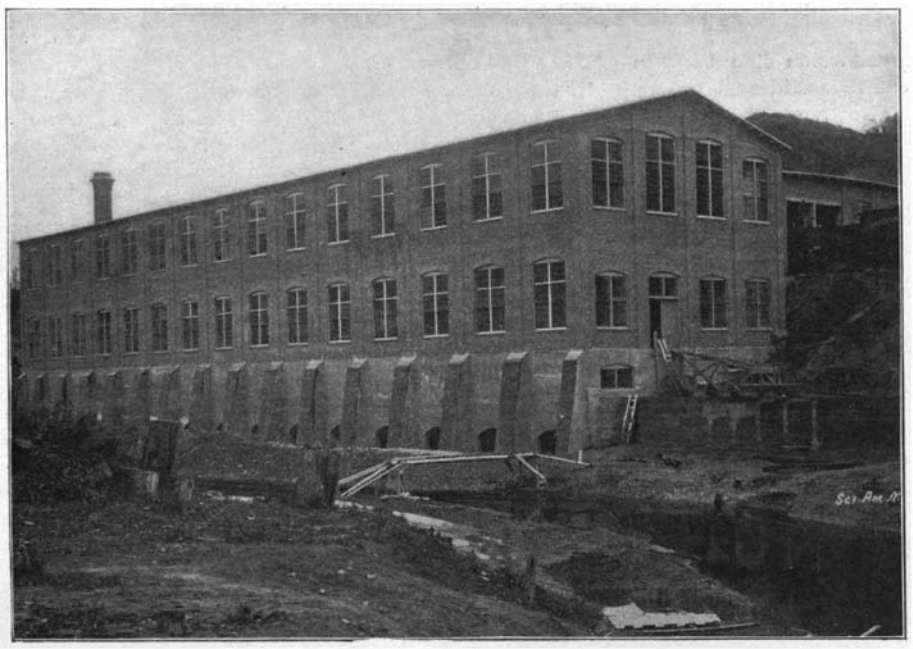
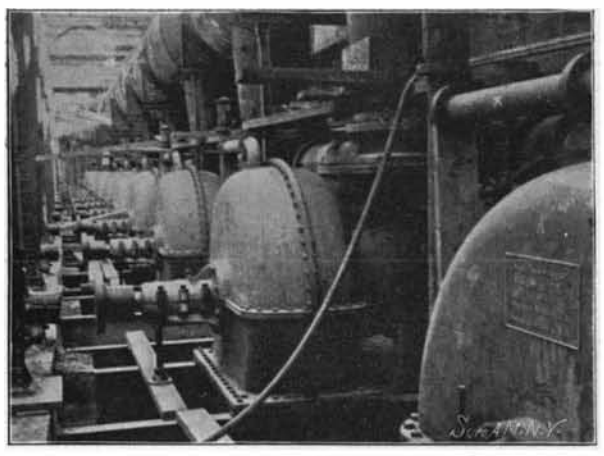
pressed the electricity flows through the contact screws into the earth and travels to the receiver. No preparations of any description have to be made, and the operation can be readily accomplished from any coign of vantage. The disadvantage of the present system of land mines is that the presence of the explosive charges is betrayed by the wires on the ground, and, as the war in South Africa has demonstrated, a vigilant enemy can destroy the effect of these mines by crawling up in the dark and cutting the wires. With the Armorl system interruption of the circuit can only be accomplished by the destruction of the receiver or the unearthing of the mine itself, and it would not only be a difficult matter to locate the precise spot at which the charge was buried, but the action of excavating it, even when discovered, would be attended by considerable danger. A vast tract of country might thus be undermined, any one of which mines could be detonated individually, by synchronizing the receiver and transmitter. It might be pointed out that the process of tuning is so simple that a single engineer with one transmitter could fire any number of mines of different tunes, provided he kept a record of the various tunes of the receiver, and adjusted his transmitter accordingly, whenever he wished to explode a particular mine.



POWER HOUSE OF BELGO-CANADIAN PULP COMPANY—UTILIZING 8,000 TO 10,000 HORSE POWER.



TURBINES OF 8,000 HORSE POWER CAPACITY.

