THE RAPID TRANSIT TUNNEL.

Work on some sections of the Rapid Transit tunnel is so advanced that it is now possible to get a good idea of the appearance of the inside of the tunnel as it will look when completed. The accompanying photographs were taken on Broadway at 135th Street, at the point where the long viaduct, by which the tracks will be carried across the Manhattan Valley, intersects the northern slope. The subway at this point has been built in an open excavation, and our illustrations were taken when the steel bents had been placed in position and before they had been walled in with a covering of concrete.

The whole of the subway and tunnel construction is to be of absolutely waterproof construction, and some description of this waterproofing and of the concrete filling will be of interest. The floor consists of a layer of concrete which varies in thickness, being 8 inches upon rock, and thicker when it is laid upon a loose or moist formation. Above the 8 inches of concrete is spread a layer of waterproof material, which is put down in the following manner: After the 8 inches of concrete has been carefully smoothed off, a layer of hot asphalt is spread upon it, and upon this is rolled down a sheeting of felt. Then follows another layer of asphalt and felt, the layers varying from two to six, according to the dampness and general characteristics of the surrounding material. Above the waterproofing is another layer of concrete, in which are laid the tracks and the stone or concrete footings for the columns and I-beams which support the roof and sides of the tunnel. The steel framework, as shown in the engraving, is made up of transverse bents, consisting of built-up columns, spaced 5 feet apart longitudinally and 12 feet 6 inches apart measured in the direction of the tunnel. The top member of each bent is a heavy I-beam. The wall posts also consist of I-beams, and angle iron knee-braces are riveted at the upper angles formed by the junction of the center and side columns with the roof to give lateral stiffness to the whole framework. The spaces between the I-beams of both the wall and the roof are filled in with concrete, which is smoothed off flush with the outer flanges of the metal. Immediately upon the flanges and the outer surfaces of the concrete filling as thus finished off is placed a complete layer of asphalt and felt waterproofing similar to that used in the floor as above described. After the felt has been put in place an outer layer of concrete whose thickness is determined by the nature of the excavation is carefully rammed in place. The subway as thus finished is inclosed in a waterproof envelope, which extends entirely around it.

The two interior views of the subway which we present are taken at the point where the masonry viaduct which forms the abutment of the steel viaduct across Manhattan Valley commences. This viaduct, which will be located about a thousand feet east of the Riverside Drive viaduct, will consist generally of plate girders carried upon braced towers, except across Manhattan Street, which will be spanned by a single elliptical arch of handsome design.

The engineers and the majority of the contractors of the Rapid Transit Commission are to be congratulated upon the progress which is being made. With a few exceptions, such as the section along Forty-second Street, the work has been opened up from Duane Street to 181st Street on every mile of the route, and for long stretches the excavation is practically continuous. In several sections the steelwork is in course of erection, and the concreting is keeping pace with it. The two deep shafts at 167th and 181st Streets are down to grade, and the drifts are being pushed forward. Steel is on the ground in sufficient quantities to keep the erecting gangs busy; and altogether the prospects of completing the tunnel on contract time are promising.

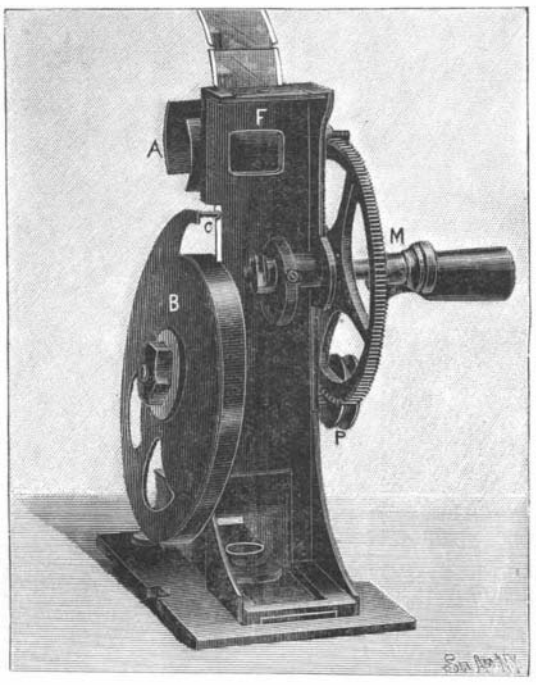


Fig. 1.—THE MIROGRAPH ACTUATING AND OBTURATING MECHANISM.

