THE NIAGARA FALLS ELECTRIC POWER PLANT.

The operations of the Niagara Falls Power Company have on several occasions been illustrated and described in our columns. The original designs have been in some respects departed from, owing to the great advance in the scope of electric engineering, and the plan, as matured, has taken largely the shape of the production and sale of electric power, but hydraulic power is still furnished if desired.

A surface canal has been excavated leading inward from a point on the Niagara River a few miles above the falls. Nearly two hundred feet below the surface of the ground a tunnel has been driven which from a point almost directly beneath the inner end of the canal runs beneath the neck of land and opens on the bank of the Niagara River below the falls, and near the Clifton Bridge.

A large rectangular wheel pit has been excavated at the side of the canal, connecting with the tunnel. Large steel pipes or penstocks lead from the canal down the wheel pit nearly to its bottom, where the water is delivered under a head of about 140 feet to turbines situated almost on the tunnel level. These turbines generate the mechanical power, and from the turbines shafts rise through the pit vertically to the surface. Over the pit the power house has been constructed, within which the electric energy is generated. One of our small cuts shows the power canal.

On the right hand is seen the power house, a massive stone structure with flag staff in front of it. Crossing the canal is a bridge, designed not only for use by the staff of the works, but also for carrying the cables, and on the left side of the canal is seen a second stone building, to be used for transforming the potential of the system.

The interior of the bridge, with its cable racks on each side, is shown in another of the small cuts. When it is remembered that there are installed in the present power house several five thousand horse power polyphase electric generators of the most advanced type of construction, and that for the manipulation of the currents a most elaborate switching system is required, that adjuncts for the operation include elaborate lubricating devices, governors, electric elevators, an electric fifty-ton crane, exciters and transformers, it is evident that the space at our disposal is inadequate to give more than a general idea of the great installation.

Referring now to the large cut, three of the great generators are shown in it, which are placed on a line parallel with the axis of the rectangular wheel pit, which goes down nearly two hundred feet into the earth beneath them. In the distance is seen the electric crane for mounting or dismounting the parts of the machinery. To the left is seen the elevated switchboard. Several staircases give access to the floors or decks over the pit, and two electric elevators are provided for carrying the workmen up and down the wheel pit.

The generator presents the peculiarity of having a stationary armature and a rotating field. The field surrounds the armature, the latter being almost hidden from sight, and the rotation is effected directly by the turbine.

The generators, which may be termed a genuine triumph of electrical engineering, are of the Tesla vertical type, and were built by the Westinghouse Electric Manufacturing Company. For each generator there is a turbine wheel. The axis of the generator comes directly in line with the axis of its own turbine, situated 150 feet below it. From the turbine rises a steel shaft, whose upper end passing up through the center of the generator carries on its top a concave disk-shaped mass of cast steel. To the disk is secured a solid weldless ring of nickel steel, in itself a metallurgical triumph, which ring is the base of the field. The ring, which is 11 feet 7⅛ inches in external diameter, was made from a single ingot of nickel steel, 4 feet 6 inches in diameter at the bottom and 16 feet 6 inches long. A hole was drilled through its center and a piece of proper size was cut off, expanded and forged and turned into shape.

To the interior of the great field ring, field poles are secured, each, with their winding, weighing 2,800 pounds. In the center of the ring is the armature, whose core is built of thin sheets of mild steel all annealed with consequent oxidation, which oxidation is relied on to break up the electric continuity, so as to dispose as far as possible of the Foucault currents. The armature conductors consist of copper bars $\frac{43}{32}$ by $\frac{14}{32}$ inch in section, and insulated from each other principally by mica. As the armature is stationary, no collectors are used, the cables coming directly from the winding. The numerous pole pieces of the field have their coils supplied with current from a direct current exciter or generator, and its current is transmitted to the rotating field by collecting rings, thus exactly reversing the ordinary role of the parts.

It is calculated that the maximum speed which could be imparted to the ring is 400 revolutions to the minute, which gives a very large factor of safety (13:48); at double this speed it is calculated that the ring would burst, but its resistance to the centrifugal force is to a certain extent increased by the magnetic pull exerted by its pole pieces upon the armature core. This magnetic pull would operate to increase the centrifugal strain were the field stationary and the armature in rotation.

On the upper part of the dynamos will be seen little hoods. As the armature rotates, these are drawn rapidly through the air, the motion creating an out draught from them, cooling the structure, for it is calculated that heat equivalent to 100 horse power may be produced as a waste effect in the operation of the dynamo.

