consideration the question of supplying current for motors during the day, which is quite an item in American practice.

Dr. J. A. Fleming recently read a paper before the Institution of Electrical Engineers on "Experimental Researches on Alternating Current Transformers," which is a marvel of painstaking labor. The object of the investigation was to determine the best method of practically testing transformers in actual use and to compare the relative superiority or advantages of open and closed magnetic circuits. Numerous tests were made, extending over several months, including transformers of the leading English and American makes. The efficiency of the transformers was measured by a number of different methods embracing the three-voltmeter, the three-ammeter and the wattmeter. The difficulties encountered and the liability to error in using the different methods for measuring alternating current power are mentioned. Regarding the three-voltmeter method, Doctor Fleming concludes: (1) It is only applicable when a very steady alternating pressure can be obtained. (2) The number of instruments to be read necessitates the assistance of several observers. (3) It is difficult to get good results when testing transformers of the open magnetic circuit type in which the power factor, or ratio of the true power to the apparent power (as given by the numerical product of the virtual volts by the virtual ampères) is small. (4) Owing to the nature of the formula for the calculation of the power, unless all conditions for maximum accuracy can be secured, the results will not be very trustworthy. By an arrangement of mercury cup connections the three-ammeter method was reduced to the use of a single ammeter, which while possessing all the advantages of the three-ammeter method was much simpler to work. The conclusion arrived at was that the ordinary commercial ammeter did not possess the desired accuracy when operating on open magnetic circuit transformers at no load, it being necessary to read currents of the value of from .25 to 5 ampères to the third decimal place, which is not in general a practicable matter with commercial instruments. A large number of tests were made with the dynamometer wattmeter, and while numerous sources of error were discovered, the conclusion reached was that with proper precautions a suitable dynamometer wattmeter is a very useful instrument for measuring the power being taken up in inductive circuits and is much easier to manage than the more complex methods, which while looking well on paper are difficult to carry out satisfactorily in practice. If the movable coil has few turns and no metal near it and the external shunt circuit is non-inductive, excellent results can be obtained. Doctor Fleming's tests show conclusively that the iron losses are practically constant from no load to full load. It will be remembered that the tests of Messrs. Ayrton and Sumpner showed the same result. This effectually explodes the theory held by some that the iron losses are decreased at full load. The efficiency of a 6,000-watt transformer was 85.7 per cent at one-tenth full load and 96.9 per cent at full load. This was of the Westinghouse make, the frequency being about 83 periods per second. The efficiency of a 3,000-watt "Hedgehog" transformer was 71.7 per cent at one-tenth full load and 93.5 per cent at full load, showing that this particular open magnetic circuit transformer did not compare with the closed magnetic circuit either when partly or fully loaded. Doctor Fleming also carried on numerous experiments on the behavior of transformers at the moment of switching them on to a live circuit. It being discovered that at certain times, when the transformers were connected in the circuit of a high pressure lead, an abnormal rush of current took place, and in some instances the insulation of the transformer was pierced. These experiments led Doctor Fleming to conclude that the condition under which a transformer is disconnected from the circuit determines what happens when it is reconnected. When the current is interrupted the iron is left magnetized one way or the other or perhaps not magnetized at all, depending on the phase of the current when it ceases. When the current is switched on again the incoming current finds the iron already in a magnetic condition, it may be in such a direction that the current is able to instantly produce the counter electro-motive force, or, it may be that the direction is such that so far from introducing a back electro-motive force it actually assists the current, the effect being for an instant to destroy the impedance, the amount of current being controlled simply by the ohmic resistance of the primary circuit, thus allowing a momentary rush until the impedance is built up by the magnetism of the core falling into step with the current. Further experiments showed this rush of current to be accompanied by a sudden rise of pressure at the terminals of the transformer. Doctor Fleming's results also show that the power factor for most closed magnetic circuit transformers practically reaches unity at about one-tenth full load, that is the apparent power supplied to the transformers is the real power when all the transformers on the circuit are more than one-tenth loaded. A loss of 112 watts was shown in the "Hedgehog" transformer, which was rather difficult to account for, as both the iron and copper losses were apparently small. Doctor Fleming ascribed it to Eddy currents generated in the secondary circuit, but in the subsequent discussion Mr. Swinburne seems to prove it due to Foucault currents generated in the iron core caused by the laminæ of the iron core being crowded together by the tension put on the wire in the winding.

A paper read before the Sociétè International des Electricians, by M. R. V. Picou, deals in a novel way with the subject of transformer distribution. M. Picou attempts to analyze the losses in transformer distribution by drawing a curve, the area of which represents the paying load for an average day of twenty-four hours, the ordinates being the watts. To this is added the losses which arise in the transformer and mains. These are divided into two parts: those due to the iron, which are constant at all loads, and those due to the copper or C^2R losses, the former being represented by a line drawn parallel to the base, and the latter b increasing the ordinates of the curve by an amount representir the total copper loss at any instant. This diagram shows in striking manner the dead weight of the iron losses at times o light load when the copper losses are negligible, and clearly illustrates the advantage to be derived by sacrificing some of the maximum efficiency to increase the average efficiency. Two noteworthy solutions of the problem have been proposed by Mr. Swinburne and M. Dolivo-Dobrowolski, both of whom propose to decrease the volume of iron. In the Hedgehog the iron loss has been diminished by simple suppression, the magnetic circuit being completed through the air; the hysteresis loss is thereby diminished, as air is apparently perfectly magnetically elastic, but the copper losses are greatly increased, as the primary current is



much greater than in the case of a corresponding closed magnetic circuit transformer. If it were only a question of a simple transformer, it would be easy to increase the size of the wires, keeping the copper loss constant, and thus obtain the full benefit of the reduction of the iron loss; but when the transformer is considered as part of a system of distribution, the dynamos and conducting network have to be taken into account. The net gain, therefore, will depend upon the average load on the station, and may indeed in some cases have a negative value, where the average is high. M. Dolivo-Dobrowolski's solution of the problem is to reduce the volume of the iron while still maintaining the closed magnetic circuit. It would not do to increase the induction density, as the hysteresis losses vary with the 1.6 power of the density. To reduce the iron it is accordingly necessary to decrease the length of the magnetic circuit, allowing just sufficient room for the coils; a smaller wire must be used, as the number of turns must remain the same, and as this increases the resistance, the reduction of the iron will be accompanied by an increased copper loss, as in the Hedgehog. Another disadvantage would be the impairment of the self-regulation, caused by the increased drop in the secondary circuit, due to the increased resistance. M. Picou thinks it is of no use looking only at the transformers; it is the system as a whole that must be taken into consideration, and for this reason he does not consider the Swinburne and Dolivo-Dobrowolski solutions of the problem satisfactory, as their attentions have been confined to the organ rather than the organism. As the conductor efficiency decreases and the transformer efficiency increases as the load rises, the condition of maximum efficiency is when the C^2R losses equal the iron losses. Matters should therefore be arranged so that this equality of iron and copper losses is attained for the average current. Owing to the absence of reliable data regarding the actual C^2R losses in the mains in ordinary practice, it is difficult to tell how nearly this condition is realized in modern transformers. Dr. Fleming's recent tests show that the copper losses at full load are about equal to the iron losses; for the average load, however, the copper losses are less than those in the iron, and when the losses in the mains are added, it is probable that M. Picou's condition of maximum economy represents very nearly the conditions of actual practice with closed circuit transformers.

A brief article in the *Electrical World* gives some conclusions arrived at by Mr. D. Jonesco regarding the condition under which trees are subject to destruction by lightning. Mr. Jonesco concludes that at very high potential discharges all kinds of trees may be subject to destruction. That trees containing oils are less liable to be struck, as lightning appears to prefer those which contain starch and those which contain oil to a slight degree only. The quantity of water contained in the trees has no effect on their liability to being struck, as dead limbs seem particularly liable; further, the nature of the soil does not appear to affect the result.

A SYNOPTICAL INDEX OF CURRENT ELECTRICAL LITERATURE.

AGRICULTURE.

"Applications of Electricity to Agricultural Work — IV." A series of illustrated articles in *Electrical World*, Dec. 31, Jan. 14.

ALTERNATING CURRENT PHENOMENA.

"Alternate Currents of High Potential and High Frequency — I." By Nikola Tesla. (Author's abstract in Transactions of a lecture delivered Feb. 4, 1892, before the Royal Institution of Great Britain.) *Electrical Engineer*, Jan. 11.

"Experimental Determination of Electrical Oscillations. (Abstract of deductions made by Messrs. Bedell and Crehore, of Cornell University.) *Electrical World*, Jan. 7.

AMMETERS.

"Non-Polarized Ammeters." By Clarence E. Gifford. *Electrical World*, Dec. 24.

ALTERNATING CURRENT APPARATUS.

See "Central Stations" and "Transformers."

ACIDIMETER.

"Electrical Acidimeter." (For determining the degree of acidity in fermented beverages. Reprint from *Annales Industrielles.*) *Scientific American Supplement*, Dec. 24.

AMUSEMENTS.

"An Electric Race-Track." (Dummy horses operated by motors and ridden at variable speeds, at Sohmer Park, Montreal.) By L. M. Pinolet. *Electrical Engineer*, Dec. 28.

BATTERIES, PRIMARY.

"Primary Battery Investments." By Albert Scheible. *Popular Electric Monthly*, November.

"Primary Batteries." (Correspondence indorsing porous cell batteries.) *Electrical Review*, Dec. 31.

"Circulating Battery." (Serrins.) *Electrical Engineer*, Dec. 21.

"Experiences with Primary Batteries." By George H. Lee. *Electrical World*, Dec. 17.

"Practical Primary Batteries." By Converse D. Marsh. (A brief reply to G. H. Lee's article.) *Electrical World*, Jan. 7.

"Reorganization of the Fool-Killer's Office Needed." (Editorial comment on Pennock primary battery swindle.) *Electrical World*, Jan. 14.

BATTERIES, STORAGE.

"Secondary Batteries for Central Stations." Editorial. *Electrical World*, Dec. 24.

"Storage Battery Experiment on Ninth Avenue." (Acme Storage Battery Company's car.) *Electrical Review*, Dec. 31.

"Storage Batteries in Central Stations." By Gautherot. (And editorial comment.) *Electrical Engineer*, Jan. 4.

"Tommassi's Accumulator." (Reprint of details from London *Industries.*) *Electrical Review*, Jan. 14.

"The Wladimiroff Accumulator." *Electrical Engineer*, Jan 11.

"Storage Battery Lighting." Abstract of report in London *Electrician* regarding omnibus lighting. *Electricity*, Jan. 11.

BIOGRAPHICAL.

"Werner von Siemens. Biographical Notes." *Electrical Engineer*, Dec. 28.

"In Memoriam, Dr. Werner von Siemens." By V. M. B. *Electrical Review*, Dec. 17.

"Dr. Cornelius Herz (with portrait and editorial eulogy). *Electrical Review*, Dec. 31.

"An Insult to Intelligent Readers." (Editorial comment on *Electrical Review's* eulogy of Dr. Herz.) *Electricity*, Jan. 4.

BOILERS.

"Water Tube Boilers for Electric Light and Railway Service." (Illustrated description of the leading types.) *Electrical Industries*, December.

"An Interesting Boiler Explosion." By Fred H. Daniels. (Details of explosion of boiler in the Washburn & Moen Manufacturing Company's plant at Worcester, Mass.) A paper read at the New York meeting of the American Society of Mechanical Engineers, November, 1892. *Power*, January.

CENTRAL STATION, THE.

(See Municipal Lighting.)

"The Cost of Electric Supply—II." By Dr. John Hopkinson, F.R.S. Presidential address delivered before the Junior Engineering Society, London. (Showing comparative cost of supplying current under varying conditions.) *Electrical World*, Dec. 24.

"On the Operation of Electric Light and Railway Plants from the Same Station." By H. K. McKay. (And editorial comment.) Data showing economical results from combined service. *Electrical Engineer*, Dec. 28.

"Combined Electric Railway and Lighting Plants." By C. J. Field. (Commenting on Mr. H. K. McKay's article.) *Electrical Engineer*, Jan. 11.

"The Use of 500-Volt Motors." *Electrical Engineer*, Dec. 28.

"Efficiency of Alternating Plants." (Correspondence.) *Electrical Engineer*, Dec. 21, Dec. 28 and Jan. 4. And article by Harris J. Ryan, Jan. 4.

"An Ideal Central Power Station." Discussion of paper read by C. J. Field before Chicago Electric Club, Dec. 19. *Western Electrician*, Jan. 7.

"The Boosters at the Twenty-seventh Street Edison Station, Chicago." (An arrangement for compensating for drop in feeder mains on long circuits.) *Western Electrician*, Jan. 7.

"Boiler Room Economy." By W. H. Lahman. *Electrical Industries*, December.

"Light and Power Stations—XII." By Robb Mackie. (Suggestions for designing and locating switch-board and wire tower.) *Electrical Review*, Jan. 14.

"Central Station Economy." By F. B. Crocker. (Commenting on J. H. Vail's article in *Electrical Engineer*, Nov. 30.) *Electrical Engineer*, Jan. 11.

CARBONS.

