

successive waves. While the above is but a rough comparison, the scientific process followed in Capt. Russo's method has led to the construction of an apparatus, in which it is claimed that a perfect similitude is established between the case of the ship in the waves of the sea and that of the navipendulum carried by the apparatus which we herewith illustrate. The whole object of the various axles, gears, electric motor, etc., is to give to the plate on which the navipendulum rolls a complex motion of a special nature, which is determined on the basis of the length, height and period of the wave constructed in the experiment. The navipendulum enables the naval architect to ascertain in the designing of a ship, the degree of steadiness which she will actually possess. Its importance in this respect may be judged from the fact that many ships have been found after construction to be wanting in a proper margin of stability. With the navipendulum to guide him the naval architect would never make any mistake on this question of stability. The apparatus described has been officially adopted by the Italian Admiralty, who have provided their experi-

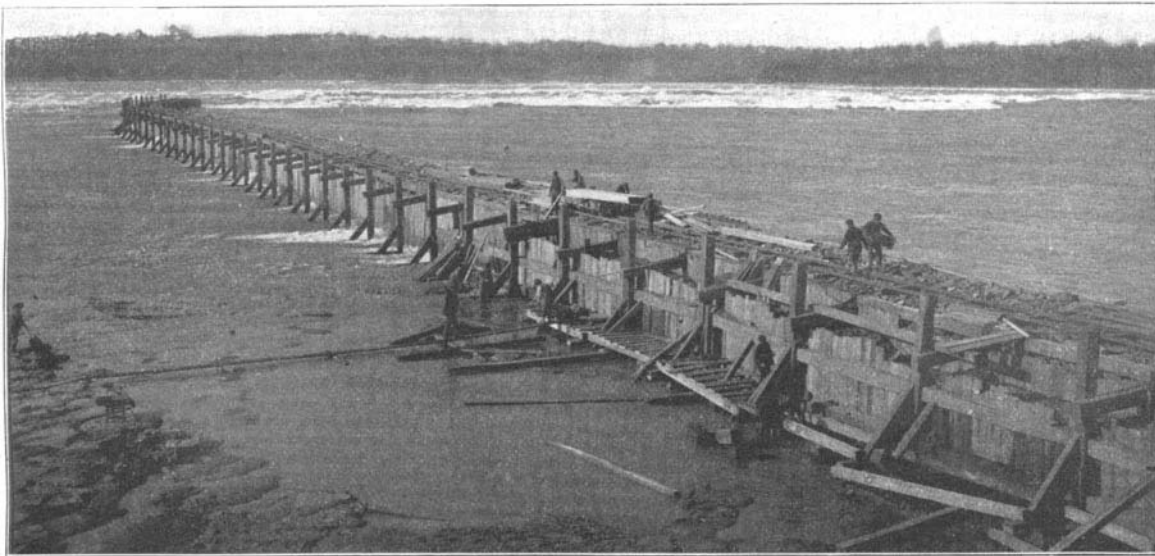
velop power by means of a wheelpit and tunnel tail-race. The length of the wheelpit when completed will be 480 feet, but a section 266 feet in length is now being built. This pit will be 21 feet wide and 170 feet deep. It has reached a depth of about 115 feet at present. The method of construction, and the rock through which it is being sunk, are almost identical with that of the two pits on the New York side.

When completed the wheelpit will be lined with brick from top to bottom. The first section now building will afford a development of 50,000 horse power through the installation of five units of 10,000 horse power each. The contract for three of these has been awarded to Messrs. Escher, Wyss & Co., of Zurich, Switzerland, none of the shops in the Dominion of Canada having facilities for their construction. It is understood that they will be somewhat similar to the turbines installed by the Niagara Falls Power Company in wheelpit No. 2, but each of just twice the output capacity. The turbines just ordered are to be delivered within a year, and the first power from the