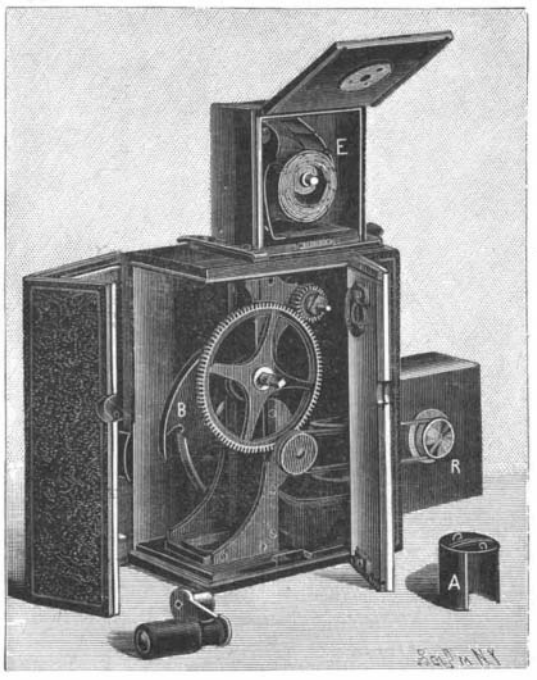
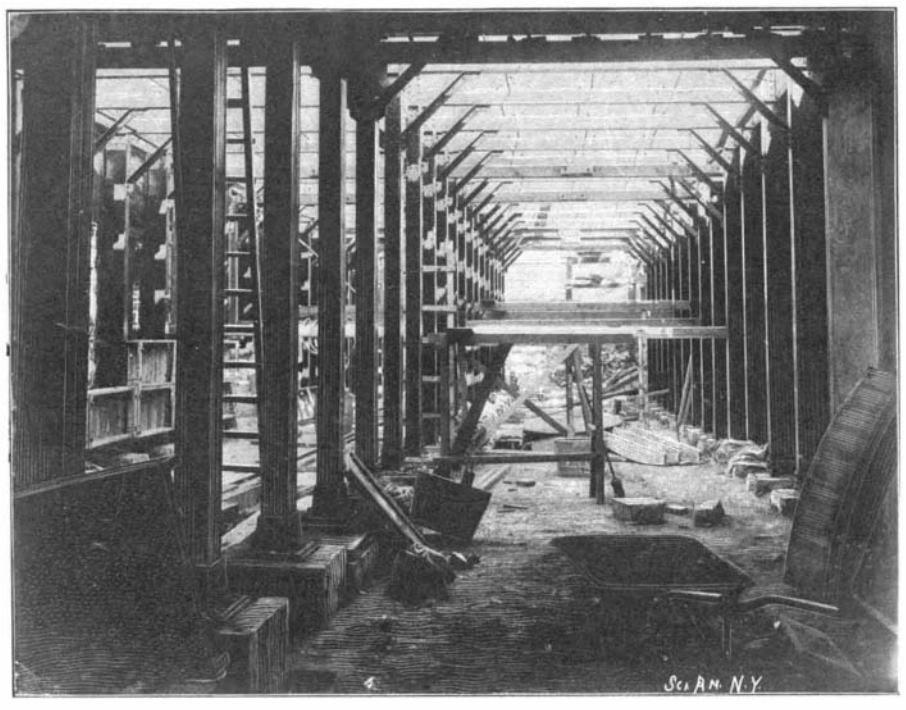


Fig. 2.—THE MIROGRAPH ARRANGED FOR TAKING A PHOTOGRAPHIC NEGATIVE.