"Joining Arc Light Carbon Stubs." (Describing the Stevens process for cementing broken points.) *Western Electrician*, Jan. 7.

CRANES—ELECTRIC TRAVELING.

"Leonard's System of Control for Electric Traveling Cranes." *Electrical Engineer*, Dec. 14.

"Electric Cranes." (Editorial comment on "Some Defects of Electric Traveling Cranes," in *Engineering News*, Dec. —.) *Electrical World*, Jan. 7.

CONDENSATION OF MOISTURE.

"Electrification of the Steam Jet." (Review of John Aitken's paper "On Some Phenomena Connected with Cloudy Condensation," read before the Royal Society, London.) *Electrical Review*, Jan. 14.

COPPER.

"The Copper Resources of the United States." By James Douglas. *Scientific American Supplement*, Jan. 7.

DYNAMO ELECTRIC MACHINERY.

"A Simple Method of Finding Cross Connections in a Coil." *Electrical World*, Dec. 24.

"Motors Without Counter E. M. F." (Editorial comment on the "inventing" of motors having little or no E. M. F.) *Electrical World*, Dec. 31.

"Short *vs.* Long Armatures." By T. H. Reardon (commenting on Professor Crocker's article, "Some Fallacies in Dynamo and Motor Design," in *Electrical World*, Dec. 17). *Electrical World*, Jan. 7.

"Empirical Formulæ for H–B Curves of Magnetization." By Charles E. Emory. (An abstract of Part II of the paper "Rational and Empirical Formulæ Showing the Relation Between the Exciting Force (H) and the Resulting Magnetization (B)," read at the Chicago meeting of the American Institute of Electrical Engineers.) *Electrical Engineer*, Dec. 28.

"The Bear Dynamo." (Comment on prospectus issued.) *Pacific Electrician*, Dec.

"Laminated or Divided Iron and Other Metallic Masses in Electromagnetic Apparatus — I." By Thomas D. Lockwood. (With portrait of Dr. James Prescott Joule.) *Electrical Engineer*, Jan. 4. Part II (with portrait of Charles Grafton Page.) *Electrical Engineer*, Jan. 11.

"Choking Coils." (From London *Electrical Review.*) *Electrical Engineer*, Jan. 4.

"Operating Polyphase Alternating Current Motors." (Note on Bradley's patent.) *Electrical Review*, Jan. 14.

"Rotation of the Magnetic Field." By Charles Steinmetz, *Electrical Engineer.*

"Wood's Alternating Current Dynamo." (Patent note.) *Electrical Engineer*, Jan. 11.

ENERGY, DISSIPATION OF.

"On the Dissipation of the Electrical Energy of the Hertz Resonater." By V. Bjerknes. (From the *Comptes Rendes*, No. 19.) *Electrical Engineer*, Dec. 14.

"On the Dissipation of the Electrical Energy of the Hertz Resonater." By Nikola Tesla. (Commenting on results obtained by Bjerknes.) *Electrical Engineer*, Dec. 21.

ENERGY.

"Utilizing the Forces of Nature, Part I." By Nelson W. Perry. *Electricity*, Jan. 4. Part II, Jan. 11.

ELECTRO–THERAPEUTICS.

"A Simple Magnetic Detector." By Dr. James Bowstead Williams. (For locating metal imbedded in body of patient.) *Electrical Engineer*, Dec. 21.

"Transactions of the American Electro-Therapeutical Association." Abstract of. By Dr. J. M. Bleyer. *Electrical Review*, Dec. 31.

"Electro-Diagnosis." Reprint from London *Electrical Review. Electrical Review*, Jan. 14.

"An Attempt at the Solution of a Few Electro-Physiological Conundrums." By Dr. J. M. Bleyer. *Electrical Review*, Jan. 14.

EXPOSITIONS.

"The Frankfort Exposition of 1891." (Brief reference to final statement showing net profit of over $20,000. *Electrical Engineer*, Dec. 28.

ELECTROLYSIS.

"Metallic Chromium Obtained by an Electrolytic Process." *Electrical World*, Dec. 31.

EDUCATIONAL.

"The Teaching of Science in Schools." By Henry Cunynghame. (Reprint from London *Electrician*.) *Electrical World*, Jan. 14.

FUSE WIRES.

"Fuse Wires." By C. P. Feldmann. (Reprint from London *Electrician*, showing platted curves secured from tests.) *Electrical World*, Dec. 24.

INSULATION.

"Tables Showing Permissible Ampèrage and Depth of Winding for Cotton-covered Wire." By Walter S. Dix. *Electrical Engineer*, Dec. 21.

"Insulation Resistance of Cotton and Silk Covered Wires." (Electrical engineering thesis, Columbia College.) By Thatcher T. P. Luquēr. *Electrical Engineer*, Dec. 28.

"Vital Importance of Armature Insulation." (Editorial comment.) *Electrical Engineer*, Dec. 28.

"Micanite, and Its Application to Armature Insulation." (Paper read before the American Institute of Electrical Engineers, by Edward P. Thompson, for Charles W. Jefferson and Arthur H. S. Dyer.) *Electrical Engineer*, Dec. 28.

"Mica." By C. Hanford Henderson. (Reprint from *Popular Science Monthly*.) *Electrical Review*, Jan. 7.

"Insulated Electric Conductors." By Dr. J. B. Williams. Part XV. *Electrical Engineer*, Jan. 11.

"The Conductivity of Insulating Bodies." (Editorial on Dr. M. E. Branley's article in *Philosophical Magazine*.) *Electrical World*, Jan. 14.

"What Constitutes Good Vulcanized India Rubber." (Comment on tests conducted by Lieut. Vladimiroff, at the St. Petersburg Technical Institute.) *Electrical Review*, Jan. 14.

HISTORICAL.

"Chronological History of Electricity—Part II, 1800–1820." By P. F. Mottelay. *Electrical World*, Jan. 7, 14.

"Gilbert's 'De Magnete.'" (Approval of Mottelay's version and Wiley & Son's publication.) *Electrical Engineer*, Jan. 11.

INSURANCE.

"An Insurance Meeting on the Pacific Slope. *Electrical Engineer*, Dec. 28.

"The Trolley and Insurance Rates." Editorials. *Electrical World*, Jan 7, 14.

"The Insurance of Electrical Risks." (Editorial.) *Electrical Review*, Jan. 14.

ISOLATED PLANTS. (LIGHT AND POWER.)

"The Rope-driven Electric Plant of the Racquet Club, New York." *Electrical Engineer*, Dec. 21.

INDUSTRY, THE ELECTRICAL.

"Statistics of Electrical Manufacture in Germany." *Electrical Engineer*, Dec. 21.

INDICATOR.

"The Steam Engine Indicator." (Selection and care of the Instrument.) *Power*, January.

INDUCTION.

"The Effects of Self-Induction and Distributed Static Capacity in a Conductor." By Frederick Bedell and Albert C. Crehore. *Electrical World*, Dec. 24.

LAMPS, INCANDESCENT.

"The Life of Incandescent Lamps in its Relation to Mercury and Metallic Vacuum Pumps." A. A. Frei. *Electrical Engineer*, Dec. 14.

"The Lamp Situation." (Editorial on the final outcome of the Edison-Sawyer-Man suit.) *Electrical Engineer*, Dec. 21.

"The Incandescent Lamp Situation." *Electrical World*, Jan. 7, 14.

"Advantages of Forcing Lamps at the Expense of their Life." By Carl Hering. (And editorial comment.) *Electrical World*, Dec. 24.

"On Inert Gases in Incandescent Lamps." By Dr. L. K. Böhm. *Electrical World*, Jan. 7.

"Prentiss Incandescent Lamp." *Electrical Engineer*, Jan. 11.

"The Situation up to Date." *Electricity*, Jan. 11.

LIGHTING, ARC.

"A Competitor of the Arc Light." (Editorial reference to magnesium light in Staten Island lighthouse.) *Electrical World*, Jan. 7.

"A Mercury Arc Light." (Brief reference to Arons' demonstration before the Physical Society of Berlin.) *Electrical Engineer*, Jan. 4.

"Arc Meters and Arc Lamp Revenues." By Albert Scheible. *Electrical Industries*, January.

LAMP POSTS.

"Artistic Lamp Posts." (Illustrating post used in London.) *Electrical World*, Dec. 24.

LIGHT HOUSES.

"The Statue of Liberty." By Major D. P. Heap, U. S. A. (Abstract of article in *Lippincott's* for December.) *Electrical Engineer*, Jan. 4.

LEGAL DECISIONS.

"Legal Decision Regarding Contract for Personal Services." The Johnston-Hunt case. *Electrical World*, Dec. 24.

LIGHTNING.

"Conditions under which Trees are Subject to Destruction by Lightning." Abstract of statistics compiled by D. Jonesco. *Electrical World*, Dec. 24.

LIGHTNING ARRESTERS.

"Lightning Arresters for Street Railway Circuits." By William A. Turbayne. *Electrical Engineer*, Dec. 28.

"The Commercial Success of Non-arcing Metal Lightning Arresters." By Alexander J. Wurts. *Electrical Engineer*, Jan. 4.

MOONLIGHT SCHEDULE.

"Moonlight Tables for January." (Frund's.) *Electrical World*, Jan. 14.

MAIL CARRIERS, ELECTRIC.

"An Electric Mail System between New York and Brooklyn." (Brief reference to Bryson's miniature trolley railway system, inclosed in a 16-inch square conduit.) *Electrical Engineer*, Dec. 28.

(See Electric Railways.)

MICA.

(See Insulation.)

MINING, ELECTRIC.

"An Electric Mine Railroad." (An Hungarian road about 1¼ miles long, using 330-volt current.) *Electrical World*, Dec. 24.

"An Electric Mine Pumping Plant." (Describing installation in the William H. colliery.) *Electrical Review*, Jan. 14.

METERS, ELECTRIC.

"Scott's Sliding Scale Electric Meter." By W. B. Sisling. (And editorial comment.) *Electrical Engineer*, Jan. 11.

"Suggestions for Metering Devices — I." By S. D. Mott. *Electrical World*, Jan 14.

"Meters, Electrical Recording." By Caryl D. Haskins. (A paper read before the American Institute of Electrical Engineers, Jan. 17.

MERCURY.

"The Action of an Electric Current in Displacing a Magnet on Mercury." From London *Electrical Review. Electrical Engineer*, Jan. 4.

(See Arc Lamps.)

MOTORS.

(See Dynamo Electric Machinery.)

"Regulation Test of the Ryan Special Series Motor." By W. L. Bliss. Reprint from Sibley *Journal of Engineering*. *Electrical Review*, Dec. 31.

"The new Baxter Railway Motor." *Street Railway Journal*, January.

"Motive Power." By F. W. Thomas." (Suggestions regarding use of motors in printing offices.) *Inland Printer*, January.

MUNICIPAL LIGHTING.

"The Cologne Municipal Lighting Station — I." By Clarence P. Feldmann. *Electrical World*, Jan. 6. "Part II," Jan. 14.

PROGRESS, ELECTRICAL.

"Steps in the Electrical Progress of 1892." A partial review of the year's work. *Electrical Review*, Dec. 31.

"Electrical Progress During 1892." *Electrical World*, Jan. 7.

"Electrical Progress in Germany." *Electrical World*, Jan. 7.

"Uses of Electricity." (A record of the commercial activity prevailing in electrical circles during 1892.) By William Taylor, of Taylor, Goodhue & Ames. Chicago Morning *News Record*, Dec. 31.

POWER TRANSMISSION.

"Generating Power at Coal Fields and Transmitting it Electrically to Industrial Centers." (Review and abstract of B. H. Thwaite's paper read before the Manchester Association of Engineers.) *Electrical World*, Dec. 31.

"Electric Power Transmission Schemes Abroad." Editorial, *Electrical Engineer*, Jan. 4.

"Emancipating the Canal Mule." (Editorial comment on Governor Flower's message.) *Electrical Engineer*, Jan. 11.

"Motive Power on Canals." (Editorial comment on Governor Flower's message.) *Electricity*, Jan. 11.

"Producing Power by the Utilization of Ocean Currents." (Brief reference to projected plan at the Mull of Cantire, Scotland.) *Power*, January.

RAILWAY PLANTS, ELECTRIC.

"Car House of the Watertown, New York, Street Railway." *Street Railway Journal*, January.

"St. Joseph-Benton Harbor Electric Railway." *Street Railway Review*, December.

"Washington, Alexandria and Mount Vernon Electric Railway." *Electrical Engineer*, Dec. 21.

"Kansas City Elevated Adopts Electricity." *Street Railway Review*, December.

"The Lindell Electric's Loss." (Fire loss, $150,000.) *Street Railway Review*, December.

"Philadelphia's First Electric Railway." *Electricity*, Jan. 4.

"Evansville Street Railway." *Electrical Industries*, January.

"The Rock Creek Electric Railway, Washington, D. C." By F. G. Bolles. (A combined Love conduit and T. H. overhead trolley system.) *Electrical World*, Jan. 14.

"A Mountain Railway." (Details of electric road from Grutsch to Murren, Switzerland, 525 volts.) From London *Engineering Review*. *Electricity*, Jan. 11.

RAILWAYS, ELECTRIC.

(See Mining, Mail Carrier, Storage Batteries.)