While the work of installing the electro-pneumatic system of signaling upon railroads was in progress upon one of the leading trunk roads of Great Britain, the inventors had their attention drawn to the possibility of operating signals by their system. For this purpose an experimental signal was erected at a distance of 1,200 yards from their laboratory, with a view to ascertaining if the idea were at all practicable. At the base of the signal post was placed a small box containing the electro-capillary relay, and connected by wires to two iron rods driven into the ground. From the relay to the arm of the semaphore extended two more wires. Directly the button at the transmitting station was touched the semaphore arm fell, and remained in that position until the transmitter button was again pressed, when it immediately returned to its former position. Since it acted with perfect facility and celerity at 1,200 yards, the inventors repeated their experiments at a distance of five miles with the same conspicuous success. This method of operating signals opens up a vast field in railroad signaling, since it will work to an indefinite distance, possessing none of those limitations inherent to the electro-pneumatic or other processes of actuating signals.

Another important development of the invention is the illuminating of electric lamps. Erected near the top of the experimental signal post is a lamp fitted with two 20 candle power Edi-swan incandescent electric lamps. The transmitter is attached to a battery or accumulator. To light the lamp it is only necessary to depress the transmitting button, and the lamp will remain alight until the battery or supply of electricity is exhausted, or until the key is again touched, when it is immediately extinguished.

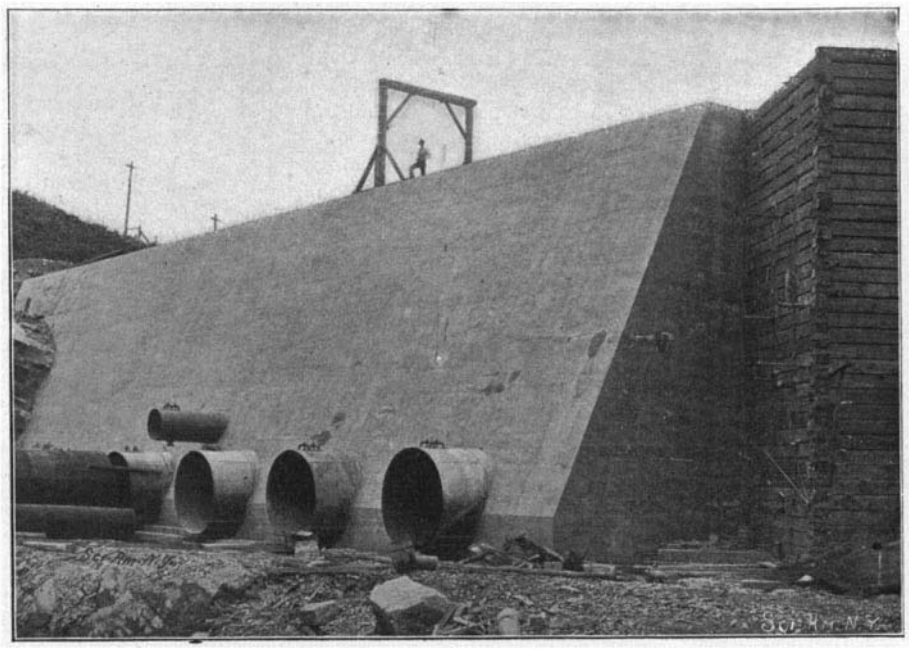
SHAWENEGAN FALLS POWER PLANT.

BY FRANK C. PERKINS.

One of the most important electrical power transmission plants in all Canada is rapidly nearing completion. When it is delivering its full capacity it will undoubtedly supply practically all of the power used in Montreal and Quebec, and will also supply power in the vicinity of Shawenegan Falls to many industrial plants. There is no question but there is a great industrial and commercial future for this little city of 3,000 inhabitants, which two years ago consisted of only a few houses.

The accompanying map shows its location and the general direction of power transmission lines to reach Quebec and Montreal, the former 90 miles distant and the latter 84 miles away. Three Rivers, which is located 21 miles from Shawenegan Falls, will soon have electric service from this power house, as will many of the towns along the Great Northern Railway between Quebec and Montreal. For a number of years the great power of the St. Maurice River has attracted the attention of promoters; but until recently the title to the property and water has been more or less complicated. The Privy Council of England recently decided that the provincial government could dispose of its water powers, and recently it has been selling these privileges with the understanding that the development be immediately commenced.