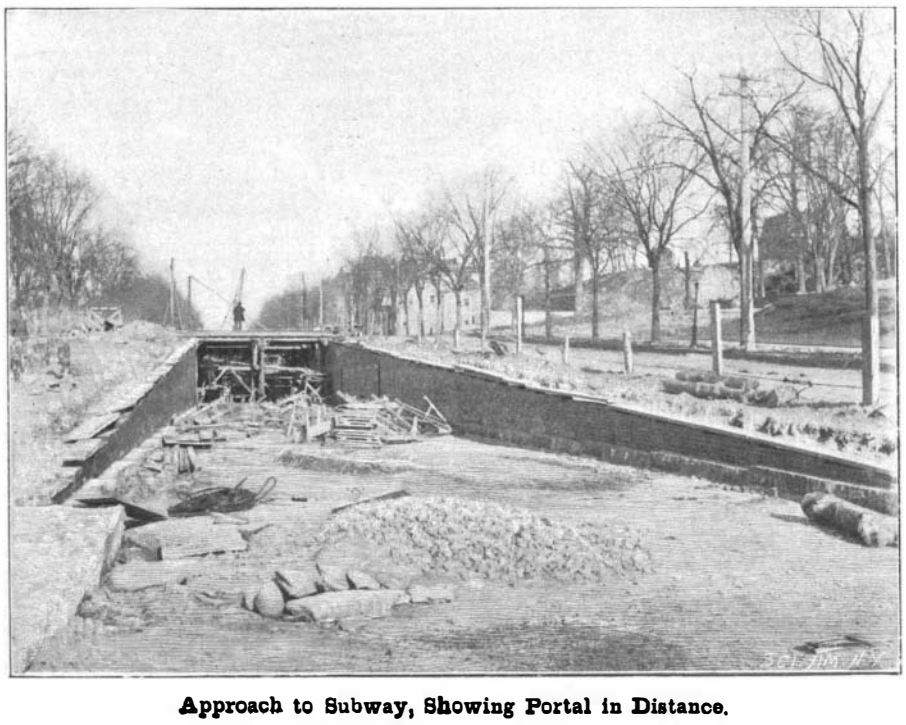
THE MIROGRAPH.

It would require a volume to set forth all the solutions that have been proposed for the problem of intermittently actuating the films of cinematographs. None of the devices invented, we think, is simpler than the "Mirograph" of MM. Reulos and Goudeau. The actuating mechanism, according to La Nature, consists of a disk, *B* (Fig. 1), the circumference of which is provided with a flange, *C*, at right angles with it. This disk is mounted on a central horizontal shaft driven by a crank, *M*. The flange, *C*, is not completely circular. For three-quarters of the circumference every point is equally distant from the shaft. After the three-quarter point the flange gradually approaches the center. From this arrangement it follows that the two ends do not meet, but are located on the same diameter, about 0.01 of a meter apart (Fig. 2). This is what constitutes the principle of the invention. The film is not perforated, but is provided with notches on each side at the level of the line of separation of the images, which notches are engaged by the flange, *C*, of the disk. The film will remain immovable as long as a notch is in engagement with the circular part, but when the eccentric part is brought into action a forward movement will result equal to 0.01 of a meter; that is to say, to the width of the image. The film having moved forward through this distance, the notch escapes the eccentric extremity, but the other extremity immediately engages the following notch. Then, as the disk continues to rotate, the film is intermittently fed along.

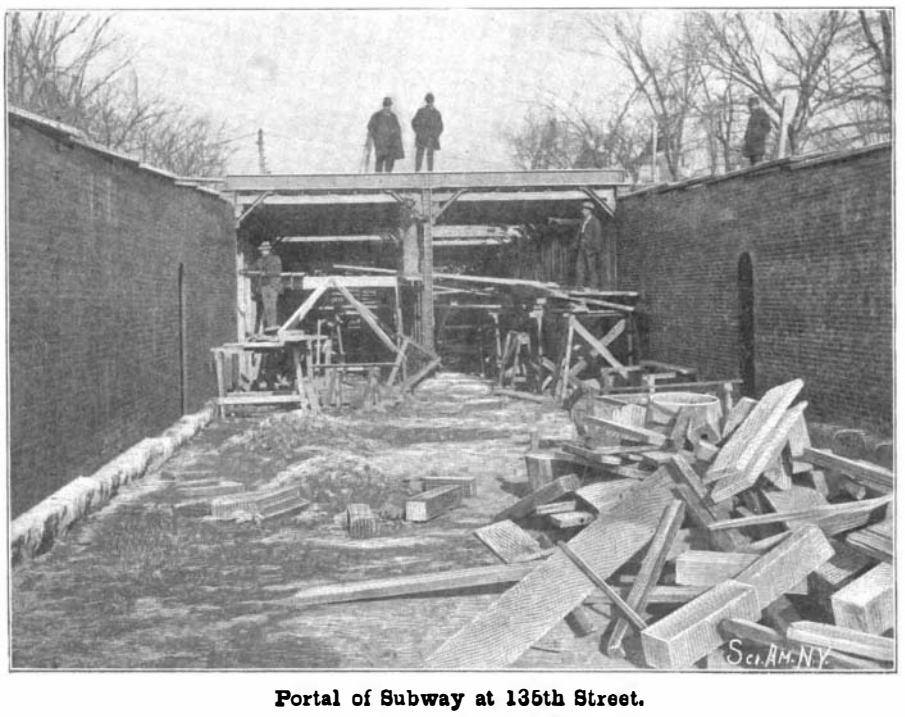
The rotary motion is not given directly to the disk, *B*, but through the medium of gearing connecting the crank and the disk-shaft (Fig. 2). The gearing comprises a spur-wheel engaging two pinions, the lowermost of which is keyed upon the shaft of the disk, *B*, and the uppermost of which carries the shutter. The shutter, *A* (Fig. 2), consists simply of a tube having cutaway portions situated opposite each other. The shutter is placed horizontally (Fig. 1) against the opening, *F*, behind which the film passes. In its revolution the shutter presents its closed and open part alternately. The size of the pinions is such that the open part of the shutter presents itself opposite the opening during the inoperative position of the