The weight of each generator is 170,000 pounds, the field representing 79,000 pounds. Each generator is of about 5,000 electric horse power and has a potential of 2,000 to 2,400 volts with 25 cycles or reversals per second. This is at a speed of rotation of 250 turns per minute. To produce this energy 5,150 horse power are expended on driving the turbines. As a graphic way of putting the compactness of the machine, it is stated that the entire dynamo could be placed in a room 15 feet square and 15 feet high. The journals of the shaft are kept constantly oiled by a never ceasing flow of oil under a pressure due to its own head. This oil, after passing through the journals, is filtered and returned thereto. Water also circulates about the bearings to insure coolness, and the temperature of the liquid is constantly watched in order to ascertain when any heating occurs. One of the cuts shows the funnel through which the oil is delivered from the bearings with a thermometer in it to show if any heating is taking place. Finally, the cut illustrating a section of the steel shaft also shows a friction brake used to stop the turbine. If the governing gate at the bottom, which is employed to shut off the water, be closed, a sufficient leakage occurs to keep the machine in rotation, and the brake is relied on to check the slow rotation due to such leakage.

In the transformer house which is seen to the left of the canal are to be established step-up transformers for raising the potential to perhaps 20,000 volts for transmission of energy to Buffalo. At present the plans for this transmission have yet to be developed. When electric energy is transmitted to Buffalo, the Niagara plant will have reached a high level of development.

Removal of Tattoo Marks.

Various methods suggested for removing tattoo marks have appeared from time to time in these columns. The following, mentioned by the Paris correspondent of the Lancet-Clinic, seems new: The principle of the method is to form a dermic destruction of the tattooed part. Here is how it is done: It is first necessary to paint over the tattooed marks with a concentrated solution of tannin; afterward, by means of fine needles, we make a series of pickings over the tattooed design. Over the surface thus picked we pass a stick of nitrate of silver. At the end of a few minutes we see detached the black pickings previously made, and know that the superficial layers of derma contain a tannate of silver. In order to assure success this surface must be powdered with tannin two or three days. The end is very simple. After an inflammatory action, lasting two or three days, the picked parts turn black, forming a thin crust, very adherent to the deeper skin, but painless. At the end of from fourteen to eighteen days the scab falls off, and in its place a superficial red mark is seen, which gradually fades away until, at the end of a few months, all signs of coloration disappear. Dr. Baillot also suggests the use of binoxalate of potassium in place of nitrate of silver. Of course, antiseptic precautions are all taken in performing this operation, and the old tattoo needle is used to remove all tattoo marks.

Spectacular Effect of an Electric Tower.

A curious effect in lighting at the Atlanta Exposition has provoked some discussion as to its æsthetic propriety. There were very beautiful electric fountains on the Clara Meer, but the thing that attracted equal if not greater attention was a towering column afloat on the bosom of the lake, above which it rose to a height of thirty feet. The column, which was of graceful proportions, rested on a broad platform, and this in turn was supported by a lot of unseen oil barrels, contributed for the purpose by the Standard Oil Company. All around the white shaft, and up into its capital, ran spirals of small incandescent lamps, which were on different circuits, and could be readily flashed in and out. Current was led to this tower of light from the shore by means of about 600 feet of submerged cable. The result was quite weird, and greatly puzzled the colored brother, who saw the tower "winking" at him across the water; while the artist and architect do not know whether to praise heartily or condemn roundly a solid tower swaying lightly on the water, and sending out its bright beams with curious mirage effect. This odd experiment, says the Evening Post, was due to Mr. Luther Stieringer, the consulting electrical engineer of the exposition, who also designed the electric fountains at the World's Fair, and it is suggestive of many new applications of electricity to spectacular marine lighting.

The Source of Malaria.*

The investigation on the source of malaria has had the writer's attention for over two years, and in that time a large amount of clinical testimony has been collected from all known malarial districts in North America; the final report, however, will hardly be ready for publication for some months, but from the work already completed certain facts have been obtained which will be embodied in this short notice.

The introduction of artesian wells, first by the railroad companies who desired a larger supply of water than had hitherto been available, and the accidental use of that water by the people in the immediate vicinity, soon produced a marked diminution of malarial trouble in those localities. The artesian supplies were, on the whole, so satisfactory to the railroads that their introduction became very rapid, and in a few years most of the South Atlantic lines depended upon this source of water supply. The evidence that in the exclusive use of the deep-seated waters there was entire immunity from malarial trouble was apparently so incontestable that I determined upon a critical examination of all waters known to produce malaria and those that in malarial districts were proof against it; this examination is not only chemical, but biological and pathological.

In the present state of our knowledge we do not expect to be able to draw a sharp line between waters that produce malaria and those proof against it by purely chemical analysis, nor, on the other hand, can we hope to identify by biological examination the protozoa producing that trouble; but we may by the former succeed in isolating certain toxic products peculiar to those waters only, and by the latter a certain line of testimony that, in conjunction with the chemical investigation, will yield very valuable results. The work thus far has proved satisfactory beyond expectation, and, from the work already done and the character and amount of evidence before me, I am justified in stating that the long current belief that the source of malaria is in the air is in error.