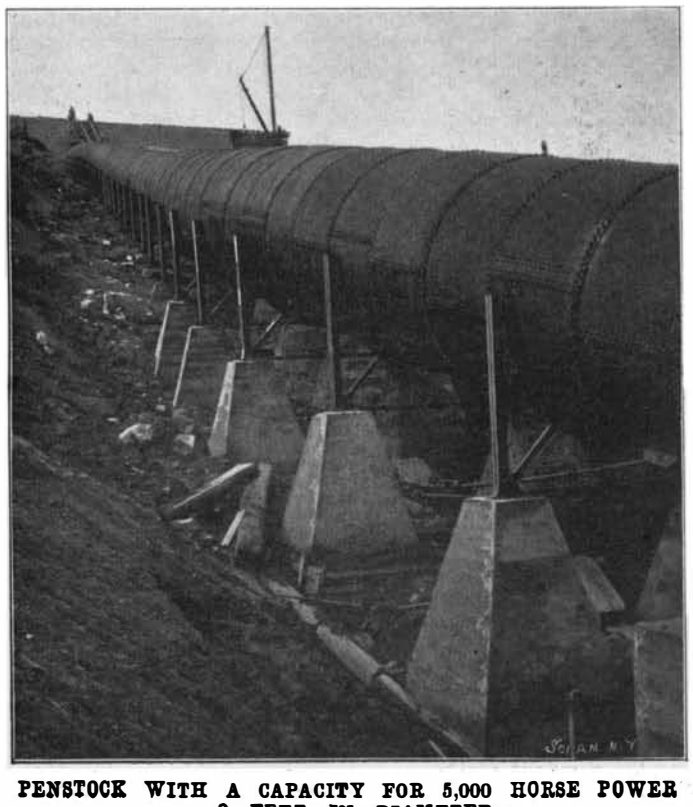
The Shawenegan Water and Power Company was formed under a charter granted by the provincial government, with the power to develop the water power, manufacture gas and electricity for the purpose of light, heat and motive power, to construct works needed for such purposes, to transmit power generally throughout the Province of Quebec, and to transmit electric power and sell same in the various towns and cities, with the right to expropriate land for its various purposes, including the necessary right of way to any point.



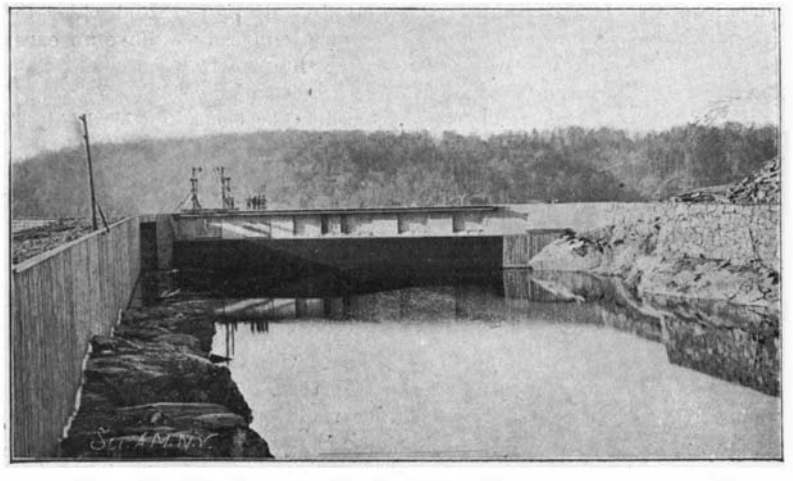
OUTSIDE BULKHEAD, SHAWENEGAN FALLS POWER PLANT, 40 FEET HIGH, 30 FEET THICK AT BASE.

The president of the Shawenegan Water and Power Company is J. N. Greenshields, K. C., of Montreal; the vice-president is John Joyce, of Andover, Mass.; and the treasurer is Mr. J. E. Alfred, of Boston, Mass. For the accompanying illustrations and data in reference to this power plant the writer is indebted to the secretary, Mr. Richard W. Douglas, and the chief

INSIDE PENSTOCK—9 FEET IN DIAMETER.