"The Electric Mail Car in St. Louis and Other Cities." *Electrical Engineer*, Jan. 11.

"A Sweeping Trolley Victory in Philadelphia." *Electrical Engineer*, Jan. 11.

"Electric Railway Crossings." (Reprint from New York *Evening Post.*) *Electrical Engineer*, Jan. 11.

"Rapid Transit." (Details and review of the sale of the Broadway franchise, with extracts from *Engineering News*, Nov. 24, and giving opinion of A. S. Hewitt, F. L. Pope and H. W. Leonard.) *Electrical World*, Jan. 14.

"Passenger Traffic in Great Cities." Extracts from an address by J. James R. Croes, M. Am. Soc. C.E., M. Inst. C.E., delivered before the students of the Rensselaer Polytechnic Institute, as reported in the *Railroad Gazette*. *Electrical World*, Jan. 14.

"How Shall Electric Railways be Tested?" By E. A. Porter. *Electrical Engineer*, Dec. 21.

"The Wynne System of Electric Traction." Reprint from London *Electrician*. *Electrical Engineer*, Dec. 21.

"Irish's Closed Conduit for Electric Railways." By W. E. Irish. *Electrical Engineer*, Dec. 21.

"A Table of Statistics." (Showing the number of horse, electric, cable and steam street railways in the United States at the close of 1891 and 1892.) *Street Railway Journal*, January.

"Street Railway Securities." (Opinions of bankers on the effect of the recent election and the outlook for 1893.) *Street Railway Gazette*, Jan. 2.

"Westinghouse Electric Railway Apparatus." *Street Railway Gazette*, Jan. 2.

"Expansion of Continuous Rails." (Correspondence relating thereto.) *Street Railway Journal*, January.

"The Possibilities of High Speed Electric Railroading." (Criticism of claims made by the Chicago & St. Louis Railway Company.) *Street Railway Journal*, January.

"That Chicago-St. Louis Electric Railroad." (Editorial comment on the impossibility "of such a road being a commercial success at present.") *Railway Master-Mechanic*, January.

"The West End Fight at Boston." (Editorial reference to the petition of Cambridge Storage Battery Street Railway Company for permission to run on tracks of the West End Company.) *Street Railway Gazette*, Jan. 9.

"Maximum Speed on Electric Railways." Comment of J. Kraemer's article. *Electrical Engineer*, Dec. 21.

SIGNALS, ELECTRIC.

"Where the Block System Fails." Editorial. *Electrical World*, Dec. 24.

"Signaling and Speaking by Means of Electrical Currents Without Wires." By Sidney F. Walker in London *Electrical Engineer*. Reprint, *Electricity*, Jan. 4.

"Improved Electric Light Signaling Apparatus." (C. V. Broughton's telephotos for day and night signaling.) *Scientific American*, Jan. 7.

STANDARDS, ELECTRICAL.

"Entities, Magnitudes, Quantities and Units." By E. Hospitalier. From *L'Industrie Electrique*, Aug. 10, 1892. Translation in *Electrical Engineer*, Dec. 28.

"On the Exact Adjustment of Standards of Resistance and the Determination of Temperature Coefficients—I." By Elmer G. Willyoung. *Electrical Engineer*, Dec. 21. Part II, Jan. 4; Part III, Jan. 11.

"Electrical Standards." (Editorial on final report of Board of Trade Committee.) *Electrical World*, Dec. 31.

"Report of the Board of Trade Committee on Electrical Standards." *Electrical World*, Jan. 7.

"The Alternating Current Ampère." From *Engineering*. *Electrical World*, Jan. 7.

SUBWAYS.

"New York's Electrical Subways—I." By William Maver, Jr. (Subheads: Introductory; Routes and Methods; Wrought-Iron Ducts; Trunk and Distributing Ducts; Capacity of the Subway; Circuits, etc.) *Electrical Engineer*, Jan. 4. Part II. (Cables Employed in the Subways; Condition of the Cables; Heat in the Subways; Rodding the Ducts.) *Electrical Engineer*, Jan. 11.

TUNNELS.

"Tunnel Ventilation." (Note describing electric ventilating plant in Pennsylvania Railway tunnel in Baltimore.) *Railway Master Mechanic*, January.

TRAIN LIGHTING.

"Pullman System." (Note describing axle-driven system.) *Railway Master Mechanic*, January.

"The Silvey System of Electric Lighting for Railway Trains." (Illustrating Silvey storage battery system and method of handling.) *Electrical World*, Dec. 31.

TARIFF.

"New Submarine Cables for Thunder Bay." (Correspondence and comment.) *Electrical Review*, Jan. 14.

TRANSFORMERS.

"Experimental Researches on Alternate-Current Transformers." By Dr. J. A. Fleming. (Showing: I, Methods of measurements employed.

II, Experiments with the three-voltmeter method of measuring alternating-current power.) Abstract of a paper read before the London Institution of Electrical Engineers. *Electrical World*, Dec. 24 and Jan. 7.

"Transformer Tests." (Editorial reprint from London *Industries* on Dr. Fleming's paper.) *Electrical Engineer*, Dec. 28.

"Genoa Continuous-Current Transformer." (Reprint from *L'Electrician.*) *Electrical Engineer*, Dec. 14.

"Continuous to Alternating Current Transformer." (An invention of Sir David Salomons for changing a current of 100 volts and 10 ampères into 1,000 volts and one ampère, at 1,000,000 alternations a minute.) From London *Electrical Review*. *Electrical Review*, Dec. 31.

"High versus Low Frequency in Transformers." By Louis T. Robinson. (Commenting on H. Franklin Watt's paper.) *Electrical World*, Jan. 7.

"The Transformer." By John A. Grier. *Popular Electric Monthly*, January.

TELEPHONE.

"Telephone System for Street Railway at Tacoma." *Street Railway Review*, Dec.

"Novel Telephone System." (Description of patent allowed John S. Stone.) *Electrical Review*, Dec. 31.

"Antediluvian Telephone Transmitter." (Letter from Park Benjamin.) *Electrical Engineer*, Dec. 21.

"Strowger Automatic Telephone Exchange System." By H. M. Underwood. *Electrical Engineer*, Jan. 4.

"The Telephone in Sweden." By H. Jalmar Van Kohler. (With illustration of telephone building at Stockholm, Sweden.) *Electrical Review*, Dec. 24.

"Mercadier's Bitelephone." *Electrical Review*, Jan. 14.

"Long Distance Telephony and Telegraphy." (Note on patent granted Stephen D. Field.) *Electrical Review*, Jan. 14.

"The Field Telephone Repeater." (Note on patent.) *Electrical Engineer*, Jan. 11.

TELEGRAPH.

(See Tariff.)

"Wanamaker Again Urges a Postal Telegraph System." (Annual Report of Postmaster General.) *Electrical Review*, Jan. 7.

"The Police Telegraph System of the City of Brooklyn." (Abstract of annual report and portrait of F. C. Mason, superintendent.) *Electrical Review*, Jan. 14.

VEHICLE, ELECTRIC.

"Keller-Degenhardt Electric Vehicle." *Western Electrician*, Jan. 7.

WAR.

"Electricity in the Art of War." By Lieut. C. D. Parkhurst. Reprint from *Journal U. S. Artillery* in *Electrical Review*, Dec. 24, 31, Jan. 7.

WIRING.

"Methods of Wiring a Building with Conduit." By Paul C. Oscanyan. *Electrical Engineer*, Dec. 28.

"Electric Wire Regulations in Paris." (Reprint from *Engineering News.*) *Electrical Review*, Jan. 7.

WATTMETERS.

"A Differential Wattmeter for Alternating Currents." By A. E. Kennelly. *Electrical Engineer*, Dec. 21.

WELDING, ELECTRIC.

"Development in Electric Metal Working." By Frederick P. Royce. Abstract of a paper read at the Buffalo Convention of the Carriage Builders' National Association. *Electrical Engineer*, Jan. 4.

Mr. P. K. Stern read a paper before the Buffalo Electrical Society on electric heating, in which a comparison is made of the cost of heating by electricity and by coal direct. The average of numerous tests made by a number of experimenters led to the conclusion that about 7,000 heat units, or about 2.82 horse-power, could be obtained from a pound of coal when evaporating water from the boiling point. This was considered a fair comparison to the behavior of coal in stoves and furnaces. In electric light stations a horse-power can be produced with the consumption of about two pounds of coal, and about twenty per cent of this is lost in transformation to electrical energy and in distribution. About eighty per cent of the value of the two pounds of coal is therefore available for the electric heater, or .4 horse-power per pound of coal, which is about one-seventh of the amount of heat received from a coal heater. As hard coal costs about three times as much as the soft coal used in electrical stations the actual cost, so far as coal consumption is concerned, is 2⅓ times the cost of stove or furnace heating. Electrical power at the metered rate of 14.12 cents per horse-power hour would cost about one hundred and fourteen times as much as coal at $6.50 per ton under similar conditions, and at the rate of .28 cents per horse-power hour would cost about the same as coal at $8 per ton.

ELECTRICAL PATENTS.

ISSUED DECEMBER 20 AND DECEMBER 27, 1892; JANUARY 3, JANUARY 10 AND JANUARY 17, 1893.

This list is intended to include all electrical patents which are noteworthy. It is not a complete list of all patents.

489,318.—*Electro-Magnetically Heated Receptacle.* W. Mitchell.

The body of the receptacle is made of magnetic material, and is provided with extending cores of similar material, which are wound with helices of wire included in an alternating-current circuit. The heating effect is the result of the heat developed due to the resistance of the wire, and also that due to hysteresis.

490,034.—*Electric Heater.* Thomas E. Morford.

A metallic plate is provided which receives the heat produced by the passage of an electric current through a conductor and conducts the heat to the article to be operated upon. The electric conductor is embedded in an enamel coating which is applied to the surface of the heating plate upon the rear side. In securing the conductor in position a coating of enamel is first applied to the plate, and while in a plastic condition the conductor is laid upon it. A second layer of enamel is then applied, and, upon the application of heat, the two coatings of enamel unite and adhere together, thus leaving the conductor embedded in the enamel.

490,082.—*Electric Heater.* J. F. McLaughlin.

The electrical conductor is in the form of a flat strip of metal of high resistance, preferably iron, which is bent into sinuous loops in order to distribute the heat uniformly over a large area. The conductor, having been bent into proper position, is embedded in fireclay which is baked in the ordinary manner. In order to exclude air and moisture from the heating conductor to prevent its oxidization as well as to prevent the access of moisture to the pores of the clay, a coating of glazing or enamel is provided upon the surface of the clay. This enamel may be made ornamental by fanciful designs in colors, thus rendering unnecessary an exterior mantle of iron.

488,726.—*Secondary Battery.* Nicholas Wladimiroff.

The electrodes are circular in form and provided with spiral grooves upon their surfaces which are filled with the active material, thus furnishing a continuous strip of active material.

488,233.—*Storage Battery.* G. A. Washburn.

The masses of active material are supported in position in contact with the electrodes by means of a porous partition or diaphragm, through the walls of which the electric current passes. The electrodes are perforated in such a manner that a free circulation of the liquid electrolyte is afforded, and at the same time the electrolyte comes in contact with and permeates every portion of the masses of active material.

488,635.—*Incandescent Electric Lamp.* Frederick H. Prentiss.

A section of the glass bulb below the metal cap is composed of glass that is softer than the glass of the rest of the globe, so that when it is desired to replace a broken filament the soft section may be removed, thus separating the end of the globe carrying the metal cap from the remaining portion ; the old filament may then be removed and a new filament be attached to the same leading-in wires, after which the two parts of the globe may be secured together by a similar section of easily fusible glass.

489,046.—*Electric Arc Lamp.* Elihu Thomson.

The feeding carbon is suspended from a band wound around a drum, the drum being adapted to feed forward the carbon by the act of unwinding the band. When the carbon has reached the bottom of its stroke or meets any resistance that causes a stoppage, the end of the band ceasing to descend and the drum continuing to unwind, the slack thus formed acts upon the arm of a bell crank to lift the same and open a contact.

488,696.—*Duplex Arc Lamp.* Henry M. Odell.

A shunt circuit around both lamps contains a resistance and a cut-out adapted to be held open successively by both lamps as they burn. The two lamps or pairs of carbons are connected in multiple and a cut-out is located in the circuit of the second lamp to burn, and is held open during the burning of the first lamp and is closed when the arc of the first lamp becomes abnormal, thus throwing into action the second lamp.

488,585.—*Electric Arc Lamp.* Elihu Thomson.

A shunt magnet and a series magnet act against one another and upon the same regulating lever, the shunt magnet having uniform magnetic power for the same strength of current in all positions of its parts, while the magnetic power of the series magnet decreases as the armature approaches the end of its movement under the influence of the current. To accomplish these results the ends of the cores of the magnets are curved, the core of the shunt magnet being so shaped that as the lever moves on its pivot the armature of the shunt magnet carried thereby will continually approach the core, thus decreasing the air space and increasing the attractive effect; the end of the series magnet core is curved so that its armature, as the lever moves on its pivot, will continually remain at a constant distance from the core, thus causing a constant attractive force for a given current.

488,835.—*Regulating Socket for Incandescent Electric Lamps.* Elias E. Ries.