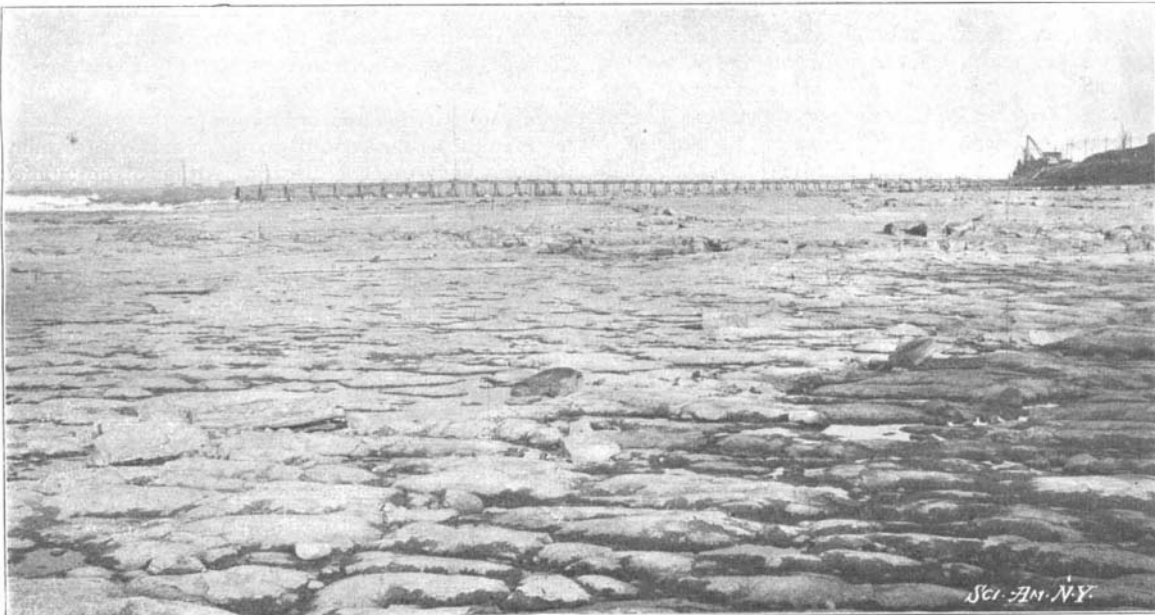
plant by means of three cables strung across the upper steel arch bridge.

In connection with the development on the Canadian side the Canadian Niagara Power Company is constructing a large forebay. This will extend the full length of the wheelpit, but at a point where it will be bridged it will narrow down to 250 feet, passing which point it will again broaden out to 400 feet or more. The forebay will carry an average depth of 18 feet of water. From the north end of the wheelpit a canal 16 feet wide will be built for 500 feet to the river, affording facilities for an ice run. The flow in this canal will be regulated by gates. The bridge that will span the forebay will be of the stone arch type, built in five arches. It will have a width of 60 feet and will carry the tracks of the Niagara Falls Park and River Railway as well as a boulevard driveway. When finished the bridge will be one of the prettiest in the Niagara region.

