THE ST. CLAIR TUNNEL DRAINAGE SYSTEM.

Our first page illustrations enable one to readily comprehend the amount of work that was deemed necessary for the purpose of keeping the great railway tunnel between the United States and Canada always free from water, and the manner in which the engineers met the difficulty. The area of sunken roadway included in the approaches, and the land on each side, for which drainage had to be provided, was fourteen acres on the Canada side and eleven and a half acres on the American side. The amount of rain which may fall in twenty-four or forty-eight hours at any given place, in localities where even the most complete records are kept, is always a variable quantity; but in a work of this kind, where absolute safety and the most thorough provision against any interruption of traffic are required, it was necessary to provide ample facilities for the immediate disposal of any quantity which might fall, and the engineers appear to have made their calculations on this basis.

On the Sarnia side two sizes of pumps are provided, the larger one, shown in our first page view, being a vertical, direct-acting, compound steam pumping engine, with a capacity of five million gallons in twenty-four hours. It is not expected that it will be necessary to employ this pump except during heavy and prolonged rains, a smaller duplex pump being located in the bottom of the shaft for ordinary use, and having a capacity of five hundred gallons per minute. All precipitation is led by stone drains at the base of the retaining walls, and from each side of the track, through a culvert crossing under the track, to a sump or well hole, from which the water passes, through a six-foot iron pipe, to the pumping shaft, 160 feet away. This shaft is made of cast iron rings bolted together in a manner similar to that followed in the construction of the tunnel, and is 15 feet 2 inches in diameter and 81 feet 3 inches in depth. It rests upon a timber base, upon which, within the shaft, is a six-foot masonry foundation for the large vertical and the small duplex pumps.

The vertical pumps are surmounted by large waterways or pipes reaching to the surface of the floor above, and through which pass the piston rods that connect with the steam cylinders resting upon the top of these waterways. Near the top is a discharge pipe 18 in. in diameter leading to a drainage connection with the St. Clair River.

As will be seen by the plan and sectional views on the first page, all of the water collected from the drainage area provided for is directed to and discharged from the pumping shaft, none of it being permitted to enter the tunnel. The compound engines employed have two high-pressure cylinders, 19¼ by 24 in., and two low-pressure cylinders of 33⅜ by 24 in., and the pump cylinder is 22 by 24 in. These are all located in a permanent house upon the bank of the approach, where also are four large steam boilers, two independent Ball dynamos that furnish the incandescent lights in the tunnel, and two large size Root exhausters that draw the foul air from the center of the tunnel, through two 20 inch sheet iron pipes, and one air and condensing pump for engines, capacity 20,000 cubic feet per minute.

The water that collects upon the American watershed is mostly directed in the same manner as upon the Sarnia side to a well near the tunnel entrance, where, in a masonry building on the south side of the tracks, are four duplex pumps, either or all of which may be called into use if necessary. Upon this side the banks are terraced, and part way down from the top of the bank a ditch is dug—extending U form from the beginning of the approach—the full length of the bank on each side and with a fall toward the tunnel. At the lower end of the U near the tunnel entrance a sewer connection gives sufficient fall for the water to flow to the river, thus lightening the work of the four-inch pumps. The capacity of the four pumps in this section is a total of 3,000 gallons per minute.

It will thus be seen that the drainage of both approaches is independent of the tunnel. The tunnel system is quite simple, and owing to the perfection of the tunnel work, but little water is required to be raised. We are informed by Mr. Hobson, the designer and builder of the entire tunnel, that with the exception of what little would be driven in to the ends of the tunnel by a slanting rain storm, there is not much more than the natural condensation upon the sides of the tunnel. Although this section covers a length of 6,026 feet, its drainage is provided for at the lowest slope of the tunnel by two pumps, as shown in the cut, one on either side of the tunnel, upon a bracket bolted to the rings, with the suction pipes curved against the side of the rings, and extending to the center of the track. These pumps are of the capacity of 500 gallons per minute. They are operated very ingeniously and without being at all objectionable in the tunnel. At the commencement of the work on the tunnel a trial shaft was sunk near the river bank, and this shaft now serves the purpose of receiving the steam pipe, exhaust pipe, and discharge pipe of the pumps and engines.