The germ, which is of soil origin, is strictly a protozoa, and reaches its highest development in low, moist ground, with a favorable temperature. Surrounded by the proper soil conditions, this protozoa passes from one stage of life into another with considerable rapidity; so that in the present state of our experimental knowledge it is impossible to identify it, nor is it probable that by culture we shall be able to produce the accepted Laveran germ outside of the human system.

As a rule, the potable water from the malarial districts is derived from driven wells not over twenty-two feet deep, in soil with clay or some other impervious substrata, which water is generally cool and palatable, often sparkling clear, but more frequently a little turbid. This water is filled with an incalculable number of these germs in all stages of development, and if used as a potable water they naturally find their way into the system through the alimentary channel. This protozoa passes through so many forms or stages of life that in some stages it is light enough to float and be transported by the moist air of low grounds, but in this state it is comparatively harmless except under most extraordinary conditions; it is not until the service water is used that the real mischief begins, when, by reason of higher development, it has become much more virulent than that floating in the air. A very short period of incubation is sufficient to develop a severe case of malarial fever in the new-comer who uses the surface water.

From personal observation I know that the exclusive use of pure, deep-seated water affords entire immunity against malaria in sections of country where no white man dared lived using the surface water. Nor must it be understood that the exclusive use of pure water simply fortifies and strengthens the system against the attack of the germ. The water is the primary cause of infection, which acts as the direct carrier of the germ into the system through the intestinal tract.

The impression that malaria is caused by purely atmospheric influences has become so fixed in our minds that, unless we come in actual contact in the evidence produced in the use of pure water as against that heretofore used, the physician will, in all probability, be very slow to allow himself to be convinced that the word malaria (mal, bad; aria, air) is a misnomer, and that malaqua (mal, bad; aqua, water) is the word that should be used to convey the pernicious effects known under the name of malarial fever.

Discharge of the Torpedo Ray.

Some recent researches on this electric fish have been made by Dr. D'Arsonval. He covered the dorsal and ventral areas of a ray with two plates of tin, conductors from which were connected to a 10 volt incandescent lamp. On disturbing the ray by pinching its fins with a dissecting pincers, its discharge was sufficient to produce a momentary illumination of the lamp to a very high intensity.

*Irving H. Bachman, Ph.D., in Medical Bulletin.