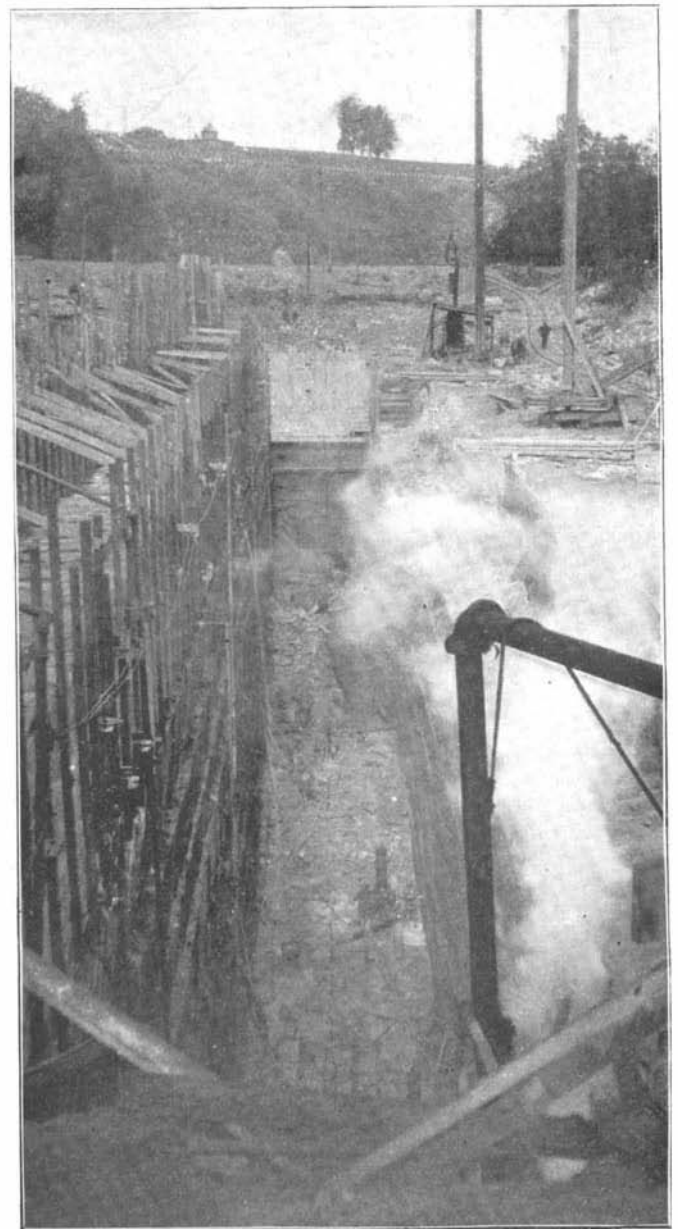
The tunnel that will connect the wheelpit with the lower river will discharge very close to the foot of the Horseshoe Fall. It is 2,200 feet long, not a third of the



OUTER END OF BIG WING DAM ABOVE THE DUFFERIN ISLANDS.



A LARGE SECTION OF BED OF NIAGARA RIVER ABOVE THE HORSESHOE FALL LAID BARE BY CONSTRUCTION OF DAM.



WHEELPIT OF THE CANADIAN NIAGARA POWER COMPANY.

mental works at Spezia with an instrument of this kind.

**THE NEW PLANT OF THE CANADIAN NIAGARA FALLS COMPANY.**

BY ORRIN E. DUNLAP.

The Canadian Niagara Power Company is making good progress with its work on the Canadian side at Niagara Falls, and the time is fast approaching when this installation that is destined to command much attention will be completed. This company is practically the Niagara Falls Power Company, and the plan it has adopted for the development of power on the Canadian side is very similar to that so successfully established on the New York side, where a tunnel 7,436½ feet long and two wheelpits, one 424 feet long and the other 463 feet long, have been built.

On the Canadian side the scene of the power development is in Victoria Free Park, a section of territory purchased by the government for park purposes, in order that the beauty of the falls of Niagara might be preserved from vandalism and the works of man. Promoters of the industrial interests of the locality have, however, found that the park is an ideal site for a great power development, and the ideas thus developed are now being carried out in their fullest detail. The Canadian Niagara Power Company will de-

installation is expected to be ready for delivery early in the spring of 1904.

The generators to be installed in the power station of the Canadian Niagara Power Company will also be of 10,000 horse power, or of twice the capacity of the generators in the two stations of the Niagara Falls Power Company. They will be wound for 12,000 volts, three-phase. The frequency will be 25 cycles, which will give uniformity with the plants on the New York side and allow of parallel operation. A generator that has an output capacity of 10,000 horse power will occupy but little additional space to a generator of 5,000 horse power, and while saving in space, the Canadian Niagara Power Company also secures a lower cost of generator per horse power and a lower cost of turbines per horse power. The speed of the generators will be 250 revolutions per minute. A feature of the development on the Canadian side is the fact that as the power plant will be located in Victoria Park, all of the power produced must, under the agreement with the commissioners, be transmitted beyond the park boundaries for use. Under these circumstances the voltage of 12,000 is expected to result in economy, and for long-distance transmission the voltage will be increased to 40,000 or 60,000. The power plants on the New York side will be connected with the Canadian

