

THE SAULT POWER CANAL.

BY WALDON FAWCETT.

In this era of universal utilization of water power it must be no mean undertaking that is accounted the greatest hydraulic development ever attempted in the United States, and yet this superlative designation is precisely applicable to the great project which has been undertaken by the Consolidated Lake Superior Company in the construction of a power canal at Sault Ste. Marie, Mich.

The sister cities of Sault Ste. Marie, Mich., and Sault Ste. Marie, Ontario, are situated, it may be explained, on either side of the St. Mary's River, which connects Lakes Huron and Superior and through which passes the bulk of the enormous commerce of the great lakes. The river at a point opposite the cities takes a tremendous drop by means of rapids, and it was to obviate this obstacle to navigation that the United States and Canadian governments expended millions of dollars in the construction of a number of canal locks, one of which is the largest in the world.

About the time of the construction of the government locks the city on the American side experienced a distinct boom, but it died out, after the fashion of booms, more than a decade ago. Now there appears to be opening for the little city of ten thousand people a wonderful future as a manufacturing center. All the claims which have been made for the possibilities of development at Niagara Falls apply with equal if not greater force to Sault Ste. Marie. A water power canal half a mile in length is already in operation on the Canadian side, and a canal with a length of a mile and a quarter is under construction on the American side. The canal on the American side alone will supply a row of mills upon its banks more than a mile in length and will give each a fall of water of 18 feet and an ample quantity. In short, the whole scheme is designed, as it has been aptly expressed, to turn the twin cities into one vast water mill, with Lake Superior as a will pond.

The summary given, too, is but an elementary outline of the project, for there is in contemplation a plan whereby the generation of electricity will enable factories of various kinds to secure power over an area fully fifteen miles in diameter. Senator McMillan, of Michigan, recently stated that he saw no reason why the water power should not be applicable to the mines and saw mills scattered so thickly throughout the adjoining territory, and a clew to the ultimate purposes of the master movers in this novel project may be gained from the fact that the same capital that is constructing the power canal is building a railroad from Sault Ste. Marie to Hudson's Bay, tapping unlimited storehouses of iron, nickel and copper.

The syndicate of American capitalists which is responsible for the hydraulic improvements at Sault Ste. Marie first acquired a right of way on the Canadian side of the river. The Lake Superior Power Canal Company was then formed and built a water power canal which developed 20,000 horse power. From the Lake Superior Power Company as a parent organization there was formed on the Canadian side the Sault Ste. Marie Pulp and Paper Company, which operates the largest pulp mills in the world, and other manufacturing corporations. On the American side the sub-organization took the name of the Michigan Lake Superior Power Company, and upon it devolved the devel-

opment of the water power on that side of the river. Within the past year the Consolidated Lake Superior Company, with a capital stock of \$20,000,000, was formed to absorb the interest of all the original companies engaged in the development of the industries of the two new industrial centers. An incidental or-



CHANNELING-MACHINES AT WORK IN ROCK CUT.

ganization also recently perfected was the incorporation of the American Alkali Company, which will use a considerable proportion of the power provided by the American canal. The last mentioned company, which will manufacture chemical products by electrolytic methods, has an authorized capital of \$30,000,000.

Measured according to the ordinary rules of hydraulics, the actual physical energy to be developed by the

feet in width and will rise 75 feet above the water level. The building contains eighty-one turbine chambers, each being about 16½ feet in width and containing four American turbines, installed in tandem fashion, and all connected to one shaft, at the end of which, outside of the turbine chambers, an electric generator is coupled. One of the turbine chambers, located in the central part of the building, will not be equipped with turbines, but will be utilized instead as a spillway through which accumulations of ice or debris may be discharged into the river without the possibility of the turbines sustaining any injury.