In making the plans for this great drainage work, the meteorologist of the Canadian government was consulted as to the records of the heaviest known rainfalls, and due consideration was given to all other available data. The average annual rainfall of the State of Michigan, and of all that section, has been for several years considerably below that of the sea coast in the vicinity of New York, but it is not the average rainfall so much as the sudden, heavy storms which require such extensive provision for the quick disposal of the water. The heaviest rainfall ever known in New York was in September, 1882, when the precipitation was just over six inches in depth during twenty-four hours, and during three days the fall was fifteen inches. Taking the rate for the day in which the fall was heaviest, a similar rain upon the fourteen acres for which this drainage system has been established at Sarnia would give only 2,280,936 gallons of water to be disposed of, which is not half the quantity whose removal is positively provided for at Sarnia in any twenty-four hours.

Oil Fires.

The *Engineering Magazine* for November contains a number of excellent articles. Among them is one by Edward Atkinson, in which some very practical and wholesome lessons are given relative to the construction of buildings for mechanical purposes. The following hints on oil fires are also given:

When oil or cotton waste takes fire in shops, one of the first impulses is to throw water upon it. The points brought out by Mr. Atkinson are of importance to all mechanics. He says that one of the largest losses which the insurance company of which he is president was ever called upon to pay was mainly caused by the misuse of a bucket of water. He describes the occurrence as follows:

"In the early evening a mechanic, who was working alone after mill hours near the main gears, dropped his lantern in the slush box, setting fire to the grease and lint collected therein. It burned with dense smoke and very little flame. Two or three shovels of sand or a wet blanket would have put it out. But he did what he supposed was the right thing—he threw a bucket of water upon the burning grease. Instantly a fierce flame sprang up to the very ceiling of the basement, passing through the belt holes, setting the mill on fire, which was completely destroyed. I was not then an officer of an insurance company, and I did not at that time take up the subject for investigation. A little later I happened to go to my seaside house with my boys in the early spring. I had not then invented the Aladdin oven, and we undertook to fry some fish on the top of the cooking stove; not being very skillful, we set the fat on fire. I took a dipper and poured some water into the burning fat. Straightway another great flash of flame roared up, singeing my hair and whiskers and reaching the ceiling of the kitchen. I then recalled the incidents of the mill fire, and determined to find out what it all meant."

Mr. Atkinson then consulted Prof. Ordway, of the Massachusetts Institute of Technology, who explained that steam combines with and takes up other gases, its own volume lifting or raising them, thus becoming a carrier of combustible vapor and flame to anything combustible situated over the fire. The best thing to extinguish burning fats or oils or oily waste is sand; and it would be a prudent thing to have buckets of this material standing in shops where flames of this character are liable to originate.

Printers' Roller Composition.

This composition, by Hawkins and Stacey, London, has an affinity for printers' ink, and is free from glycerine, which is a principal ingredient in roller compositions as usually made, but which repels the ink. A composition prepared according to the following formula has been found to answer well in practice: Glue or gelatine, 1 pound; water, 12 ounces; linseed or other suitable oil, 1 pound 8 ounces; treacle or sugar, from 1 pound to 1 pound 8 ounces; calcium chloride or potash, ¾ ounce; powdered resin (if required), 2 ounces. The glue is first soaked in the water and then melted, and the linseed oil (warmed to a temperature of about 150° F.) is then very gradually added and thoroughly mixed with the melted glue. The sugar or treacle is then added to the mass kept at a suitable temperature, and the calcium chloride then incorporated. If a very tough composition be required, the resin (dissolved by heat in a little linseed oil) is to be added. The composition may be made non-absorbent of water by dispensing with the calcium chloride and substituting a similar amount of bismuth carbonate.

A Word to Mail Subscribers.

At the end of every year a great many subscriptions to the various SCIENTIFIC AMERICAN publications expire.