length of the tunnel on the New York side. However, it is 25 feet high, which is four feet higher than the New York tunnel, and its width will be 18 feet. The tunnel has been driven, and the contractor, Anthony C. Douglass, is now removing the bottom bench, having taken out about 1,200 feet of it, or more than half. Owing to the great scarcity of brick, in lining this tunnel concrete is being used from the spring line down, but the concrete lining will have a facing of vitrified brick. This application of concrete will do away with 3,000,000 brick, but 1,250,000 brick will be used in forming the arch. Owing to the closeness of the portal to the Horseshoe, the masonry to be built there will be massive. As it is located at a point where ice gathers in immense quantities in the winter time, it will be subjected to great stress. This work will not be begun until next spring, owing to the nearness of the winter season. At the portal about 60 carloads of granite from Quebec and 200 carloads from Queenston will be used. In timbering the tunnel over 2,000,000 feet of lumber was used.

A SECOND GREAT POWER PROJECT.

The Ontario Power Company is also working on its project for the development of power in Victoria Park. This company's plan is to develop power on somewhat the same principle as that in use by the

Niagara Falls Hydraulic Power and Manufacturing Company on the New York side. This latter company, however, carries its water to the edge of the high bank of the gorge through a surface canal, whereas the Ontario Power Company will conduct its water supply from the upper river, through the park, in large pipes, but whether they will be of wood or steel is not yet stated. The company will have its power station in the gorge, a short distance below the Horseshoe Fall, where a large force of men has been at work several weeks excavating the debris slope of the bank.

It is the Ontario Power Company that has constructed the immense wing dam out in the river above the Dufferin Islands. This wing dam is nearly 800 feet long, and already it has had the effect of diverting the waters of the river to such an extent, that a large area of the river bed between the dam and the Falls has been laid bare. The depth of water over this portion of the river was always inconsiderable, and the interference with the current by the dam easily produced the large area of dry river bottom shown in the accompanying photograph. It is interesting to note the curiously rounded appearance of the rocks resulting from the age-long attrition of the rushing waters.

#### THE MANUFACTURE OF TOYS AND DOLLS.

In a quarter of New York's "East Side," imbued with the half-European, half-American atmosphere so characteristic of Bohemian, Hungarian, and Polish settlements in America, a toy factory is situated which furnishes the children of our Eastern States with cheap, gayly-colored playthings. The factory, industrially considered, is a picturesque combination of modern labor-saving and old-fashioned labor-employing methods; for the most ingenious machinery and the simplest form of hand labor work side by side. There are some things that machinery can never do; and for that reason the factory girl cannot be dispensed with—in a toy-factory at least.

Historically considered, the toy industry may be said to have begun in Nuremberg. The development of the industry that made the old town so famous may be easily traced in the collections of the Germanic Museum. There completely furnished doll-houses, with cellars, vestibules, staircases, servants' quarters and drawing-rooms, are set up, and faithfully represent the home life of olden times. The old mechanical toys which are here to be seen are the work of locksmiths; for besides working at his trade the Nuremberg locksmith made many a clever toy. Tinkers opened a new field for the toy industry by the introduction of optical instruments, such as magic lanterns, and of magnetic toys, ships and swimming animals. The use of steam power and later of electricity gave the industry another impulse.

From roof to cellar the interior of the New York factory referred to is a chaos of flaring color. Paint—red paint, green paint, yellow paint, paint of all possible hues—is spread with lavish hand on the tin. The factory girls are besmeared with it; every floor reeks with it.

The tin used in making the toys is purchased in large sheets. By treadle-operated shearing machines fitted with reciprocating-knives the sheets are cut into strips or pieces of various sizes and shapes. Some of the sheets are embossed with designs, and are then passed through the paint-covered rollers of a painting machine, by which the embossed surface is coated and the intaglio left in its original bright metallic condition. These embossed and colored sheets are variously utilized in the making of kitchens, seashore-sand pails for boys and girls, shovels, comb cases and the like.

From the shearing-floor the cut sheets are taken to another floor to be stamped into various forms or "pressed," as it is technically called. The presses used comprise each a substantial frame with a horizontally mounted shaft connected by a crank with a plunger carrying a die. With but a single downward movement of the plunger a piece of metal is given any desired shape. Kitchen utensils such as cups, saucers, plates, dishes and the thousand and one articles that are made in a toy-factory are stamped out by these machines. Many of the products are taken to another room and turned in order to remove the jagged edges.