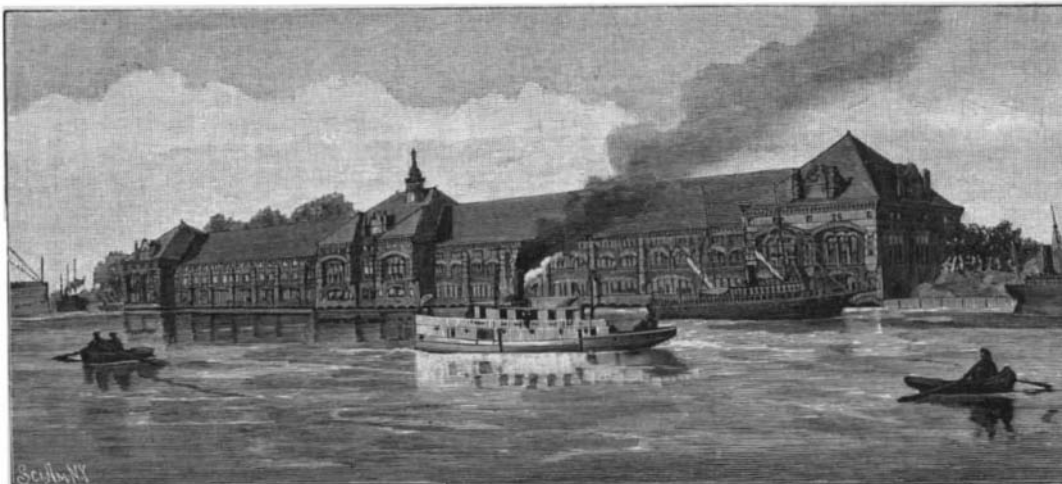
To facilitate description, the building may be divided into the component parts of foundation, substructure or pit, superstructure comprising pen-stocks and dynamo floor, mill floor and roof. The foundation consists of ten thousand 20-foot piles. The substructure consists of eighty-one pit walls each 100 feet long, 20 feet high and 3 feet thick, being closed at the up-stream end by arch-shaped forebay walls of the same height and thickness. A concrete floor is laid between each two walls in the shape of an inverted arch, and the top is also closed by a concrete arch. The pit and forebay walls are formed from concrete blocks fabricated in imitation of cut stones.

It will thus be understood that the substructure consists of 81 concrete tunnels, each 100 feet long, 15 feet wide, and 18 feet high, and open only at the downstream ends. Above these the superstructure is raised, consisting of 81 penstock partitions, each about 20 feet high, 40 feet long, and 17 inches thick. The downstream end between each two partitions is closed by a semi-circular steel plate bulkhead. By this arrangement the turbine chambers proper remain open, of course, on the up-stream side and top. Here the turbines will be installed, receiving the water from the front and top and discharging it through the steel penstock tubes into the pit below, whence the water escapes into the river. The installation of electric dynamos will occupy that portion of the pits not devoted to the penstocks. For this there will be provided a continuous floor about 40 feet wide and fully 1,400 feet in length. The mill floor will be of the same length by 75 feet in width.

Perhaps the best idea of the size of this great power house may be conveyed by the statement that there will be required for its construction a quarter of a million linear feet of piles; 100,000 linear feet of 12-inch logs, 40,000 cubic yards of concrete, 3,000 tons of structural steel, and 10,000 cubic yards of stone masonry. The installation will consist of 320 turbines and 80 electric dynamos. The estimated cost of the building is in the neighborhood of \$500,000, and it is expected that the equipment will necessitate an additional expenditure of fully \$750,000.

Lake Superior has an area of about 30,000 square miles and its mean outflow through the rapids at Sault Ste. Marie is about 90,000 cubic feet per second the year round. The mean elevation of the lake is 601 feet and the elevation of St. Mary's river below the rapids 582 feet, giving a vertical fall of 19 feet. The quantity of material to be moved in the construction of the canal on the American side, amounts to more than 500,000 cubic yards of rock and considerably over 2,000,000 cubic yards of other material.

The manufacturing interests to be developed at the Sault will undoubtedly be of a most extensive character. Mention has already been made of the pulp mills which give employment



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Length, 1,400 feet; width, 100 feet; number of turbine wheels, 320; number of dynamos, 80.

THE 60,000-HORSE-POWER POWER HOUSE.

canal now under construction on the American side will amount to fully 60,000 horse power. The power house within which this power will be transformed into electrical energy will be nearly 1,400 feet in length, 100

about 30,000 square miles and its mean outflow through the rapids at Sault Ste. Marie is about 90,000 cubic feet per second the year round. The mean elevation of the lake is 601 feet and the elevation of St. Mary's



Width on bottom, 200 feet; depth, 23 feet; length, 1¼ miles; available head, 18 feet.

EXCAVATION OF THE GREAT FEEDER CANAL OF THE MICHIGAN LAKE SUPERIOR POWER COMPANY.

to a force of over 1,000 men. The Canadian Electro-Chemical Company on the Canadian side is the first in the Dominion to manufacture caustic soda and bleaching powder. The development of the nickel mines of New Ontario will be another ultimate result. These mines which are about 120 miles distant from the Sault are now capable of yielding 500 tons of ore per day, all of which will be utilized in the reduction works just constructed. These works will produce daily 250 tons of nickel steel, perfectly adapted to the requirements of armor plate manufacturers. It is claimed also that the process to be introduced at Sault Ste. Marie will so reduce the cost of production of nickel steel as to make it available for shafting and all other similar uses where severe strain is encountered. The company has already secured a contract to supply the Krupp plant in Germany. Then there is the general reduction works intended to reduce to the most perfect purity ores of all kinds and at so low a cost as to make of practical value many ores formerly considered useless. A calcium carbide works will be another feature.