The bills for 1892 are now being mailed to those whose subscriptions come to an end with the year. Responding promptly to the invitation to renew saves removing the name from our subscription books, and secures without interruption the reception of the paper by the subscriber.

Correspondence.

Pure Coal in Oregon.

To the Editor of the Scientific American:

In your answer to inquiry in the SCIENTIFIC AMERICAN of November 7th regarding the finding of a supposed mineral wax at the mouth of the Nehalem River, Oregon, you state:

"The occurrence in quantity indicates the possibility of a . . . lignite bed in the neighborhood."

There are two distinct veins of pure coal found within three miles of the beach where the wax is found, 30 in. and 26 in. in thickness respectively. Both veins are of excellent quality for this coast. The analysis of the 26 in. vein is as follows:

Fixed carbon	54·7 per cent.
Combustible gases	35·1 "
Water	7·2 "
Ash	3·0 "
	100·00

These may be of the lignite age, but hardly a lignite coal. AUG. C. KINNEY.

Astoria, Oregon, November 20, 1891.

Ring Magnets.

To the Editor of the Scientific American:

In the early part of July, 1891, I separated the plates of a compound horse shoe magnet to remagnetize it, and, placing two of the plates on a board, with opposite poles touching, passed the poles of the other plates several times over them. The same process was used, alternately, with all the plates.

On the 13th of July it occurred to my mind that a study of the closed circuit of magnetism, when the two plates were lying on the table, with opposite poles touching, might open the way to some interesting discoveries. This led to an investigation of the old proposition, that a solid steel ring or circle cannot be magnetized in a circular direction. The usual proofs offered to establish this proposition are: (1st) That it has been tested by trial and found to be true, and (2d) that the proposition is self-evident, because there are no points, breaks, or openings for poles in a continuous or solid ring. Not satisfied with extant theories, the writer commenced a series of experiments in order to be able to demonstrate clearly and positively that the proposition is true, or to show, beyond question, that it is false. The result of these experiments fully establishes the counter proposition, and decisively proves that *a solid steel ring can be circularly magnetized.*

The first step was to have a flat steel bar, one-half inch wide, three-sixteenths thick, and twelve inches long, bent edgewise into a circle, and the two ends solidly welded. While hot and soft, it was sawn at two opposite points, on the flat side, more than half way through its thickness, that it might the more easily be cut into two semicircles, when cold, and after an attempt had been made to magnetize it. Then, when separated, if the two semicircular parts were not magnetic, the old proposition would be confirmed. If, on the contrary, any polarity, however feeble, could be observed, acting longitudinally, in the severed pieces, this would be irresistible evidence that the ring had been magnetized.

For obvious reasons, that ring has not yet been divided into two pieces. At each of the marked places, magnetism developed into a corresponding pair of poles, with power sufficient to take up and hold in suspension an eightpenny nail. This settles the question.

Instead of two, had several partial cuts been made in the ring, at each of them polarity would have appeared. The magnetic current passes through every atom of the metal, and only requires an opening to develop its presence. Further trials have revealed the peculiar fact that widening the cut within given limits, not indefinitely, increases the power. It has also been ascertained, by preparing a second ring, that one single cut develops more magnetism than each of two or more.

Pushing the investigation onward, as new paths for exploration came into view, another ring was prepared, similar to the first and second, except that it was not welded. The two ends were nicely dressed and brought into close contact, so as not only to touch but to press tightly together, by the elastic force of the steel. This ring, as were the others, was left untempered, except at the two ends, where it was made very hard. When magnetized, it possessed extraordinary attracting power, at the ends or poles. By a simple device they were made to separate or touch at pleasure. When the opening was from a sixteenth to an eighth of an inch wide, the magnet would lift more than three times its own weight. A ring magnet is certainly stronger than that of any other form, and yet I have never before known that shape to be used. If a number of such plates or rings were bolted together, they would make a surprisingly effective compound magnet.

THOS HENDERSON.

Black Horse, Md., July 21, 1891.