A choking coil is provided in the lamp socket, one end of the coil being connected to one end of the lamp filament, the other end of the lamp filament being connected to one side of the mains; a lever is connected with the other side of the circuit and is adapted to be moved over contact terminals connected successively with the turns of the choking coil, so that as the lever is moved over the contact terminals, a greater or less number of the turns of the choking coil are thrown in series with the lamp, thus varying the intensity of the light, by opposing against the alternating current supplied to the lamp the back electro-motive force due to the induction of the core upon greater or less number of turns of the choking coil. The lever is mechanically connected with the lamp so that the act of twisting the lamp will alter its brilliancy.

488,951.—*Regulating Socket for Incandescent Electric Lamps.* Elias E. Ries.

From the lamp socket is suspended a cylindrical iron core provided with notches in the sides adapted to engage with springs carried upon an enveloping tube secured to the lamp. Around the tube throughout its whole length is wound a coil of wire which is in series with the lamp; as the lamp is moved up or down the amount of the core contained within the coil is changed to alter the brilliancy of the lamp. When the entire core is within the coil the back electro-motive force due to the induction of the core upon the turns of the coils is almost equal to the electro-motive force of the generator, thus choking the current and causing the lamp to glow very dimly. As the core is removed partially from the coil, the number of turns of the coils acted upon by the core is decreased and the back electro-motive force is decreased to permit the flow of a larger current through the lamp. When the core is entirely withdrawn from the coil the brilliancy of the lamp is a maximum.

489,526.—*Electric Lighting System.* Harry M. Doubleday.

The invention is designed to enable the regulation of a number of incandescent lamps as to brilliancy by the use of a single reactive coil. A reactive coil is provided with a sectional winding and the ends of the different sections are connected with terminals upon each of the lamps, a contact arm being provided to each lamp which may be moved over the terminal points. The number of sections of the reactive coil in circuit with each lamp may be regulated by the contact lever of that lamp so that the brilliancy of each lamp may be regulated independently of all of the other lamps.

489,249.—*Electrical Measuring Instrument.* J. H. F. Görges.

The instrument is designed for measuring currents of large volume, and comprises a copper bar adapted to conduct the current to be measured, to which is secured a bar of magnetic material having a semicircular cavity in its end. An armature is mounted upon a shaft, and moves concentrically with the inner surface of the cavity when influenced by a current transmitted through the conductor. An index point is attached to the armature, and moves over a scale to indicate the value of the current.

488,871.—*Electric Soldering Iron.* Charles L. Coffin.

The soldering iron is composed of a bar of iron, around one end of which is wound the fine primary wire, while around the other end are wound three or four turns of coarse wire forming the secondary, the ends being cut obliquely and the oblique faces soldered together to form the soldering point to be applied to the work. In order to render this point of a high temperature a material of high resistance is interposed between a portion of the soldered ends, thus increasing the resistance at that point.

488,811.—*Trolley Wheel.* Louis J. Hirt.

The trolley wheel is cut away on its sides so that the thickness of the walls of the groove are such that they will be entirely cut through when the wheel has been too much worn, thus giving an ocular proof that the wheel should be replaced.

489,330.—*Electric Elevated Railway.* A. L. Rutter.

A track is suspended from towers situated at distances along the roadway, and each car is provided with two trucks which run upon the track, each truck carrying a motor from which it derives its motion. From the trucks, and beneath the track, is suspended the body of the car, which is of cylindrical or cigar shape.

488,930.—*Electric Locomotive.* Charles J. Van Depoele.

The motors are connected rigidly to the axles of the truck, and the required flexibility of the truck to accommodate itself to the rounding of curves, irregularities in the track, etc., is provided for by making the webs of the wheels of the truck elastic. This may be accomplished in a variety of ways, one being to interpose between the hub and the felloe of each wheel a series of radial helical springs which permit a certain freedom of motion of the hub of the wheel relatively to the felloe.

489,573.—*Conductor System for Electric Railways.* George W. Von Siemens.

Two conductors are used, one a continuous supply conductor, and the other a sectional contact conductor composed of a series of relatively insulated sections. Normally interrupted connections are provided between the supply and contact conductors, electromagnetic devices are disposed at each section whose amatures are adapted to be successively operated by a magnetic device on the vehicle to close the circuit through the magnetic devices to complete the interrupted supply connection of the section into which the vehicle is moving, and interrupt the corresponding connection of the preceding section.

489,597.—*Multiphase Railway System.* Francis B. Badt.

The contact conductor consists of three sectional conductors laid side by side in parallel positions and adapted to make contact with the triple trolleys upon the car. Each section of each sectional conductor is connected with a secondary of a transformer through a connection normally open. The primary of the transformer is permanently connected with the supply conductor, which consists of three wires connected with a generator of triphase currents. The primaries and secondaries of the transformers are properly connected for triphase currents. In each of the normally open connections between the sections of the sectional conductors and the secondaries of the transformers is included an electromagnetic device adapted to be actuated upon the approach of the car to close the connections and connect the sections with the triphase motor on the car.

490,183.—*Commutator Brush.* C. O. C. Billberg.

The brush is designed to overcome the cutting of the commutator, due to the formation of globules of copper oxide upon the bearing surface of the brush when a spark is produced at the brush, which oxide is much harder than the copper of the commutator bars, and consequently cuts the latter. The spark is always formed between the commutator segment and the leaving side of the brush, and to prevent the formation of the copper oxide, a backing is provided upon the leaving side of the brush which is composed of carbon, plumbago, or equivalent material. When such a backing is used the effect of the spark is to oxidize a portion of the carbon forming carbon di-oxide, which is a gas and can have no deleterious effect upon the commutator, leaving the bearing surface smooth.

489,114.—*Electrical Metal Working.* C. R. Arnold.

The metal-working tool consists of a carbon pencil connected in circuit with the metal to be operated upon, the carbon pencil being first brought in contact with the plate to establish the circuit, and then withdrawn a short distance to establish the heating arc. In circuit with the carbon pencil is placed a choking coil, the current supplied being an alternating one, and the effect and direction of its self-induction being to oppose the passage of the current between the carbon pencil and the metal when contact is first established, thus preventing a short circuit, as the ohmic resistance of the circuit is naturally very low; when, however, the pencil is withdrawn from the plate, the direction of the self-induction is such as to assist in breaking down the air medium, thus rendering certain the establishment of the arc.

488,978.—*Brush Holder for Dynamos and Electric Motors.* R. Ashley.

The brush holder is designed to feed the brush forward as it is consumed, and to maintain a uniform pressure upon it. To the brush holder is attached a rack which engages with a pinion actuated by a spring or other device to cause a steady pressure upon the rack and a forward motion as the brush is worn away.

489,065.—*Alternating Current Dynamo.* J. J. Wood.

The dynamo belongs to that type in which the armature is stationary and the pole pieces movable. The armature consists of a series of inwardly extending coils arranged in a circle, their axes extending radially. The field magnet comprises a single axial coil, the pole pieces extending in radial planes and equal in number to the armature coils.

489,071.—*Field Magnet for Electro-Motors or Dynamos.* C. F. Daniels.

The field magnet comprises a number of field magnets, each separately wound and placed side by side and secured together. After being secured together a coil of wire is then wound around all of the cores, thus completing the winding. The advantage claimed is that the winding is more effective in being brought into more intimate connection with the material of the core.

488,261.—*Dynamo Regulator.* Charles J. Bogue.

The pole pieces of the dynamo are movable circumferentially, and are controlled in their motions by an electro-magnet whose armature is connected with the pole pieces in such a manner that an increase of current in the working circuit will act upon the electro-magnet to move the pole pieces in a direction to reduce the difference of potential of the current delivered to the brushes.

488,306.—*Alternating-Current Motor.* Charles S. Bradley.

The armature of the motor is wound with two circuits, one of which will start the machine from a state of rest and bring it up to synchronism, and the other of which, connected in shunt relation to the first, is arranged to take but little current until the armature arrives at synchronism, when the high counter electro-motive force in the first circuit will force the current to traverse the second, and thus automatically throw the synchronous system into operation.

488,928.—*System of Electrical Distribution.* Charles J. Van Depoele.

Four brushes are provided upon the commutator of a two-pole machine, one pair being set upon the diameter of maximum commutation, while the other pair is set at right angles to the first; that is, at the neutral points. Translating devices connected between the first pair of brushes are supplied with a current of the full potential of the generator, while translating devices connected between a brush of the first pair and one of the second pair receive a current of half the potential of the machine. By connecting continuous wires to each of the brushes set upon the diameter of maximum commutation, and connecting both of the brushes set at the neutral points with a third continuous wire, a three-wire system is obtained.

490,178.—*Electric Circuit Breaker.* Elihu Thomson.

The circuit breaker is particularly adapted to electric switches that are placed in circuits carrying currents of large volume. In such switches it is customary to provide a number of pairs of contact fingers with which the blade may engage, the pairs of contact fingers being connected in multiple with one side of the circuit so that the current may have a number of paths from the blade to the other side of the line. On account of unavoidable inaccuracies of workmanship, when the blade is withdrawn from the contact fingers it does not break connection with all of the contact fingers simultaneously, but some one or two pairs of the contact fingers break connection last, and in consequence, receive for an instant the entire current, which abnormal current greatly increases the trouble caused by arcing.

To overcome this difficulty, a reactive coil is placed in circuit with each of the pairs of contact fingers. When the switch blade is withdrawn and all but one or two pairs of the contact fingers have broken connection with the switch blade, the whole current tends to pass through the remaining contact fingers, but this increase of current through the remaining contact fingers creates a counter electro-motive force in the reactive coils, which counterbalances the increase so that only the normal currents flow through the contact fingers last breaking contact with the switch blade.

489,709.—*Variable Speed Electric Motor.* Carl Hering.

The variable speed motor comprises two electric motors having their armatures mounted upon a common shaft, the field magnet of one motor being stationary, while the field magnet of the other is mounted upon sleeves supported upon the armature shaft so that it may revolve independently of the latter. To the mounted field magnet is secured the pulley from which the power is to be taken. When the armatures are similarly wound, and the currents in each motor are so regulated that the strengths of the fields in each and the current transversing the armatures of each are equal, the mounted field magnet will remain stationary. If, however, the current be so manipulated that the armature of the motor with fixed field tends to rotate faster than the armature of the other, the mounted field magnet will rotate in the same direction as the armatures and with such a speed that the difference between the speed of the armatures and that of the field magnet will equal the speed with which the armature of the motor with the mounted field magnet tends to rotate due to the mounted field. In this case the speed of the mounted field magnet is less than that of the armatures. If the currents in the two motors be so manipulated that the fixed-field motor tends to rotate its armature in one direction, and the mounted-field motor tends to rotate its armature at an equal speed in the opposite direction, the mounted field magnet will rotate at a speed, double the speed of the armatures. By proper changes of the currents the speed of the mounted field magnet may be varied from zero up to double the speed of the armatures.

489,100.—*Test Circuit for Multiple Switch Boards.* C. E. Scribner.

A retardation coil for each of the lines is provided in a ground branch connected with a test battery and a cord switch and a listening and calling key, and the operator's telephone and switching devices are so arranged that the operator, on raising the plug in response to a subscriber's call, brings her telephone into circuit and throws on the branch containing the retardation coil and battery to make the line immediately test busy. The listening and calling key is so arranged that on forcing in the plunger the telephone may be disconnected without opening the test branch containing the retardation coil.

489,990.—*Telephone.* Charles E. Scribner.

Deflecting surfaces are placed at such an angle or at such angles with respect to the diaphragm below as to afford sufficient impact surfaces so that the carbon will be properly compressed to change or vary its resistance in response to the vibrations of the diaphragm, yet so arranged that the particles of carbon striking against these surfaces will be deflected and caused to circulate, thus serving to avoid that condition of the carbon particles known as packing.

488,993.— *Telephone Switch.* J. C. Francis.

The switch is designed to automatically cut the generator out of circuit when the receiver is removed from the hook, but the hook, instead of having a vertical movement, as is usual, has a rotary movement about a horizontal axis, the hook lying in a horizontal plane when the receiver is hung up and assuming a position in an oblique plane when the receiver is removed, due to the action of a spring. The switch proper is in the form of a cylinder provided with a conducting and an insulated section, brushes bearing upon the cylinder being included in circuit or cut out according to the position of the cylinder.

489,099.—*Testing Apparatus for Multiple Switch Boards.* C. E. Scribner.

A generator of undulatory direct or alternating currents of such low frequency that no audible sound is produced in the telephones on the line is provided at the central office in circuit with all of the telephone lines. In the operator's telephone circuit is provided a rheotome adapted to render audible the undulations of the generator, and in the same circuit is also included a circuit-changer which periodically changes the direction of the current through the operator's telephone set. When a line tested is free, and the operator touches her test plug to the test ring of the spring-jack, current will pass through her telephone set independently of the position of the circuit changer, and she will hear a continuous buzzing sound, indicating that the line is free; when, however, the line is busy, the connections are such that the current will flow through the telephone set only when the circuit changer is in one position, so that the operator will hear only an intermittent buzz, indicating that the line is busy.

488,740.—*Electrical Switch.* Charles E. Pattison.