The project for the establishment of the power canal at the Sault was proceeded with so quietly that the work was well under way before the general public learned much if anything regarding the scheme. It is now expected that the canal on the American side will be in operation late in the present year, and those persons most thoroughly conversant believe that the Consolidated Lake Superior Company will not be much behind its rival at Niagara Falls in the development of 100,000 horse power.

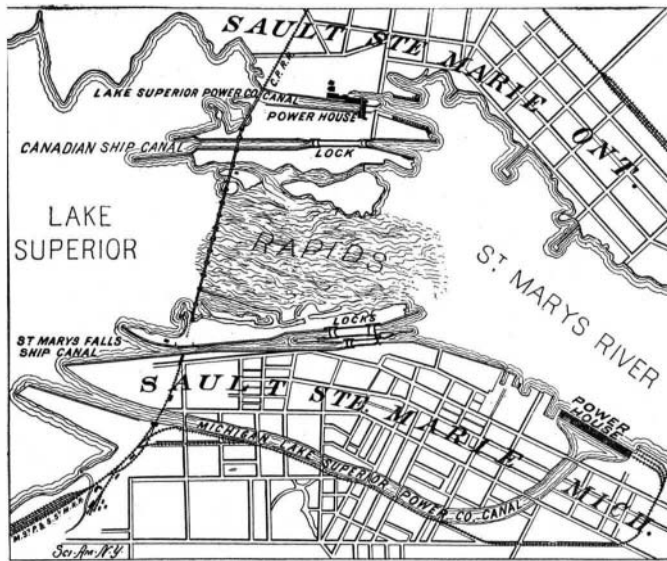
During the early part of the present year the Lake Carriers' Association, comprising in its membership all the principal vessel owners on the great lakes, became aroused lest the power canal project would affect the level of Lake Superior and the ship canal and thus work serious injury to navigation interests on the inland seas. Representatives of the vesselmen's association declared before a committee of the House of Representatives that if the power canal lowered the level of the government ship canal around the rapids at the Sault so much as one inch, it would entail a loss of a million and a quarter dollars to the vessel and iron ore interests every year. Engineering experts have disagreed regarding the influence which the power canal will exert. Just what action will be taken is problematical, but that some legislative limitations will be exacted ultimately seems highly probable. Meanwhile, the excavation of the canal goes actively forward, and upward of fifteen hundred men are engaged in the work.

CURIOSLY CUT YEW TREES.

The yew tree is often called the "melancholy yew," a description which is not altogether unwarranted, having regard to the position it usually occupies. The use of the yew tree in Christmas decorations in England is no new fashion, and several centuries ago the yew was more largely employed in decorations at Easter than at Christmas.

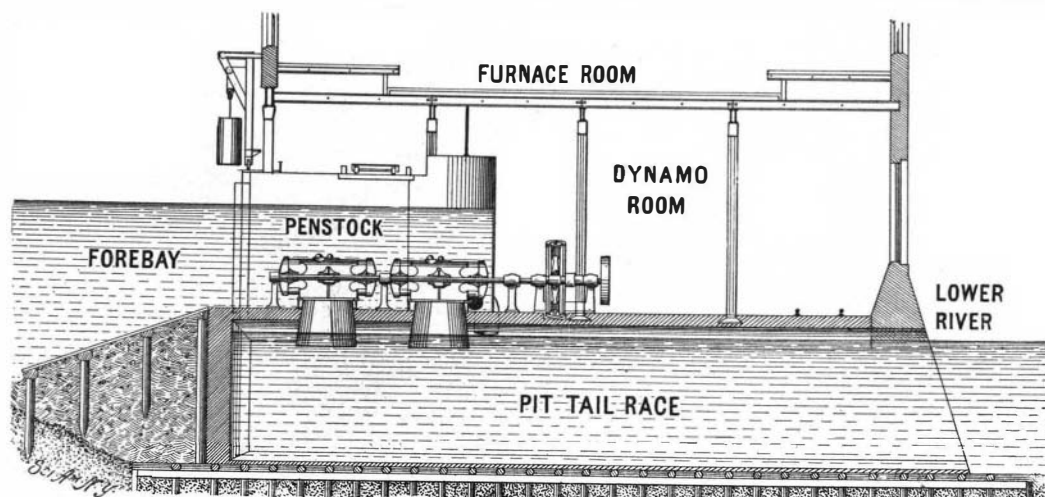
The common yew tree has a wide geographical range.