Besides the presses peculiar forming-machines are used which are of exceedingly simple construction, and which serve the purpose of forming tin tubes from long strips of metal, and of crimping the edges of various utensils. The tube-forming machines consist primarily of a table having a semi-cylindrical groove, and of a plunger carrying a die the length of the semi-cylindrical tube. By dextrously manipulating a long strip of tin, an operator causes the die to force the strip into the groove, in order to form a perfect cylindrical tube.

After the various articles have been made by the presses and forming machines, they must be painted. For that purpose they are turned over to girls who apply the color by brush. No machine could possibly

perform this work; for the girl must know exactly where the color is to be applied and how to apply it. Almost every toy that is made must eventually pass through the hands of the painters. Railway cars are striped, kitchens are ornamented, horns are encircled with bright bands, and horses are given colored coats and furnished with painted harnesses. The painted toys are dried in a special steam-heated room.

Many of the toys either before or after they have been painted are turned over to men whose duty it is to rivet in their places parts which cannot be applied by machinery. Railway cars, for example, must be furnished with wheels. Certain workmen are therefore supplied with miniature axles upon which a single wheel is rigidly secured at one end. The axle is clamped in a vise; the car bearings are slipped over the axle, and the remaining wheel placed in position and riveted with a few taps of the hammer. Similarly, horns must be furnished with sound-producing means. For that purpose solderers are employed, who are furnished with small brass reeds, which are leaded in place at the mouth-end of the horn and covered with wooden mouthpieces. The horns after having been equipped with their reeds are tested. If the reed has been improperly applied, the error is corrected. Some of the toys, as for example human figures, must be dressed, and are therefore passed to girls, who sew the garments on the tin bodies.

Mechanical toys, which, at one time, were almost exclusively made in Germany, are also produced in this New York factory, though in limited quantities, to be sure. Many of these toys are ingenious pieces of mechanism and comprise interesting mechanical movements. Without exception the mechanical toys are all driven by clock-trains, the escapement of which is so mounted as to produce the peculiar effect desired. By an ingenious arrangement of the escapement and the clock-train, miniature drunkards are produced, with reeling walk, maudlin nodding head, and absurdly moving arms, which simulate an attempt to fill a glass held in the one hand from a bottle held in the other. A fiddler who industrially saws away, without, however, producing any sounds, is another interesting mechanical toy. But perhaps the funniest of all these mechanical playthings is the so-called "balking mule," which represents a clown seated in a cart drawn by a rather refractory mule whom he seeks to control by rocking himself forward and backward, and violently jerking the reins. The toy is so constructed that the mule gallops forward for a few paces and then backward with equal rapidity for the same distance—all apparently the result of the frantic efforts of the clown to stop him.

In another New York factory situated in the heart of the business district, dolls are made; not China dolls, but dolls that can be dropped upon the floor without breaking. The process of manufacture on the whole is decidedly simpler than that of making metallic toys. The steps are few and simple. A peculiar composition is poured hot into a mold to form the head, arms, or feet. After the portion thus cast has cooled, it is removed from the mold and passed on to workmen, who pare off the seams and jagged edges by means of knives and smooth the surface with sandpaper. The eyes, which are specially imported from Europe, are then inserted through the neck into the sockets. Other operators thereupon paint in the eyebrows and hair and tint the cheeks. The more expensive dolls are provided, not with painted hair, but either with artificial hair of jute or with real hair.

The bodies of the dolls are merely stuffed sacks with extensions upon which the arms and legs can be sewed. After the entire doll has been completed, it is dressed in clothes varying in splendor with the price of the doll.

#### The Need of a Safe Match—A Chance for Inventors.

At a meeting of about forty manufacturers and dealers, called at the suggestion of the Fire Commissioner of New York, to consider the possibility of finding a match that would be safe to use, it was stated that the safety match is in reality no safer than the parlor match. If this be true, there is not much to be gained by the law prohibiting the sale of parlor matches. There seems to be here a chance for some inventor of a chemical turn of mind to use his ingenuity in designing a match which shall be safer than the matches at present in use, and shall not entail any danger in its manufacture.