The lever carrying the switch blade is pivoted to a plate adapted to move around an axis; the contact fingers are arranged around the circumference of a circle with the axis of the plate to which the lever is pivoted as a center. The lever blade may be moved around the circumference of the circle and may make contact with any of the contact fingers.

490,064.—*Telegraphy and Telephony.* Fred H. Brown.

The invention embodies means for utilizing the same instrument and line for either telephonic or telegraphic purposes. A diaphragm is placed in a normally closed electric circuit, against which rests a contact point in mechanical and electrical contact with the diaphragm, the contact point being supported upon a lever which may be raised to break the connection between the diaphragm and the contact point when it is desired to transmit telegraphic messages.

NEW PUBLICATIONS.

THE successful electrical engineer of yesterday is the mechanical and electrical engineer of today, so closely allied are these two branches of engineering, and to a thorough knowledge of the principles governing the construction and operation of dynamo-electric machinery must be added as thorough an understanding regarding the details of steam engineering and all thereto pertaining. Thus for convenient perusal and ready reference the following named books will be found useful, not only to the engineering student but to the practical engineer and to many of the central station managers.

A MANUAL OF THE STEAM ENGINE. For engineers and technical schools; advanced courses. Part I. Structure and Theory; Part II. Design, Construction, Operation. By Robert H. Thurston, A.M., LL.D., Doctor of Engineering; director of Sibley College, Cornell University; formerly of the U. S. N. Engineers; past president American Society Mechanical Engineers; author of "A History of the Steam Engine," "Manual of Steam Boilers," "Materials of Engineering," etc., etc., etc. Second revised edition. First thousand. 2 vols., $12. New York: John Wiley & Sons, 53 East Tenth Street.

The author states that "The first part contains the salient points of theory and an account of the gradual development of the engine from the crude forms of earlier times to the elegant and efficient types familiar to the engineer of today, and also a description of the general structure and the various special forms of the modern engine. The second volume gives the principles of general design, of the construction of the details of the machine, and the methods of operation and repair found satisfactory in recent practice. In the construction of this work, it has been assumed that the reader is familiar with the higher mathematics and the principles of thermal physics, and generally well-read in those subjects which constitute the essential scientific basis of the professional training of the engineer. This assumption, which, a generation ago, would have been unjustifiable, is today perfectly reasonable. The profession of engineering has become one of the learned professions in a single generation, a consequence of the rapid development of the system of technical education now forming an essential and, often, the most extensive department of modern education in all civilized countries. The book is intended especially for the use of educated, practicing engineers and of students, undergraduate and graduate, in those technical schools which are sufficiently extensive in curriculum, and which have so large a student body as to justify specialization and the offering of advanced courses of instruction ; institutions which include graduate schools of professional, specialized, work ; for example, in the mechanical engineering of railways, of naval construction, of steam engine building."

DYNAMOMETERS AND THE MEASUREMENT OF POWER : A treatise on the construction and application of dynamometers ; with a description of the methods and apparatus employed in measuring water power. By John J. Flather, Ph.B., M.M.E., Professor of Mechanical Engineering, Purdue University ; author of American edition Wilson's "Steam Boilers." 5 by 7½. Cloth, $2.00. New York : John Wiley & Sons, 53 East Tenth street.

In the preface the author states : "The aim in the following pages has been to present in convenient form, for the use of technical students and engineers, a description of the construction and principles of action of the various types of dynamometer employed in the measurement of power. The work here presented has been used as the basis of a course of lectures to engineering students, and is the outgrowth of a series of articles published in the *American Machinist.* In its preparation free use has been made of numerous publications relating to the subject, and references for further information are given in foot notes throughout the text. The chapter headings are respectively: Determination of Driving Power, Friction Brakes, Absorption Dynamometers, Transmission Dynamometers, Power required to Drive Lathes and Measurement of Water Power.

VALVE GEARS FOR STEAM ENGINES. By Cecil H. Peabody, Associate Professor of Steam Engineering at the Massachusetts Institute of Technology. 6 by 9½; 128 pages; 33 folding plates; cloth, $2.50. New York: John Wiley & Sons, 53 East Tenth street.

Intended primarily to afford instruction to engineering students in the theory and practice of designing valve gears for steam engines, it presents the salient principles found in all radial valve gears, calls attention to the important features in the drop cut-off gear, more especially of the Corliss type, and also illustrates the use of cam gears. To add to the value of the treatise, each type described is illustrated by examples selected from good practice; and there is presented a "combination of a skeleton model with construction for laying out link-motions and other irregular or complicated gears." The chapter headings: Plain Slide Valve, Shifting Eccentrics, Link Motions, Radial Valve Gears, Double Valve Gears and Drop Cut-off Valve Gears.

A TEXT-BOOK OF EXPERIMENTAL ENGINEERING. For engineers and for students in engineering laboratories. By Rolla C. Carpenter, M.S., C.E., M.M.E., Associate Professor of Experimental Engineering, Cornell University. 6½ by 9½; cloth, $6. New York: John Wiley & Sons, 53 East Tenth Street.

A third edition of "Notes to Mechanical Laboratory Practice," published in 1890; of which a second edition was published in 1891, and soon exhausted by an unexpected demand from engineering schools and the profession, and is said to be the only work on the subject which contains in a single volume the principal standard methods which have been from time to time adopted by various engineering societies for the testing of materials, engines and machinery. The chapter headings are: Reduction of Experimental Data, Apparatus for Reduction of Experimental Data, General Formulæ — Strength of Materials, Testing Machines — Strength of Materials, Methods of Testing Materials of Construction, Friction — Testing of Lubricants, Measurement of Power, Measurements of Liquids and Gases, Hydraulic Machinery, Definitions of Thermodynamic Terms, Measurement of Pressure, Measurement of Temperature, Methods of Measuring Moisture in Steam, Heating Value of Coals — Flue-Gas Analysis, Method of Testing Steam Boilers, The Steam-Engine Indicator, The Indicator-Diagram, Methods of Testing the Steam Engine, Engines for Special Uses, Experimental Determination of Inertia, The Injector and Pulsometer, and Hot-air and Gas Engines. The volume is well printed and strongly bound.

TIPS TO INVENTORS: Telling What Inventions are Needed, and How to Perfect and Develop New Ideas in Any Lines. By Robert Grimshaw, Ph.D., M.E., author of a series of catechisms and numerous other practical works. New York: Practical Publishing Company, 21 Park Row. 1 vol., 5 by 7, 84 pages. Price, $1.

ELEMENTARY MANUAL ON APPLIED MECHANICS. Specially arranged for the use of first-year science and art, city and guilds of London Institute, and other elementary engineering students. By Andrew Jamieson, M. Inst. C.E., Professor of Engineering, the Glasgow and West of Scotland Technical College; Member of the Institution of Electrical Engineers; Fellow of the Royal Society, Edinburgh; author of "Text-book on Steam and Steam Engines," Magnetism and Electricity," "Electrical Rules and Tables," etc. With numerous illustrated experiments and examination papers. Philadelphia: J. B. Lippincott Company. Cloth, 268 pages, 5½ by 7. Price, $1.25.

The author states that "This manual has been written expressly for first-year students of applied mechanics. It therefore forms a suitable companion to the author's elementary manuals on 'Steam and the Steam Engine,' 'Magnetism and Electricity,' for it covers the elementary stage of the Science and Art Department's examination in applied mechanics."

MINING DIRECTORY AND REFERENCE BOOK OF THE UNITED STATES, CANADA AND MEXICO. By George W. Ramage. 551 pages; 8 by 11. Chicago: Poole Brothers, 1892. Price, $10.

A valuable work to many electrical companies who desire the names of the active managers of mines wherein the output of ore will justify the expenditure necessary in installing electrical apparatus. There is every indication of careful compilation, and included in the information given is the location of the mine, the railways, water routes and shipping point; the town and county; the name of company or individual, location of principal office, names of officers, capital stock, name of mine, kind of ore, kind of mine, annual output in tons of 2,000 pounds, kind of power used, stamp mills, etc., and name of the mine superintendent.

TRADE PUBLICATIONS RECEIVED.

From the American Electrical Works, Providence, Rhode Island, *the* calendar of the season.

From the Knapp Electrical Works, 54 Franklin street, Chicago, an illustrated price list of electrical appliances for incandescent lighting.

From the American Screw Company, Providence, Rhode Island, a richly bound and very handsomely gotten up catalogue and price list of screws.

From the Hall Signal Company, 50 Broadway, New York, five attractively bound and handsomely illustrated descriptions of the Hall signal apparatus.

From Taylor, Goodhue & Ames, 827 Monadnock block, Chicago, an illustrated treatise on electric heating, and an illustrated circular showing new specialties.

From the Standard Electric Company, 623 Home Insurance building, Chicago, an illustrated catalogue showing the Standard dynamo, lamps and other Standard apparatus.

The "official catalogue of the World's Fair will be published by the W. B. Conkey Company, 341 Dearborn street, Chicago, who bought the concession for $100,000 in cash and a guarantee to pay to the Exposition Company 10 per cent of the gross receipts and to pay 20 per cent on all receipts above $500,000. The entire catalogue will be a handsome, strongly-bound volume of about 2,500 pages, and will retail at $2.50. But devoted to the exhibits in each department will be sections of the bound volume having 64 pages, 6 by 8½ inches (nearly the size of WORLD'S FAIR ELECTRICAL ENGINEERING), and selling at 10 cents each. The Conkey Company secured the exclusive right to print and sell the catalogue, and is allowed to print not to exceed seven lines of descriptive matter, in addition to the regular formal designation of each exhibit, at the rate of $5 a line, the entire description being subject to the approval of the Department of Publicity and Promotion, but will contain no display advertisements.

The "Official Directory" will also be published and sold by the W. B. Conkey Company, and will contain the official roster of the Exposition, illustrations of the buildings, names of exhibitors, etc. It will form a comprehensive guidebook, will be 7 by 10 inches in size and will contain display advertisements, but will not be sold within the grounds.

THE PRIZE ESSAY.

"How Can the Department of Electricity of the World's Columbian Exposition Best Serve the Electrical Interests?"

On December 10, WORLD'S FAIR ELECTRICAL ENGINEERING offered the following three prizes for the best essays written in answer to the above question :

$100 for the best answer.

$50 for the second best answer.

$25 for the third best answer.

The competition to close January 14.

Fifteen essays were received and handed to the gentlemen who had consented to act as a committee of award and their decision is announced in the following letter :

CHICAGO, January 26, 1893.

Mr. J. P. Barrett, Chief of the Department of Electricity, World's Columbian Exposition, Chicago, Illinois:

DEAR SIR,—The Committee of Award selected by WORLD'S FAIR ELECTRICAL ENGINEERING to determine the relative merits of the essays written in answer to the question, "How can the Department of Electricity of the World's Columbian Exposition best serve the Electrical Interests?" has the honor to announce that it has awarded :

The first prize to the writer of the essay signed "Pierre Quironle," Mr. Herbert Laws Webb, rooms 146-147, Aldrich Court, 45 Broadway, New York city ;

The second prize to the writer of the essay signed "Thales I," Mr. Nelson W. Perry, E.M., 167 Times building, New York city ;

The third prize to the writer of the essay signed, "Edylc Senoj," Mr. W. Clyde Jones, 1430 Monadnock Block, Chicago, Illinois ;

And the committee respectfully request you to forward the prize check for $100 to Mr. Webb, the check for $50 to Mr. Perry and the check for $25 to Mr. Jones.

In deciding the relative merits of the fifteen essays entered for the contest, the committee had in mind the increased value of suggestions of a practical character that could be utilized by your department rather than suggestions of a theoretical nature that indicated creditable original thought on the part of the writers, yet were obviously impractical.

Four of the essayists appear not to have grasped the main idea embodied in the question, which, in the opinion of the committee is clearly expressed.

Each member of the committee read each essay carefully and thoughtfully and entered the relative standing of each on a card, and comparisons were made during the two meetings of the committee held, and after the final decision had been announced the envelopes containing the addresses of the respective writers were opened and a public announcement made.

Sincerely yours,

A. W. WRIGHT, Vice-president Siemens & Halske Electric Co. of America;
W. H. McKINLOCK, President Central Electric Co.;
D. P. PERRY, President Standard Electric Co.;
WILLIAM TAYLOR, Taylor, Goodhue & Ames.
Committee of Award.

Mr. Webb's essay appears in another part of this magazine and the essays of Mr. Perry and Mr. Jones will appear in the March number.

The Exposition officials have no control over the rates to be charged for accommodations furnished to visitors by hotel and boarding houses, but in the formation of its Bureau of Public Comfort have done everything possible toward securing comfortable abiding places for residents of other cities, and have already arranged to take care of 16,000 visitors per day. The following prices are charged for comfortable rooms without board, located within a reasonable distance of Jackson Park:

Single room, single bed, one person	$1.36	daily.
Double room, double bed, one person	2.12	"
Double room, double bed, two persons	2.70	"
Double room, two double beds, two persons	3.50	"
Double room, two double beds, three persons	4.15	"
Double room, two double beds, four persons	5.50	"

The visitor secures the room from the Bureau and pays the Bureau officials for same, receiving in exchange a permit to occupy the room for a certain number of days, the landlord exchanging the permit at the Bureau for a cash payment after the visitor's departure, provided no complaint is lodged against him. Rooms may be secured in advance by sending for diagrams and descriptive circulars to the "Bureau of Public Comfort," 509 Rand-McNally building, Chicago.