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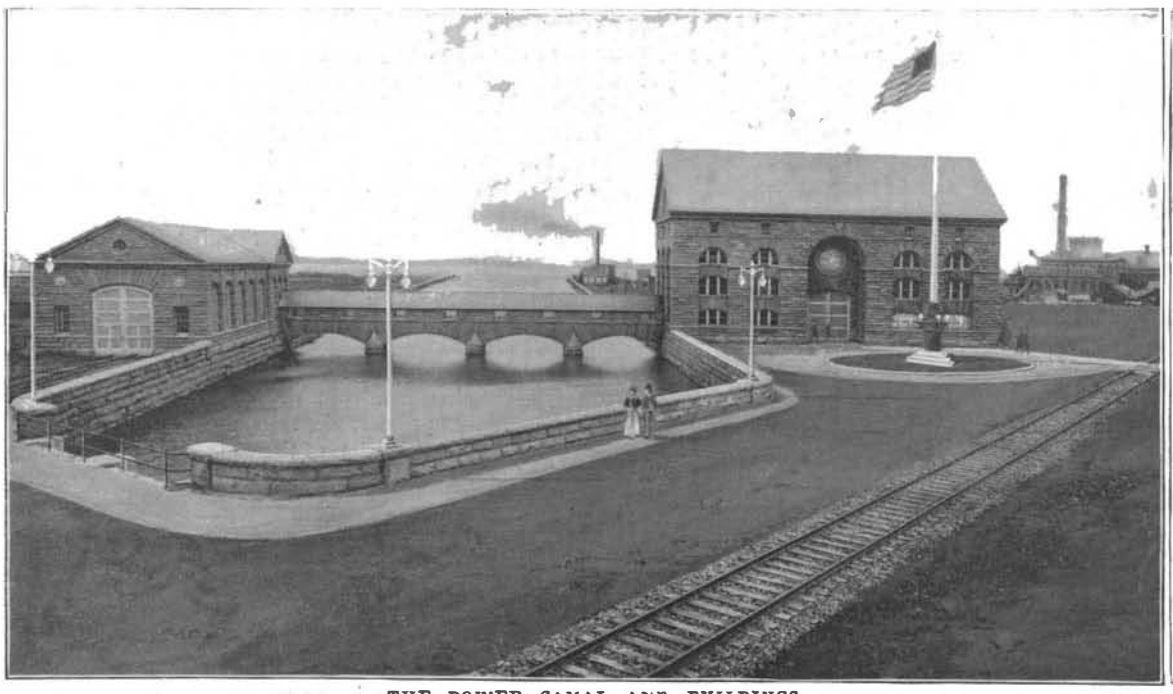
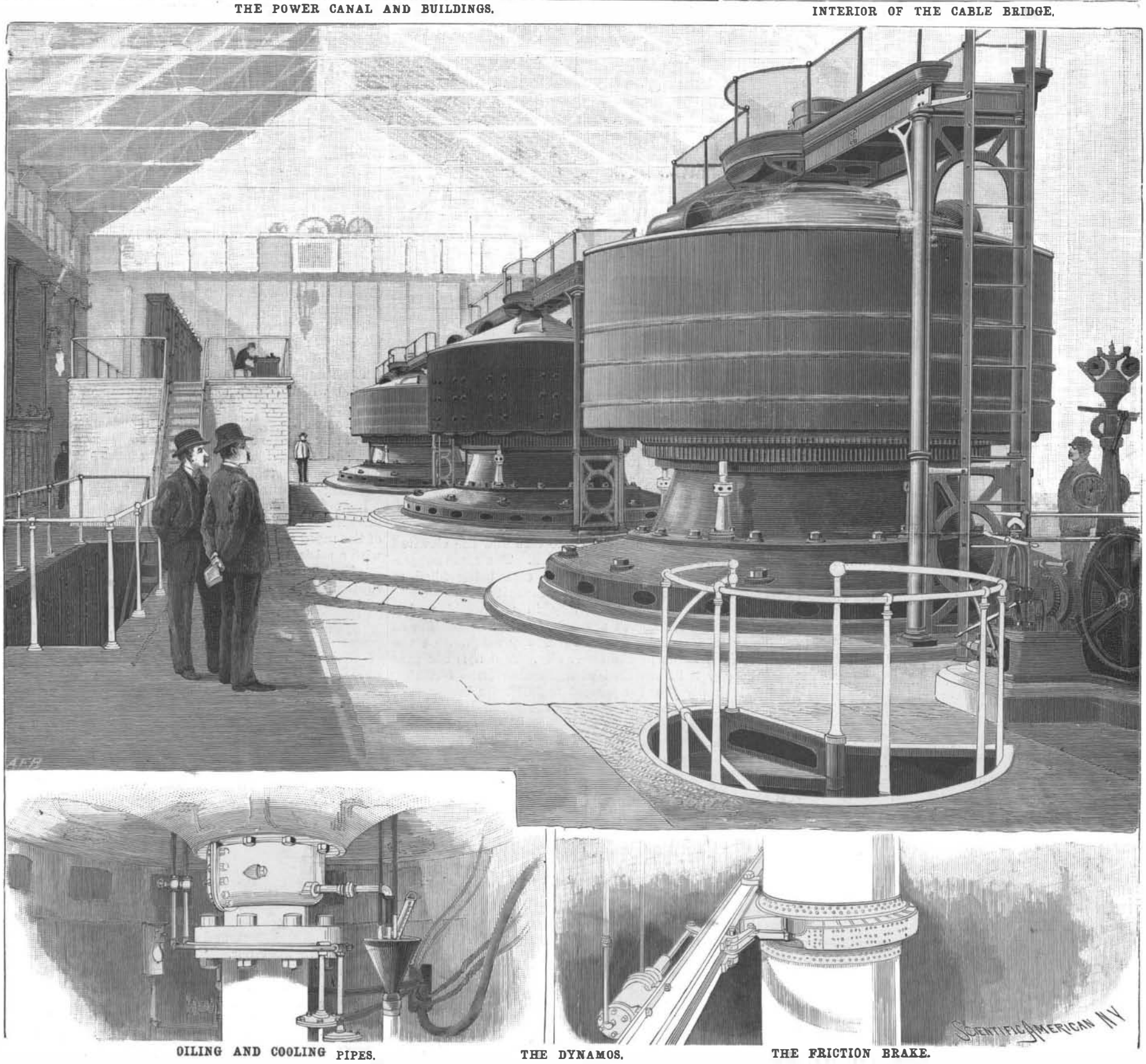


THE POWER CANAL AND BUILDINGS.

INTERIOR OF THE CABLE BRIDGE.



OILING AND COOLING PIPES.

THE DYNAMOS.

THE FRICTION BRAKE.

THE NIAGARA FALLS POWER PLANT.—[See page 55.]