#### Award of the Nobel Prizes.

The Nobel research prize of \$40,000 has been awarded to Major Donald Ross, of the Liverpool School of Tropical Medicine, in recognition of his investigations into the mosquito-malaria theory. Three other Nobel prizes were awarded, as follows: Natural science and chemistry, Dr. Emil Fischer of the Berlin University; physics, Dr. Arrhenius of the Stockholm High School; medicine, Dr. Finsen. Each prize is worth 160,000 marks.

## Correspondence.

### The Effect of Light on Animal and Plant Life.

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest a very able article in your last issue, by Dr. James Weir, Jr., in which he describes the effect of light on plant and animal life, with but one probable error, which I shall endeavor to point out. He says among other things:

"Flammarion's beautiful experiments at the climatological station at Juvisy have shown beyond question of doubt the widely different effects of the red and violet rays on plants. The plants chosen were of the genus *Mimosa*, or "sensitive plant," and were subjected to the same environments with the exception that some were reared beneath dark blue glass, and others beneath red glass.

"In four months the plants grown under the red glass had attained extraordinary development, while those subjected to the violet rays had made no progress whatever. Similar effects were noted in the case of strawberries, and numerous other plants, vines and shrubs.

"The plants grown beneath blue glass did not die, but seemed to remain in a dormant condition, without growth or further development. Zacharawietz, of Vacluse, has also shown that plants are strongly affected along the lines of rapid growth and development by red and orange rays. As early as 1883 I demonstrated and published the fact that typhoid fever germs would not live when subjected to the blue or violet rays."

From the foregoing one gets the impression that plants under a red glass are subjected to red rays of light, while the reverse must be true, as the red glass has absorbed all the red rays of light, and the remainder only have penetrated.

Who has not observed that in a photographic dark room, where a red light is used, anything therein which is red will appear white, for there are no red rays in the room, all being absorbed by the red paper through which the light is filtered.

E. RITCHISON.

Modale, Iowa, November 22, 1902.

### Koch's Last Communication.

At a recent meeting of the International Tuberculosis Congress, Prof. Koch reiterated all that he said regarding the non-transferability of animal tuberculosis to man. He asserted that statistics on the subject of intestinal tuberculosis were too incomplete to establish the frequency of that disease. Although he admitted that cases of tuberculosis do occur among butchers and other persons who handle animals, he asserted that the percentage of sufferers from the disease among joiners is equally as high as among handlers of animals and meat. Experts state that large amounts of tuberculous meats are consumed, and that not only the flesh, but even the tuberculous organs are made use of for food, yet no widespread infection follows. Prof. Koch declared that only two cases of alleged general infection were known to him, and that these two were not proved.

### Shipment of the 16-inch Rifled Gun.

The 16-inch rifled gun built at Watervliet for the United States Government, has been shipped to Sandy Hook. The railroad companies feared to transmit the 130-ton gun over their roads and refused transportation, by reason of the great strain which it would impose upon their bridges. A New York dredging company made a contract with the company to transfer the weapon from Watervliet down the Hudson River from Troy to Sandy Hook. The price for this service is said to have been \$5,400. The gun was placed on a specially-built car and run to the river front. There the gun and car were lifted onto a barge by means of a 250-ton derrick. At Sandy Hook the wharf was strengthened to receive the big gun.

### The Current Supplement.

In the current SUPPLEMENT, No. 1405, the description of the Langley aerodrome is concluded. Certain improvements in methods of quarrying slate are published, which are well illustrated. Francis J. Fitzgerald discusses exhaustively the subject of the conversion of amorphous carbon into graphite. An article on long spans for overhead electric cables is a subject which, at a time when the transmission of electrical currents over long distances is being more and more developed, should be read with some little interest. Mr. Kittredge concludes his discussion of the utilization of wastes and by-products in manufactures. Prof. Dr. von Bezold tells much that is interesting of the upper atmosphere. Archæologists will find published for their special benefit an account of the recent discoveries of the Italian mission in Crete, and an article by Eduard Seler on Prehistoric Civilization in America. V. de Turine describes photophonic books for the blind. The usual number of Selected Formulæ, Consular Notes and Trade Notes are also published.