Subscribers to WORLD'S FAIR ELECTRICAL ENGINEERING are at liberty to have their mail addressed in care of Fred De Land, 565 The Rookery, Chicago, and are requested to make this office their headquarters while in the World's Fair city. And any assistance that can be rendered in the matter of securing rooms will be cheerfully tendered.

JAMES I. AYER.

MAIN ENTRANCE TO ELECTRICITY BUILDING

THE $50 PRIZE ESSAY.

How Can the Department of Electricity of the World's Columbian Exposition Best Serve the Electrical Interests?

BY NELSON W. PERRY.

This is doubtless a question which each member of the Department of Electricity has many times asked himself, and which the members collectively have endeavored to the utmost of their ability to solve.

One cannot have followed the labors of these gentlemen from the inception of this great enterprise, through vicissitudes sometimes trying and almost discouraging, to the present day of completed plans, without recognizing the almost phenomenal ability and prescience with which the Electrical Department, especially, has been handled.

It is with great diffidence, therefore, that I undertake to offer a few suggestions which have occurred to me from time to time and which would have remained unuttered had not this opportunity of promulgating them over a *nom de plume* presented itself.

The dignity of a profession is, to my mind, one of its greatest charms — perhaps its most valuable attribute, take it all in all, for it cannot attain to dignity without having proven its genuine worth. A new profession must have demonstrated its right to exist before it will be recognized. But this very recognition, for which it has striven, attracts to its ranks the imposter and the charlatan, who like the vampire sap its lifeblood, bring it into popular disrepute and even create distrust among its worthy members. At this stage of its evolution there is no password, no mystic sign or badge by which the wolves may be distinguished from the sheep, and suspicion steps in where confidence should dwell, individual effort and consequently selfish motives press on the lever which only concert of action can move, and dignity finds no abiding place. It was so with astrology, the progenitor of astronomy, it was so with superstition, the seed whence sprang religion, of religion which first conceived the healing art, of alchemy, the father of chemistry, and it is true today of electricity, that science of the present decade, which has sprung, almost in a day, full-fledged into being. Except in the case of the latter, long centuries have had their mellowing effect. A process of elimination has fluxed away the dross, confidence has succeeded distrust, community of action has followed on the heels of individual effort and a fraternity of feeling and a recognition of the rights and merits of co-workers has bound them altogether into a band having a common interest, and that the ultimate good of their profession.

In the lapse of time there has come into existence an unwritten law for each, stronger because unwritten, than any inscribed by pen or type, which governs or shapes the attitude of the individual in his relations to the community and to his fellow. Theology, law and medicine have thrown around their respective territories a Chinese wall which none may pass save through the gate. Astronomy and chemistry are not inviting fields for the charlatan, and find sufficient protection to themselves in this and in the peculiar training required of their votaries.

It is not enough to say that the instincts of a gentleman are sufficient to govern the members of these professions in their intercourse with each other — these instincts have been supplemented by a code of ethics, differing in each, it is true, but recognized in each as laws which may not be violated without discredit to the individual or injury to the cause. The dignity of these, which has come with age, is wanting in the newer professions and not the least in the newest, but the world moves faster now than then, and with the stimulus of the spirit of the present time a thousand years are as but a single day, and a single day as a thousand years.

It may not be practicable to hedge about the profession of electricity as have been the so-called learned professions, but I think it is practicable to place it upon a more dignified plane — to bridge over, as it were, the lapse of time by formulating in some authoritative way a code of ethics which shall govern our professional intercourse with one another and with the world at large.

I would suggest the convention of the Electrical Congress at the World's Fair as a most auspicious time for the consideration of this most important question, and that the Department of Electricity request that this be a subject for profound deliberation.

Should a committee be appointed to formulate a code, that committee should be international and of a character to command the respect of all. The rules decided upon should take the form of suggestions, rather than of mandates or laws, and should then be submitted for criticism and discussion to a committee of the whole, and as modified thereby and indorsed sent out to the world as the sense of the congress of the proper etiquette to be observed by those deemed worthy of the honorable profession of which we are a part.

It seems to me that with such a light to guide our feet we will make fewer mistakes, less jealousy will be engendered, the profession will at once be lifted to a higher dignity, we will be bound by a closer fellowship and our mutual interests be advanced to an extent they could be in no other way.

The rapid substitution of electricity for gas, coming upon us as it did, almost unawares, and the exigencies of perfecting our generating appliances and methods of distribution have left us little time for æsthetic development, and we have been forced to adapt the new illuminant to existing fixtures.

With previous illuminants we were limited by their very nature to set designs. These, it is true, were often embellished, veneered, as it were, with filigree, glass and enamel; rigid straight lines gave way to graceful curves, and other departures, restful to the eye, from time to time succeeded the early uncouth shapes; but high art, with candles, lamps or gas, in its best sense, was never possible. The danger from fire, the damage from soot or dripping oil, the vitiation of the atmosphere we breathe, determined the situation and number of our flames, and little choice was left us either as to arrangement or distribution.

With the introduction of the incandescent lamp new possibilities dawned upon us, but for the reasons already assigned and because of the uncertainty of supply which characterized electricity in its earlier days, these possibilities were not developed, nor are they yet; but the combination burner found favor and is with us still, limiting the electric light to the same narrow territory as that occupied by the illuminant it was intended to supplement, but which it is capable of supplanting.

But the incandescent light practically has no limitations in the way of adornment and beautifying of our homes except those which our adherence to the chandelier has imposed. But few attempts have been made to break away from these self-imposed bounds, and these have generally not been an improvement from an æsthetic point of view. The most frequent departure as seen in our public halls, the dining rooms of hotels and clubs, is the arrangement of rows of lights around the walls near the ceiling and in the ceiling itself as geometrical figures. Aside from the cheer which their brilliancy brings, there is nothing artistic or pretty in such an arrangement. A less frequent innovation is the concealment of the lights in recessed receptacles built into the walls and ceiling from which the lamps shed their softened rays through stained or colored glass. This is capable of almost unlimited development and of producing the most beautiful and artistic effects. For purely decorative purposes there is nothing prettier than the free, or even lavish use of miniature lamps in festoons or in other arrangement, but these we seldom see.

An exposition such as the one in view has fulfilled but a small part of its mission when it has shown what *has been* accomplished. It has a far greater one to perform, namely, to educate, to cultivate and to prepare us for better things in the future. There is probably no one side of the American nature that has been more neglected and which needs more cultivation than the æsthetic. Our love for the beautiful is innate — we appreciate it when we see it, but we cannot, or rather do not, originate it. In the strictly utilitarian, we are doubtless ahead of all other nations, but in the direction just cited, far behind.

It occurs to me that the Department of Electricity can do much to remedy this defect by inviting competitive designs for interior decorations with the electric light. It would be even better to have competitive exhibits of this kind, if the time is not too short to render such a plan practicable. The premiums offered, to be effective, should be commensurate with the object in view and large enough to draw out the best work of the best artists, and I would suggest as a precautionary measure that it be stipulated that the conventional chandelier or gas fixture type of decoration be abandoned entirely.

As illustrative of what has been accomplished in other lines by similar action :

At the great exposition in 1851 England found herself at the foot of the list of great nations in respect of the quality and beauty of her industries, a distinction in which she was only eclipsed by the United States, which stood below her. Up to that time England obtained all her artistic work from France or had it made at home by French artisans imported at great expense and employed at enormous salaries. The display of 1851 led to the establishment by the government of Great Britain of the great museum and its training schools at South Kensington, the object of which was to train by precept and example her own artisans. So fruitful of good results has been this step that England now surpasses France in many lines of artistic work. So rapidly did she forge ahead that France was obliged in self-defense to establish in Paris a museum of decorative art. Speaking of this, *Galignani's Messinger*, probably the highest authority in the world in art matters, and a French publication at that, said:

"The object of this new museum is to enable France to *keep pace* with other countries, as for instance, with *England*, Austria, Belgium and *America*, in the employment of every possible means for the development and progress of art industry. France has for a long time possessed a certain supremacy in all industries to which art is applicable, owing to the peculiar good taste that has characterized the nation; but the Universal Exposition of 1878 has shown that this supremacy is considerably endangered by foreign competition."

But we need not go so far back in history for illustrations.

Previous to the Centennial our potters made nothing better than the cheapest stone china of set and clumsy pattern, and decorated ware, except the cheapest prints, of American manufacture, was unheard of. At that time some of the finest specimens of ceramic ware from Germany, France and England were exhibited, and some few pieces of American manufacture and decoration, mostly amateur work, were also displayed. From this small beginning, or from the impetus thus given, has sprung the Rookwood ware, composed, it is true, of the common clays of the country, but so original in shape, artistic in design and beautiful in decoration as to surpass anything of its kind in the world. It is distinctively American, a copy of nothing, a new industry sprung literally from our own soil, and, what is still more creditable, evolved from the mind of a Cincinnati lady of refinement, leisure and wealth, who went into the business to gratify her artistic tastes.

Also, as a direct result of the Exposition of 1876 it may be noted that at the Paris exposition of 1878 the United States appears for the first time in the rôle of competitor among the producers of the artistic and the beautiful, and that in this competition Tiffany & Company, of New York, took the grand prize for design and workmanship in their wares of gold and silver.

In 1876, also, the Royal School of Artistic Needlework, at South Kensington, which is under the patronage of the queen, sent to Philadelphia a few specimens of its best work.

Up to that time England stood *facile princeps* among all nations in this class of art, and the United States had done nothing. Today our country has far outstripped her in this, one of her chief specialties.

These few examples show what expositions have done for other industries in this and other countries. The same and more can be done for decorative electricity at the coming World's Fair by judicious effort on the part of the Department of Electricity. Are not such results worth striving for? I suggest that they are.

But it is not enough that the more elaborate and expensive designs be invited. There is a simpler art which is more far-reaching in its educational and refining influences, and this I regard as the highest type of art and most worthy of encouragement. I would therefore offer premiums for designs for simple, inexpensive but artistic fixtures, such as would be within the reach of those of limited means. The artistic decoration of a home, however humble it may be, exerts an elevating influence upon all who come in contact with it, and while it betokens intelligence and refinement also begets those same qualities. It is not unlike the "building up" effect in dynamo-electric machinery, resulting in a maximum commercial output; and in similar manner, I am sure that, could proper encouragement be given in this direction, it would result not only to the moral advantage but to the commercial advantage of the electrical fraternity and of the community at large.

The Historical Exhibit of Electrical Apparatus, proposed for the World's Fair, will doubtless be one of the most interesting of the many interesting exhibits at the Exposition, but it will fail of its widest usefulness if the lesson is not taught which it is capable of teaching, but which few, unassisted, are capable of learning. There have been historical exhibits before, and the history of invention in chronological order has been many times written with greater or less accuracy and ability, yet so far as I am aware the most important lesson to be learned therefrom has never been clearly enunciated.

In the process of evolution successive steps are not always those of advancement — sometimes they are retrograde, and not infrequently they are cyclic in their character, an abandoned type being returned to after a long detour. As in the organic world, so it is with invention, the perfected apparatus being reached through many steps. It would be manifestly unprofitable, in a scientific sense, to follow this chain of evolution unless we could see how each advancement depended upon a previous, less complete stage. It would be unprofitable to follow an invention through the various stages through which it has passed if at the end of our investigation we were to land just where we began, as would be the case where its progress (?) were cyclic, and yet that is what our chronological histories and exhibits have alone given us.

There is another way of representing the history of invention, which to my mind is quite as valuable and perhaps more instructive. I refer to the logical sequence in contradistinction to the chronological sequence of the various steps.

I would suggest that the Department of Electricity employ, at as early a date as practicable, some person who is thoroughly competent to the task, to write a history of electrical invention as exemplified by the exhibit in its *logical* sequence. In this the retrograde steps and those which but returned upon themselves would receive but little attention except in so far as the causes of retrogression, and the original abandonment and final readoption of a type might be discerned. This would give a history consecutive in thought, if not in time, and show by what course of reasoning a prescient mind *might* have evolved the perfect machine from the rudimentary.

It is thus that the science of geology has been formulated; it is thus that our new astronomy has grown from the nebular hypothesis, and it is thus, I conceive, that the science of invention, perhaps destined to become the greatest of all, as it is a factor in all sciences, will be called into being.

At the Columbian Exposition there will be displayed the largest boiler plant, the largest steam engine plant, the largest collection of electrical generating apparatus and the most extensive display of the commercial application of the electric current the world has ever seen.

These will be the product of the leading manufacturers the world over and will be working side by side under as nearly identical conditions as possible.

What better opportunity, therefore, will there ever be of settling, once for all, the many mooted questions in boiler, engine, dynamo, and motor and lamp construction, than this?

As a matter of fact we have never before had such an opportunity of collecting records and statistics in these subjects that were strictly comparable. What would be of more real benefit to the Electrical Interests in general than carefully determined statistics that could be referred to in the future with the same confidence with which we refer to the standard units of weight, volume and length? To be of value, these statistics should be obtained with the same care and under the same authoritative manipulation as have been our fundamental units of various kinds.