PENSTOCK WITH A CAPACITY FOR 5,000 HORSE POWER —9 FEET IN DIAMETER.



INSIDE BULKHEAD, SHAWENEGAN FALLS POWER FOREBAY.

engineer, Mr. Wallace C. Johnson, who has had much to do with the Niagara power development during recent years.

The Shawenegan Falls power system obtains its water by a canal 1,000 feet long, 100 feet wide and 20 feet deep. The water is conducted through this canal to a forebay, formed by building a solid concrete wall, or bulkhead, from which the water is conducted through pipes to the power house, 130 feet below. This substantial concrete wall is 40 feet in height and 30 feet in thickness at the bottom. Each pipe, water wheel and generator will produce 5,000 horse power. The water for the operation of the wheel is obtained from the forebay, and is conducted in steel tubes to the power house, each tube having a diameter of nine feet. Three of these penstocks are now in place, and three more are still to be installed and are now under way. The canal has a capacity of 60,000 horse power, and the present development includes a bulkhead for 30,000 horse power, power house and pipe lines for 15,000 horse power, and water wheels and generators for 10,000 horse power.

The company purchased about 1,000 acres of land, of which 200 acres were reserved for mill sites, and about 500 acres for the location of the town, the latter being particularly well adapted for this purpose, being high and comparatively level. The former is an ideal location for manufacturing plants using large quantities of power, both electrical energy and water power privileges being available.

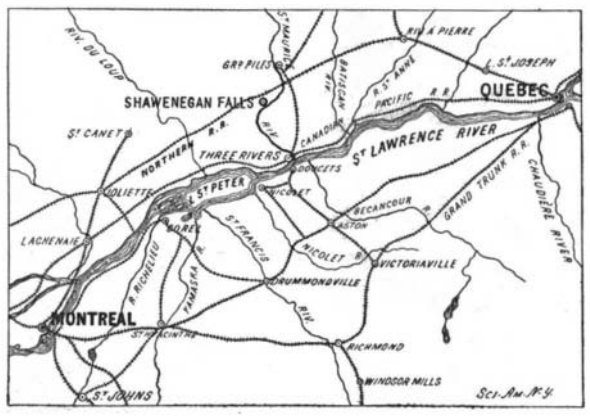
The St. Maurice has a total length of over 400 miles and is supplied from a great many lakes and streams, the drainage area being about 18,000 square miles. The water flow is very steady throughout the year on account of the dense forest covering this area, and is in the neighborhood of 26,000 cubic feet per second. The power which may be developed will not fall short of 100,000 horse power ultimately, and the working head is more than 125 feet.

Besides the main development, it was decided to take advantage of the fact that at one point the Shawenegan River and the St. Maurice came within 1,000 feet of each other, but with a difference of level of 150 feet, and it was here, at a point on the upper bay, a second installation was made. This is about half a mile from the main power station of the Shawenegan Water and Power Company. This installation was built by the Belgo-Canadian Pulp Company, whose enormous pulp mill is supplied with water for operating their turbines by the Shawenegan Water and Power Company. This development consists of a large crib dam through which the water passes at the bottom. The headworks consist of a concrete forebay, which has a height of 40 feet, with the necessary racks and headgates. This solid concrete bulkhead is inside of the crib dam on the bank of the river, and from it the penstocks lead the water through the bank and down to the lower level, discharging into the Shawenegan River as a tailrace, after passing through the turbines. The steel penstock between the forebay and the mill is twelve feet in diameter, and a special tunnel about 200 feet long had to be excavated through the clay bank for its reception. This plant will have a capacity of 15,000 horse power, which is to be utilized by the Belgo-Canadian Pulp Company, but double this power may be obtained by duplicating the crib and bulkhead next to the present one. The present pulp mill will be able to turn out 10 tons of pulp per day, using for this work about 8,000 horse power. An additional 7,000 horse power, making the entire 15,000 horse power, will soon be used by another additional paper and sulphite mill.