Interior View, Showing Steel Framing Before Concreting.



Approach to Subway, Showing Portal in Distance.



Portal of Subway at 135th Street.

PROGRESS OF THE NEW YORK RAPID TRANSIT TUNNEL.

film. This mechanism, which is but 5 inches in height, 4 inches in length, and 2 inches in width, is mounted upon a metallic plate which can be employed in different apparatus for taking a negative, for looking at the image directly, or for projecting an image in a highly magnified form.

The arrangement for making negatives consists of a box which may be hermetically closed (Fig. 2). Upon one of the sides the objective is fixed at such a height that a sharp image may be formed at the opening, *F*, behind which the film passes. The shutter is placed between the objective and the film. The sensitized film, which is 20 feet in length and ¾ of an inch in width, is placed in a box, *E*. Two slots are provided for the passage of the extremity of the film, which is secured to the actuating mechanism and to the shaft of a pulley carried by a second box, *R*, fixed near the bottom of the apparatus. A small belt connects this pulley with the actuating mechanism and facilitates the winding up of the part that has been exposed. For printing the positives, the same arrangement is used, with the difference that the negative and an unexposed film are brought in contact with each other. If it be desired to examine a positive film without the necessity of making a projection, the mechanism is taken from the photographic apparatus and placed in the microscope. This is a wooden box, upon which is mounted an optical arrangement that brings the line of sight opposite the opening, *F*. The film is wound up at the upper part, and in unwinding causes the images, slightly magnified, to pass under the eyes of the observer.

For projection, the mechanism is arranged in front of the condenser lens of an ordinary lantern, and an objective of wide aperture is placed on the other side in a special mounting. The shutter used in making the negative is removed, and in its stead a shutter having a larger aperture is used. Owing to the wide aperture of this shutter, the image is lighted for a comparatively long time, and with a four-wick kerosene projection lamp of the ordinary type a fairly bright image one meter square is obtained. If an oxyhydrogen or electric light be used, it is possible to obtain large dimensions. In all cases the image obtained is very steady. The Mirograph is essentially an apparatus for the amateur.

New Railroad Lines in the Caucasus.

The Committee of Public Works, which is under the direction of the Minister of Transports, has authorized the construction of three new railroad lines in the Caucasus region, of which a description has been recently given in the Torgovo-Promychlenaia Gazeta, one of the Russian official organs. The shores of the Black Sea, an agricultural and mining region, have scarcely any roads, and, on the other hand, but little transportation is carried on by boat, owing doubtless to the poor arrangements of the ports and the violence of the tempests which occur on the Black Sea, which is very deep in these regions. At present a road is in construction, but the Russian government, judging this to be insufficient, has decided upon the construction of a line of railroad uniting the port of Novorossiysk to the Transcaucasian railroad. The line will start from a point between the stations of Dinskaia and Stanitchnaia, on the Vladicaucasus railway, passing by the stations of Bjedoukovsk and Tchernigoff; it will traverse the Caucasus range by the Maikope route and will pass along the coast as far as Soukhoume-Kalé, which at present will be the final station.