The data thus obtained would indeed become fundamental units upon which future calculations and structures would be founded and which would find acceptance throughout the civilized world.

Particularly interesting and valuable would be the data thus derived on this occasion from the fact that oil is to be used as fuel instead of coal. Meager as are reliable comparative data in steam generation from solid fuel they are still more so in respect to oil. In fact, I believe if such are established from the World's Fair plant, they will be the first of the kind to be published.

I would not have the report say that A's boiler, or B's engine, or C's dynamo or D's lamp surpassed all others in each or any of the cardinal virtues, but rather that it should determine wherein one type surpassed another and the why and wherefore thereof. This would be a scientific discussion of methods and types. Since the prospectus provides for competitive exhibits and awards, the latter could be determined *because* they adhered most closely to the approved types, and thus a reason, a scientific reason, could be given to substantiate the practical or experimental results and at the same time serve as a check on experimental error.

THALES I.

THE $25 PRIZE ESSAY.

How Can the Department of Electricity of the World's Columbian Exposition Best Serve the Electrical Interests?

BY W. CLYDE JONES.

There is, without doubt, nothing so distracting in the contemplation of a large exhibit, and no source of such lack of satisfaction after having viewed it as the utter impossibility of seeing all and the inability to see a few things well.

It is too often the fact — if, indeed, it is not the rule — that the impression one retains after having viewed a large exhibit is rather that of a composite picture, the whole exhibit blended into one dim conception, than that of a collection of definite and distinct impressions. There are so many things to be seen, and there is such a limited time in which to see them, that scarcely anything is given a minute inspection, while almost everything receives a superficial glance. The inevitable result of such a cursory examination is that the exhibit is remembered only as a whole, remarkable for its magnitude and stupendousness, and not as a collection of parts, each part remembered because of its particular merit, and the whole because it is composed of such meritorious parts.

If, then, this has been the result of previous large exhibits, to what an extent must it be magnified in connection with the World's Columbian Exposition, which, in point of magnitude, will have never been surpassed, and in particular in connection with the Department of Electricity, where will be seen such wonderful and apparently mysterious exhibits?

How can this be remedied? This is the question that confronts us with growing importance as the opening day of the Exposition approaches. May we not properly impute the source of the evil to the lack of proper order and system in the exhibit, and the lack of proper direction to the observer? The observer has been left too much to his own resources to wander around, seeing many things superficially, seeing nothing well, passing from one place to another as curiosity or chance may lead him, and not as any logical order of things may direct him.

We see, then, that one great failing of previous large exhibits has been the lack of proper system and order, either physical or mental, and the total absence of definite and logical direction to the observer.

Again, there are two great elements in all scientific principles and their practical applications (the cause and the effect), both of which demand the attention and study of him who would understand those principles and their applications. Heretofore, exhibitors have given too much attention to the latter to the almost complete exclusion of the former. Exhibitors have shown a tendency to make brilliant displays of their products, to work upon the public mind by the effect produced, while they have given little or no atttention to the display of the means by which those effects are produced. Electrical exhibits abound in brilliant displays of incandescent lamps arranged in every conceivable manner and form; electrical fountains sparkle and emit their chameleon-like colors; myriads of arc lamps radiate rays that rival in brilliancy the rays of the sun; electric motors are interspersed here and there absorbing through little flexible cords the energy that drives ponderous machinery; all remarkable instances of the effects produced, while, search where you may, you will fail to find even a model or a picture of that little coil of wire and that bar magnet with which Faraday first demonstrated the simple law of induction, and in which we see the primary application of that principle, that *cause*, of which the incandescent lamp, the arc lamp, the motor and their progenitor, the dynamo, are but necessary and inevitable results. Thus, in endeavoring to commend their wares to the public, exhibitors have entirely lost sight of the duty they owe to the public, that of educating them.

One great object of every exhibit should be to enlighten the people at large upon the progress that has been made in the various branches of industry; its object should be to explain, not to mystify. To explain, the observer must see not only the effects produced, but must also understand the causes that produce those effects. To mystify, it is sufficient that he see but the results.

How many people within the last few years have listened to the phonograph, and have turned from it not only astonished, but mystified ; how few have had the least idea how the effect was produced. What an improvement it would be, if the observer at the World's Columbian Exposition, after having listened at the phonograph, perhaps to the rendition of some remarkable piece by a famous orchestra in the other hemisphere ; after having been held spell-bound by the stentorian and lifelike utterances of an orator who had passed from the earth years ago ; or, perchance, to the familiar tones of a departed and half-forgotten acquaintance, if, after hearing all this and being filled with wonderment and inspired with awe, that man could thus embalm human utterance and human speech, he should step just beyond to the next exhibit, a crude model, embodying a small wax-covered cylinder slowly revolving with a pointed pencil or stylus resting upon its surface, and connected with a diaphragm which he, himself, is able to cause to vibrate mechanically by tapping it with his finger ; if, then, he were able to reverse the motion of the cylinder and should see the stylus rise and fall and should note a mechanical vibration of the diaphragm, and an attendant should then tell him that the vocal organs cause a vibration similar to those he has produced, but much more delicate, and that the phonograph is but the embodiment of the same simple principle he has observed, what a happy man he would be. And, in the course of a day, and of the continuance of the exhibit, how many people would thus leave the exhibit not alone happy, but intelligent.

Thus a very crude and inexpensive model would be of inestimable value in educating the people as to the cause. Let them be inspired by the wonderful results, but explain to them the causes, the reasons. Let them see that the apparent impossibility of the effect produced is but the natural and inevitable result of the higher application of the same principles that they have seen embodied in a much simpler form.

It is not only a duty that the exhibitors owe to the public to thus educate them, but it is of the greatest importance to the electrical interests that the laity be educated in order that they may be proper judges of electrical matters, insomuch as they are the consumers and must create the demand for all electrical goods. It is of the utmost importance, therefore, that the public should be taught the underlying electrical principles and their applications; should be taught to be proper judges of electrical matters so that they might at least distinguish the plausible from the impossible.

At the present time, the public are the too ready victims of the unscrupulous impostor, who clothes his wares with the euphonious and mysteriously sounding adjectives "electrical" and "magnetic." It is surprising that a people who occupy the advanced social and political position of the people of the United States should be so ignorant of the simplest principles of a force with whose effects they daily come into the most intimate contact. If the Electrical Department should accomplish no other result than that of enlightening the public mind upon the primary and fundamental principles of electricity, it may be justly said to have nobly performed its purpose.

There are two ways, then, in which the Electrical Department of the World's Columbian Exposition may serve the electrical interests: first, by instructing the engineers and those whose vocations may bring them in close touch with the electrical industries, and, second, by educating the public; both are important, neither can be neglected.

The question, then, resolves itself into this: how can the electrical exhibit be arranged so that it may serve to instruct the engineers, and, at the same time, educate the public mind? It is evident that to attain these results the entire exhibit must not only be properly classified, but the observer, whether he be an electrical specialist or one of the laity, must be properly directed. Furthermore, the various exhibits should display not only the results, but also the causes.

Considering the subject of classification of the exhibits it would appear that it had rather be a mental than a physical one, since the physical divisions will be more or less determined by the nature of the articles displayed by particular exhibitors, as different exhibitors, although displaying many distinct classes of articles, will naturally group their entire display into one area. These mental divisions should follow the general divisions naturally mapped out by a consideration of the principles involved, and which are adopted by the text-books, such, for instance, as telegraphy, telephony, dynamo-electric machinery, electric lighting, electric mining, electric welding, etc.

In order to place the classification at the disposal of each observer, as well as to direct him by laying out a definite path for him to follow, it would appear that a pamphlet to be placed in the hands of the observer would be the most efficient. This pamphlet, first of all, should direct the observer to an exhibit where he might, through an analogy to the action of water, or otherwise, obtain at least a faint idea of the meaning of the terms "ohm," "volt," "ampère," etc.

Under each of the general divisions, the pamphlet should direct the observer — first, to some model which would illustrate the fundamental application of the particular subject he is studying, and from this he should be directed successively and in logical order to other models and exhibits which illustrate the same principle in a more complex embodiment, until he is able to view the brilliant successes of the present epoch with a calmness and admiration admixed with reason and understanding, rather than with a feeling of awe and ignorance.

It would seem that the general divisions had best be arranged in the pamphlet in historical order, thus telegraphy and telephony should appear before dynamo-electric machinery, and dynamo-electric machinery before electric lighting, electric railways, electric welding, etc., which grew out of and were rendered possible only by the development of dynamo-electric machines.

Suppose the observer were endeavoring to gain an understanding of the dynamo and dispel his popular belief that the current is induced by the friction of the armature upon the pole pieces; he should be directed first to a reproduction of the coil of wire and bar magnet of Faraday and Henry, and having grasped the fundamental idea of induction, he could be directed to an exhibit where a coil of wire is mounted upon an axis and revolved between the poles of an electro-magnet, and an attendant could point out to him the analogy between the present device and the coil of wire and magnet, and, reasoning forward, could point out the relation of the model to the dynamo of the present day.

Again, take the telephone, which has been in use for some fifteen years and which, at the present time, is looked upon as a mystery by many otherwise intelligent people. Models could easily and cheaply be constructed to illustrate how the mechanical vibrations of a diaphragm can be transmitted to the point of contact of a pair of electrodes included in an electric circuit; how the variations of pressure between the electrodes, due to the vibration of the diaphragm, alter the resistance of the circuit to change the strength of the current flowing in the circuit; how the repeated changes in the strength of a current flowing around a core of iron will cause a metal diaphragm to repeatedly approach and recede from the iron core, thus reproducing the mechanical vibrations of the first diaphragm in the second.

In much the same manner could all of the various principles of electricity and their fundamental applications be illustrated. Such models would be cheap of construction and would be of inestimable value in fixing in the mind of the observer the fundamental principles of the various applications of electrical energy. The observer, having grasped these primary principles and their simplest applications, would be able to view the more complex embodiments of the same principles with intelligence and understanding.

The laity, having obtained in this manner a general knowledge of the electrical science, would be in fit condition to view, with the engineer and him whose vocation or avocation may bring him in close touch with the electrical industries, the various machines, apparatus and products which mark the advancement of the present epoch.

The next subdivision of each of the general divisions, as set forth in the pamphlet, should be an historical review of the particular industry, tracing by means of models, illustrations and the original machines and apparatus, where available, the successive steps in its progress.

The next subdivision should be devoted to construction alone, the observer being directed to those exhibits where he may see modern methods of construction, and also see the machines and apparatus in various stages of completion.

The last subdivision should include the display of products, including not only finished machines and apparatus but also their products and results.

This is the branch in which each exhibitor will endeavor to make his best possible display, and it cannot be doubted that it will be more effective if viewed after all of the other subdivisions, as the observer will then be better able to appreciate his efforts.

To recapitulate, the entire exhibit should be analyzed and classified, and, in order to place the classification at the disposal of the observer as well as to direct him, it should be set forth in a pamphlet to be distributed among the observers. This pamphlet should first direct the observer to that place where he can, by the proper analogies, obtain a practical idea of electrical terms and the nature of electrical force.

Under each of the general divisions he should be directed, first, to models illustrating the fundamental applications of electriccity to the particular subject; second, to models, illustrations and original machines and apparatus, where available, illustrating the successive steps taken in the development to the present stage; third, to exhibits showing modern modes of construction, and machines and apparatus in various stages of completion; and lastly, to the display of completed machines and apparatus and their various products or results.

May it not be safely said that with such means for the proper direction and instruction of the public and the specialist alike, the electrical department of the World's Columbian Exposition will most efficiently serve the electrical interests?

EDYLC SENOJ.

THE WORLD'S FAIR AND INDUSTRIAL ART.

BY ALFRED T. GOSHORN,

President of the Centennial International Exhibition of 1876.

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While there are the two points of view from which to regard an exhibition — namely, first as a show for the entertainment of visitors; second, as an educational factor — there can be no question as to the relative importance of these two aspects. Indeed, the show idea is to be seriously considered only so far as it facilitates the impression of an influence toward education. This is the main reason for the support of exhibitions by European governments. The people are to be enabled to learn their own resources and powers, whether of invention, manufacture, or æsthetic expression. The competition between home and foreign exhibitors discloses not only the strength, but, most important, the weakness of the home nation, and suggests the manner of overcoming the latter. It is in the learning of what we did not know that exhibitions are helpful, not so much as opportunities for the display of our actual achievements, except as comparison may reveal lines of progress. Naturally, we take just pride in demonstrating most forcibly our own accomplishments; and the great exhibitions have always facilitated this demonstration. Yet the real return to the people comes through the other channels, in which it finds itself outstripped by others, and in which it has thus afforded it the opportunity to see why, how, and how far it is behind. Without this we may have a great show, but not a great exhibition. The men in charge of the approaching Columbian Exhibition need not be reminded of this, but the public, if one may judge from the tone of current references to the exhibition, may well be reminded that it has serious lessons to learn in Chicago this year; that it must go there not merely to be amused by a few days, or weeks, of light-hearted entertainment, but prepared for the closest observation, the most keen and diligent study — intelligent comparative study, which is far from easy — of the products of the peoples of the world, with a view solely to our own material, scientific and æsthetic advancement. The time will be short, the opportunities many.