The water wheels in the main power house were built by the I. P. Morris Company of Philadelphia and each has a capacity of 6,000 horse power under a working head of 125 feet. Two of these turbines are now in course of erection and two alternating current generators of 5,000 horse power are already installed. These electrical generators were supplied by the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa. There is provision for another 6,000 horse power unit in the present power house; and an addition is provided for duplicating the present plant, which will increase the output to about 36,000 horse power.

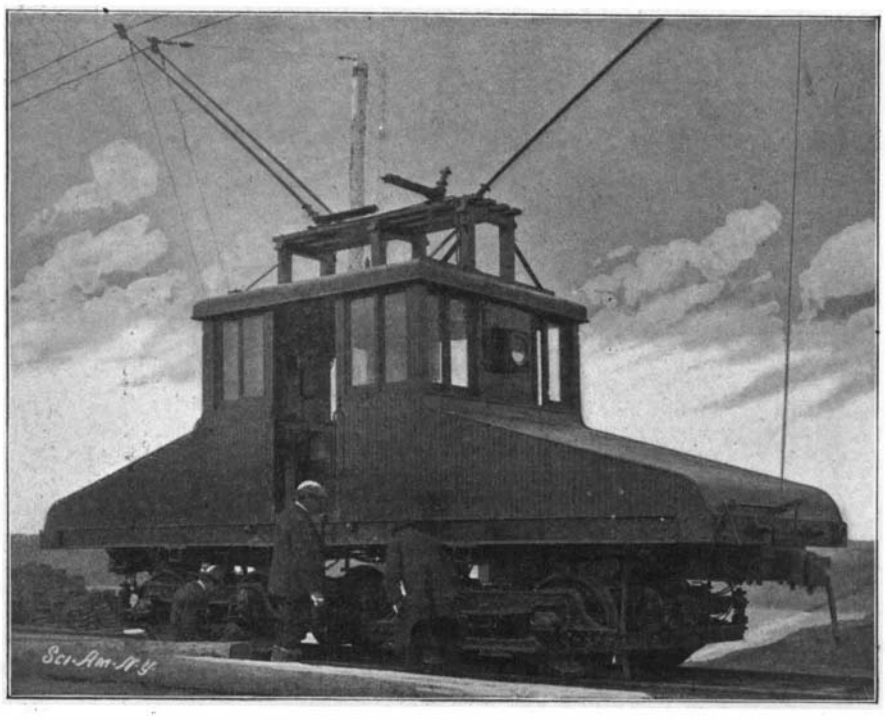
The steel tubing from the forebay to the power house increases in diameter from 9 feet to 11 feet near the turbines, the thickness of the shell of the flume also increasing from 5-16 inch to 9-16 inch. The diagram of the wheels shows them to be of the twin-turbine type, having one runner at either end of the casing. The water enters the turbines radially from without, discharging radially toward the center of the shaft into the draft chambers. The draft chambers connect with an 8-foot draft tube which passes to the tail water. It increases in diameter to 11 feet. The tail water has a low mean level of 25 feet below the center of the wheel shaft. There are two large air chambers above the casing, which is of cylindrical form. The turbine is 30 feet long, and is controlled by gates in the draft chambers. The gates consist of butterfly valves, closing together at the center between the shafts.

In connection with the transmission line between Shawenegan Falls and Montreal, it is said negotiations are under way with the Great Northern Railway and other railroads, whereby the power transmission line will run over their right of way for the greater part of the distance. This would not only lessen the first cost of the transmission lines, but would reduce the maintenance expense to a minimum, while the line in passing the fifteen towns and cities would find many users of the electric current for incandescent lighting and motor service.



MAP SHOWING LOCATION OF SHAWENEGAN FALLS POWER PLANT.

There is little question that quite an industrial center will be established at this power plant. Already the Calcium Carbide Works have been established and a large plant known as the Shawenegan Carbide Company's works has been installed. The Pittsburg Reduction Company's plant is also in operation. The above-mentioned concerns alone will in the near future use about 35,000 horse power. The example of the Pittsburg Reduction Company and that of the Shawenegan Carbide Company is being followed by other users of electrical energy. It is said large plants for the manufacture of bleaching powder, caustic potash and chlorate of potash and other electrolytic works have an exceptional opportunity at Shawenegan Falls.



ELECTRIC LOCOMOTIVE AT SHAWENEGAN FALLS POWER PLANT, USING DOUBLE OVERHEAD TROLLEY.