The total length of the railroad will be about 28 miles. There is besides a project for a prolongation of the line from the last-named station to that of Novo-Senaki, on the Transcaucasian, a distance of 80 miles. This route will shorten by 450 miles the distance between Tiflis (the capital of the Caucasus district) and Rostoff, on the river Don, the port of the Azof. The line, which is of standard gage, will besides supply the coal mines of Tkvartchelsk, which belong to the government. For this line a company is to be formed with a capital of $13,000,000. The second project is that of the Kakhetie railroad, which is to have a length of 110 miles and will pass through the wine-growing regions of Tsimondal and Kakhetie. It will start from a point near Tiflis and pass through several towns, ending at the village of Sakobo; it may possibly be continued to the station of Evlakh, on the Transcaucasian. An annual traffic of 190,000 tons is expected.

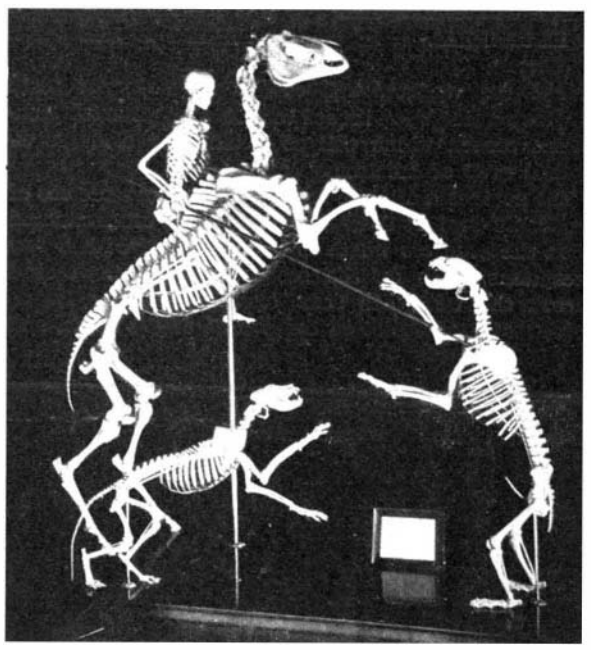
The total cost of the line, including rolling stock, is estimated at over four millions, which the promoters of the project, Prince Tchavtchavadjé and the engineer, Simberg, expect to realize by an issue of shares. The third project concerns a railroad which will supply the mines of Sadonsk and the metallurgical works of Alaguir, in the northern Caucasus. It will traverse the military regions of the Cossacks of the Terek, inhabited also by the tribe of the Ossetines. Starting from the Vladicaucasus line, the new railroad will pass the gorges of Ardone, through a flat agricultural region formed of a fertile black earth, then crosses the river Argone and passes through an important forest region, situated at the foot of mountains, which are very rich in argentiferous lead ores, copper, and especially zinc ores. Up to the present, the bad state of the roads did not permit an active working of the Allaguir mines, conceded by the government to a company of the same name. These mines are, however, very rich, and it is estimated that they contain 1,640,000 tons of argentiferous lead and 6,500,000 tons of zinc ores.

To Recognize Erased Writing.

In examining hand-writing, Comphuis, army-apothecary at Malang, Dutch East India, succeeded in making erased letters reappear by means of silver nitrate solution. Where an erasure was suspected, a one-tenth normal silver nitrate solution was applied and exposed to direct sunlight for a short time. The letters appeared on the resulting black back-ground. The cause is probably ingredients contained in the ink, which retard the reduction. In the reducing of the silver nitrate solution, impressions of the hands, etc., were also plainly visible.—Pharmaceutische Centralhalle.

AN INTERESTING GROUP.

This group represents a fight between a mounted Indian and his dog and a grizzly bear. It was arranged by Mr. Charles H. Ward, of Rochester, N. Y., who secured the skeletons and mounted them in positions which the man and animals would assume in a contest at close quarters. The bear reared upon his hindpaws and prepared to strike down the horse with his forepaws, while the dog is in the act of springing upon him. The Indian has charged with his spear,



A SKELETON COMBAT GROUPED BY C. H. WARD.

which is pointed at a vital part of the bear. This is believed to be the first bear hunt in bones ever arranged.