It may help to impress this fact to look back at the Centennial Exhibition of 1876 and at some of its influences. Can you realize the change we have undergone in the sixteen years that have elapsed? In machinery, in all applied mechanics, our activity was vigorous, and in this direction our exhibit was most creditable; in fact, so impressive was the showing of our natural resources, and so positive the evidence of our power in manufacture and commerce, that those six months sufficed to completely alter the attitude of the European mind toward us. From a provincial nation, one up to that time associated with the idea of colonies, we became at once to Europe a "great nation," with resources to be drawn upon by commercial conciliations, a nation to be reckoned with in the markets of the world. But, in culture was it not seriously otherwise? Were we not mortified by the realization of incomparable weakness? The liberal arts were manifested in the European and Oriental exhibits; not in ours. And we learned the lesson and set ourselves to applying it until now we must stand amazed by the penetration of æsthetics into every nook and cranny of our lives. From the commonest domestic utensil to the most extravagant luxury the influence has extended. Since 1876 we have passed through many phases of experience, taking lessons now from English, now from Japanese, now from French or German products, which were first extensively shown us in Philadelphia. Select almost any manufacture. Take, by hazard, wall-papers. Compare the designs of today with those of 1876, as you recall them. Look at the hopeless furniture of 1876, debased beyond redemption from the purer types which had come over in colonial times. Then textile fabrics, ceramics — including glass, in which American manufacturers have accomplished so much — in fact, all the furnishings of your house from the attic to the cellar. Nor forget the outside of the house, where architects are constantly teaching us purer taste. See what this has led to in the exhibition buildings at Chicago, of which the harmonious grouping and the beauty and elaborate decoration exceed the standard set by Paris in 1889.

As we went to Philadelphia in 1876, we must go to Chicago in 1893 to learn. It can hardly be expected that so radical a change will result. Yet in 1875 we little dreamed of the shaking-up in store for us. To now indicate in what directions we are to seek inspiration would be folly. Each one must go to seek for himself that which rounds out his own accomplishment, that which contains the richest material for future working. There will be enough — far more than can possibly be assimilated. That the stimulus we shall receive will be not unlike that in Philadelphia is assured. There is additional reason for this in the fact that the advances made since 1876 have put us on a better footing for future development. Nor is this true alone in the fine and the industrial arts. It is similarly the case in other more utilitarian directions. Business organizations are far more compact and efficient, combinations of capital are readily made for the successful pursuit of schemes of a magnitude hitherto impracticable. In this respect our manufacturers, merchants, our capitalists in general, possess a capacity far beyond anything that existed in 1876. Then, too, our natural resources are better known and the means of utilizing them are more under command. Our problems now are rather to ascertain directions into which to promote activity than to secure financial support for the perfecting of plausible plans. This condition is peculiarly favorable to the quick adoption of any congenial ideas that may present themselves in Chicago.—*From Engineering Magazine for February.*

THE ILLUMINATION OF GROUNDS AND BUILDINGS.

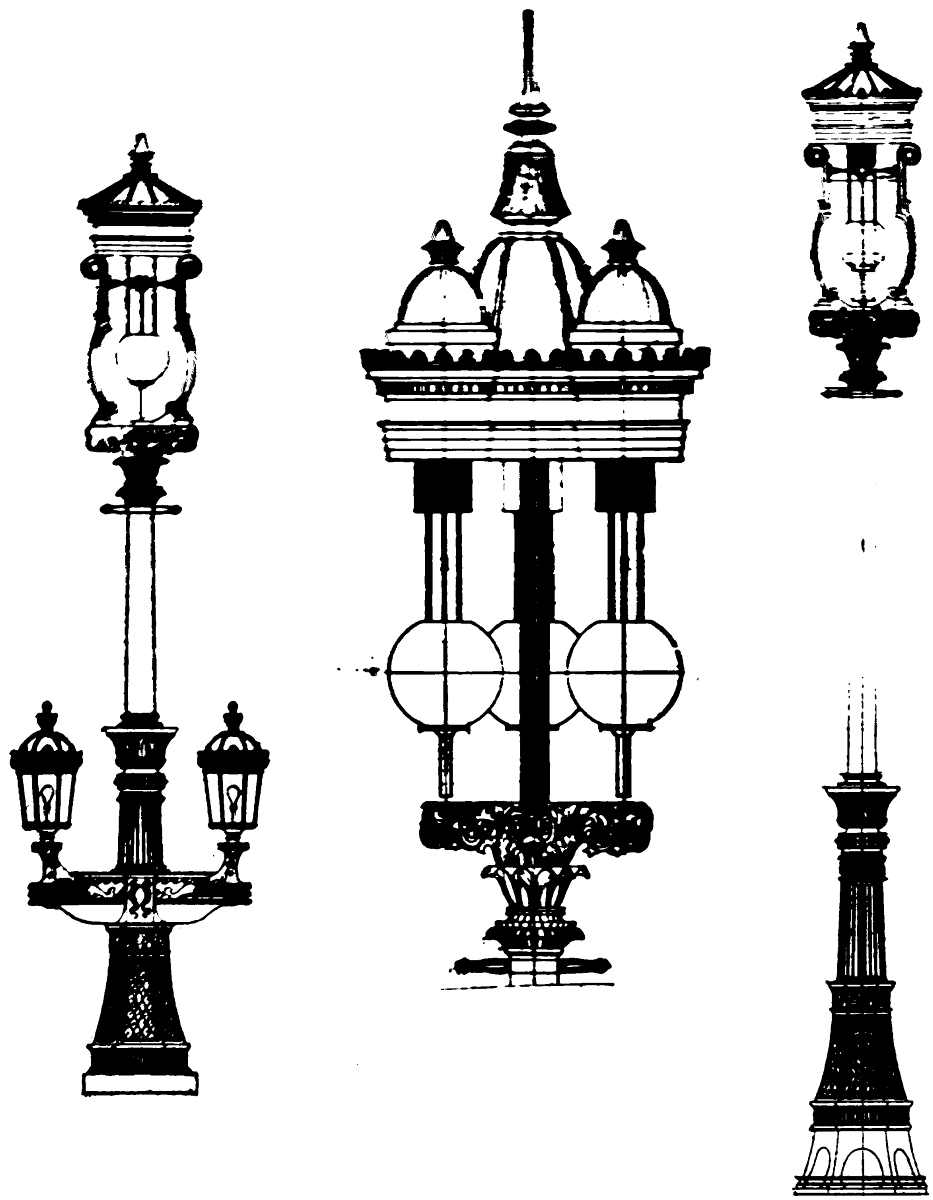
I.—ARC LIGHTING.

In solving the problem of artificial illumination, the exposition officials enjoyed the hearty coöperation and advice of the leading electrical engineers, the foremost architects, and the prominent artists of the country, and, in the plan adopted the attraction will not be the lamp or its setting, but the special features of art, of architecture, or of landscape gardening that the light accentuates. In other words each lamp is subordinated to the enhancement of the beauty of that embraced within its rays. This is clearly noted in the disposition of the arc lamps about the entrance to the Art Gallery, in the ribbons of incandescent lamps enriching the dome of the Administration building, and in other places where the glow from the white globe or the fragile bulb will add to or enrich the beauty of harmonious and symmetrical decoration.

For illuminating the grounds and entrances to the buildings arc lamps to the number of 1,550 are placed at intervals of from 65 feet to 75 feet, except in the extreme southeastern part of the grounds where the distances between some of the posts is increased to 125 feet. Around the main entrances to the principal buildings clusters of lights will be placed.

The arc lamps employed will include all the standard makes, both single and double carbon, and for exterior illumination will be supported on ornamental posts, designed to receive one, two or three arc lamps, and where deemed expedient, to have arms supporting incandescent lamps of high candle-power, inclosed within colored glass lanterns that will afford a richly decorative effect.

These artistically designed posts include a sloping cast-iron base upholding a wooden mast that is capped by a golden lyre within which is suspended the arc lamp protected by a royal canopy of galvanized iron. Each post is supported on and bolted to wooden foundations abutting the manhole from which the leading-in wires pass up through a curved vitrified pipe into the mast and thence to the lamp connections, each alternate lamp being on the same circuit. And over ten per cent of all the lamps



ORNAMENTAL ARC LAMP POSTS.

are on the patrol circuit, affording light from sunset until sunrise, as an aid in protecting the grounds and buildings from the depredations of thieves and the ravages of fire.

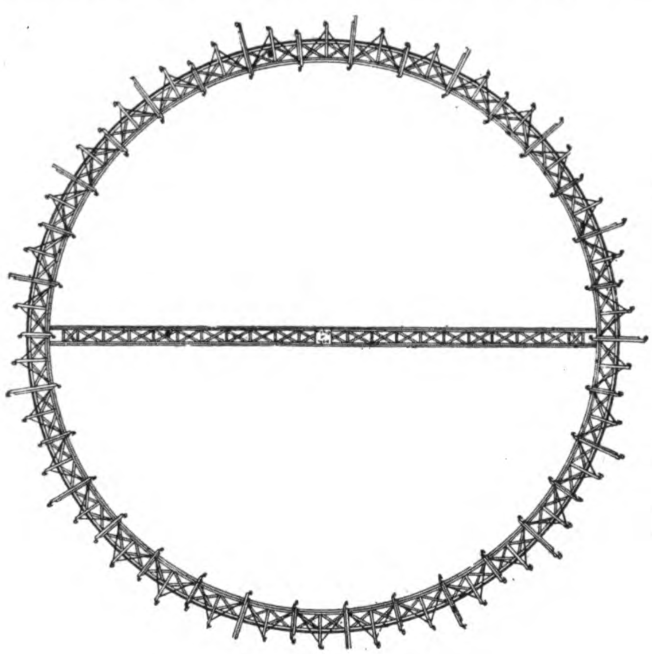
Along the high inclosed fence, plain cedar posts capped by the ordinary lamp support will be used, and this plain post will also be used in the extreme portions of the grounds. But in all prominent places only the artistic post will be found.

As far as possible in locating the lamps it has been the rule to set the posts in a straight line, and thus secure the additional effect afforded by converging lines of light, and in the vicinity of the main buildings, to erect the posts at an equal distance therefrom of 40 feet, uniformly spaced on one side of the pathway. In the Midway the arc lamps will be placed opposite each other on each side of the main boulevard, at the close distance of 75 feet, affording an abundance of light. Single lamps will be used at the bridge approaches, while three-light clusters will be placed in the center.

A problem of a different character was presented when the question of aisle lighting with arc lamps came up, owing to the varied nature of the exhibits, the character of the inclosures, the height of showcases, and the proximity of supports, and all of these details have not yet been definitely determined, owing to withdrawals and changes in the various locations of exhibitors.

In the final allotment of lamps in round numbers 1,200 were assigned to the Manufacturers' building; 500 to the Agricultural building and annex; 350 to the Transportation building proper; Horticultural building, 250; Mines and Mining, 200; the Fisheries, 50; and the Illinois State building, 77. These will all be supplied with current by the Exposition Company from the power plant, as will also some 250 arc lamps, required in Machinery hall. But in addition to this last 250 there will be a greater number supplied by a few of the leading exhibitors under special contract, who will also supply the arc lights required in the annex to the Transportation building, in the Forestry building, the pumping plant and the Choral building. Many of these extra lights will be furnished by the Standard Electric Company, the Western Electric Company and the Fort Wayne Electric Company, all of whom have installed extra dynamos for this purpose. Special lighting effects will be secured in the great glass dome of the Horticultural building by suspending from the trusses 50 arc lamps in three circular rows, having 10 in the upper row and 20 each in the lower two rows.

In lighting the interior of the mammoth Manufacturers' building a problem of an entirely different nature was presented, owing to the unusual height of the arches, and the great area requiring illumination. The plan deemed the most practicable and which promises the best results, includes five circular electroliers or coronas, four of which are 60 feet in diameter, and the center one 75 feet, built of angle iron and suspended from the arches. Here the lamps will be about 140 feet *above* the floor, and from 40 to 70 feet below the roof. These electroliers are suspended by means of a steel shaft securely bolted to a bridge passing across the center of the circle, bridge and circle having a footpath nearly three feet in width, guarded by a suitable railing, along which the carbon trimmer travels when carboning the lamps, the trimmer ascending one of the big arches to the supporting shaft and then descending by means of a ladder attached to the latter. To the four smaller electroliers 75 arc lamps each will be suspended, and to the large center-piece 100 arc lamps, the lamps being hung in pairs and sustained by cords passing over insulated pulleys, each lamp balancing the weight of its mate, as shown in figures 1 and 2.



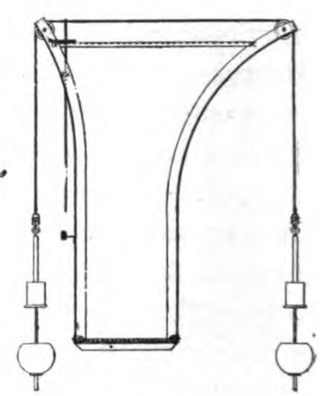


FIG. 2.

FIG. 1.