Novel Smoke Consumer.

M. D'Altoff has invented a smoke-consuming device in which he utilizes the smoke to form a combustible gas which he calls "pyro-gas." The apparatus consists of a kind of filter into which the smoke is driven by a ventilating fan. The filter is filled with porous material such as wood, tow, cotton, coke, etc., and over this is allowed to run a continuous stream of liquid hydrocarbon, petroleum, benzine or alcohol. The result is that a gas is collected from the filter which is rich in carbides of hydrogen, especially ethylene, and thus has a great calorific power. It may be used for heating or to drive gas engines. On the other hand, the filtering matter, which has stopped the soot and the heavy hydrocarbons, may be used as a combustible. In this way the smoke is suppressed and a great economy of combustion is secured. Several plants of this kind are said to have been installed at Brussels, and in one of these the "pyro-gas" is used to heat the boiler of a 50 horse power steam engine. A plant at Malines uses the gas directly with a gas engine of 50 horse power, and several others are to be installed.

The Completion of the Manchurian Railway.

We have frequently remarked, says Engineering, that the engineer is a more powerful personage than the politician, or even the military man. By his works he creates conditions against which these cannot prevail, and hence the necessity for the study of what we have called industrial dynamics. The engineer may call forces into action which upset the calculations of all who confine their attention to merely local conditions. The developments which have taken place in the methods of communication have shrunken the globe into small dimensions, and brought economic conditions to something like equality. We have had many examples of this during the past quarter of a century, and probably the most recent will be the most important. The congratulations which passed between the Czar and M. Witte on the completion of the Manchurian extension of the great Siberian railway were fully justified, not only by the magnitude of the work which had been done, but also because of the results which were certain to follow. While we cannot justify all that has been done in the name of Russian diplomacy, we must confess that a great deal of the criticism which has been made of their work in the Far East has been very unfair. A well-known man recently remarked that the Russians had not taken possession of any territory which was of any use to any other European power; and that if he were a Russian, he would rather die than give up the determination to have a free opening to the Pacific Coast for their vast territories in the north of Asia. It is only ten years since the Czar, then on a tour round the world, cut the first sod of the railway at Vladivostock, and from that time the work has been carried out with an unceasing and tireless energy. The Czar was justified in the warmth of his language to M. Witte, when he said, "I congratulate you on the completion, within so short a time, and amid incredible difficulties, of one of the greatest railway undertakings in the world." We have from time to time given some account of the details of that work; our object now is not to enter into these, but merely to note the completion of a very important section, which is destined to have great economic, industrial, and political results. As originally planned, the terminus of the railway was to be at Vladivostock; but, since the undertaking was entered upon, events in the Far East have added to the scheme. If that scheme had been British instead of Russian, no criticism would have been offered in this country to those developments. The acquisition by Russia, in 1898, of Port Arthur and Talienwan, with the right to connect these places with the main Siberian system by a railway through Manchuria, not only added to the magnitude of the undertaking, but also to its commercial and industrial importance. It is expected when the line is in good working order, and when trains may run uninterruptedly, that the distance between Moscow and Vladivostock or Port Arthur will be covered in about ten days at a fare of $60 for first-class sleeping car. It is also estimated that the journey by the Siberian route from London to Shanghai will take 16 days, and cost $160, instead of the 35 days and $450 involved in the present sea route; but probably this calculation is unduly optimistic. In any case the commercial results must be very marked. No doubt a great portion of the heavy goods will still be sent by sea; but much of the lighter goods and a large proportion of the passengers will go overland. The industrial development of Siberia, however, opens up possibilities which it is impossible at the present time even to imagine. Politically, the railway brings Russia right into the politics of the Far East, and places her practically within striking distance of Pekin. We will not, meantime, attempt to follow the commercial and political results which are certain to follow, but even to superficial observers these must appear to be very great.

Anna C. Draper, who died at her home in Hastings, N. Y., December 10, is said to have been the first woman in the world to have her photograph taken, her brother having invented a process in which a daguerreotype could be made in six minutes. By means of previous methods it took an hour, and no one could pose that long. The original is now in possession of Lord Herschel's heirs in England.