It is distributed over Great Britain and the Continent of Europe, its range extending from Norway and Sweden to the shores of the Mediterranean. It is also well represented in America and Asia. The remarkable longevity of the yew, coupled with its power to resist adverse influences, has given rise to the opinion that there is hardly any limit to the period of its existence, and the age of the majority of the more famous trees is greatly overestimated; many of the more noteworthy trees are undoubtedly several centuries old. The famous tree at Buckland, Kent, about a mile from Dover, was men-



MAP OF SAULT STE. MARIE, SHOWING RAPIDS AND LOCATION OF POWER PLANTS.

tioned in the Doomsday Book, and is, therefore, of an age exceeding a thousand years. In 1880 it was removed from one part of the churchyard to another, sixty yards distant, and was undoubtedly the oldest tree that has yet been transplanted. The trunk was split by lightning about the middle of the eighteenth century, during a storm which destroyed the



TRANSVERSE SECTION THROUGH POWER HOUSE, SHOWING FOREBAY, TURBINES AND TAIL RACE.

steeple of the church. In consequence of the injury received, the trunk assumed a horizontal position, and in the process of replanting the tree was restored to a comparatively erect position.

Probably the most curious thing connected with yew trees is the way in which they have been cut to resemble some animal or other object. The ones at Bedfont, shown in our engraving, are most interesting. Bedfont lies near London on the high road and is equidistant between Hounslow and Staines. The

primitive air of the place would hardly lead one to believe that it is within thirteen miles of the great metropolis. The quaintness of its appearance is increased by its little Norman church with its wooden tower and dwarfed steeple and its pair of trim and formal yew trees cut into the shape of peacocks, with the date 1704, and the initials of the church wardens of that time still legible in the cropped foliage. The local tradition is that the peacocks represent satirically two sisters who lived at Bedfont, and who were so very haughty that they both refused the hand of some local magnate, who thus immortalized them as being "as proud as peacocks." This is, however, only a legend and stories of the same kind will be found everywhere in England where there is anything out of the ordinary. The two peacocks have been immortalized by Thomas Hood, who makes them the subject of one of the most serious of his poems. Pope, who must also have seen these quaint artificial ornaments, satirized them in the "Guardian." He gives a list of some fifteen or sixteen subjects cut in evergreens, from Adam and Eve and Noah's Ark down to Queen Elizabeth. Of course, such artificial trimming of the trees is opposed to all rules of good landscape gardening, but they are interesting as curiosities. We are indebted to the courtesy of the editor of The Gardeners' Magazine for obtaining the photograph for us.

Experiments on the Coloring Matters of Plants.

M. Tsvett gives an account to the Academie des Sciences of a series of experiments relating to the coloring matter of plants. When plant leaves are treated with a concentrated aqueous solution of resorcinol, made slightly alkaline by ammonium carbonate, the chloroplasts swell up and agglomerate, and various constituents of the cells are dissolved and liquefied, while the coloring matter collects in large oily drops, which coagulate at once if the resorcinol is washed out by glycerol or water. These green globules are called chloroglobins by the experimenter; they are insoluble in saline solutions, but swell up when treated by carbonate of potassium and other salts, and are altered in character by the former. They are slowly decomposed by dilute acids. Like many of the proteids, the globules absorb and retain color-

ing matters such as methyl blue, magenta, etc. Chloroglobin swells up in solutions of the alkaline hypochlorites and is decolorized, the bleached substance giving indefinite results with the ordinary reactions for proteids. It dissolves in strong alcohol, and if the solution is agitated with benzine a green coloring matter, which is not affected by resorcinol, passes into the latter, and a yellow substance, which is liquefied by resorcinol, remains in the alcohol. In physico-chemical properties, chloroglobins resembles the proteids; its solubility in ether, carbon disulphide, etc., seems to be due to the chromophoric nucleus of the molecule. The chlorophyll and carotin (xanthophyll) are probably loosely associated with the proteid nucleus. Chloroglobin can be obtained in a very pure condition by extracting suitable leaves in strong alcohol, diluting to 20° and collecting the very fine precipitate by filtering through porcelain.

"WHERE the Day Changes" is an interesting article in the current SUPPLEMENT. It deals with the various day lines which have been proposed as the line of demarcation between the American day and the Asiatic day. The position of the day line in the Pacific Ocean differs, according to the various authorities, and they differ from the 180th meridian. The day line is not a straight line, but makes a number of turns at different places. The article contains a map showing positions assigned to day lines by different geographers.



YEW TREES CUT INTO THE SHAPE OF PEACOCKS, AT BEDFONT, ENG.—THE TREES BEAR THE DATE 1704.