One of His Educators.

This is the time of the year when the editor's heart is gladdened by frequent manifestations of what might be termed the personal side of the relations between himself and his readers; who frequently avail themselves of the opportunity offered by the renewal of the year's subscription, to insert a few sentences appreciative of the SCIENTIFIC AMERICAN, or a significant statement of the lengthy term of years during which they have been on the subscription list.

Among this year's letters of "renewal" was one from one of our youngest, not our oldest subscribers, in which the writer, who, by securing a new subscriber, had earned our $2 premium, stated that the SCIENTIFIC AMERICAN was a Christmas present to his son, and requested that we comply with the boy's suggestion that copies of the SUPPLEMENT be sent to him in lieu of the advertised premium. The letter proceeds: "When our son was nine years old, a copy of the SCIENTIFIC AMERICAN found its way to our house, and from that time he never let up on us until we subscribed for it for him. He is but fifteen years old; very fond of reading, and with a mind but for two studies, electricity and chemistry. We live in an isolated farmhouse, too far from schools, and the paper is one of his educators. He is very anxious to take the SUPPLEMENT, but we feel as if we cannot afford to give it to him yet." It is needless to say that we were most pleased to accommodate our young Oregon subscriber.

The Tiffany Exhibit at the Paris Exposition.

In our issue of October 6, 1900, there was an illustration of the mineral exhibit of precious stones by this company. The fact that there was a still larger exhibit by the same company of the highest type of American jewelry, silverware, etc., in a special pavilion in the Liberal Arts was inadvertently omitted.

Electrical Notes.

The first regular meeting of the Roentgen Society of the United States opened December 13, in the Grand Central Palace, New York. About two hundred delegates were present, besides the members from New York.

The authorities in Paris have called the managers of the Underground Railway to account, and they have been fined for permitting the cars to be crowded beyond their seating capacity. The decision stated that American methods would not be allowed to prevail in Paris.

The French Telegraph Department proposes to institute a series of experiments with wireless telegraphy for subterranean communications. The possibility of the scheme was first suggested by one of the inspectors of the department, who found his primitive trials to give satisfaction. The department intends to develop the idea upon a larger scale.

Wireless telegraph stations are to be erected at Inishtrahull, in the north of Ireland, and at Kildonan, Arran, Scotland, respectively, for the purpose of reporting and signaling vessels at sea. Colonel Hozier, on behalf of Lloyds' committee, has informed the various Glasgow shipowners of the fact, and expects that the installation will be ready for service by the end of January.

The Adriatic Railway Company, of Italy, has decided to equip electrically two branches of the main line down the coast to Brindisi. These branches extend from the main line toward the interior, where the Apennines furnish abundant water power. In the highlands of Italy there is considerable water power which has never been utilized, and it is considered possible to use these falls for the generation of electrical power.

An electric arc lamp capable of taking a current of only three amperes will shortly be placed on the market. It measures seventeen inches in length, and weighs ten pounds. The carbon is only five-sixteenths of an inch in diameter. Hitherto the arc lamp has been utilized only in connection with great candle power, but the constant desire for a small lamp of this description for certain purposes, in place of the incandescent glow lamp which possesses many inherent defects, has resulted in the designing of this miniature arc lamp.

It is contemplated to construct a railroad, similar to the Jungfrau line, to the summit of Mont Blanc. M. Vallot, the Director of the Mont Blanc Observatory, and M. Deperet, Professor of Mineralogy at the Lyons University, in conjunction with M. Fabre, a French engineer, have been engaged for some time past in surveying the sides of the mountain to ascertain a suitable route and the atmospheric conditions. The result of these investigations is the projection of a line probably starting from the village of Houches, on the Savoy side, to the summit, to have a total length of eleven miles. Twelve stations specially constructed to resist the climatic conditions of the neighborhood will be provided. Electricity, to be obtained from the River Arve and the Mer de Glace, will provide the necessary motive power. The plans of the railroad have been presented to the French Minister of the Interior, and it is anticipated that the official permission will be granted, in which event operations will be commenced immediately.

An attempt is being made by several American capitalists to substitute an elaborate and complete system of electric traction, in place of horses, upon the canals of England. The country is extensively intersected by these water thoroughfares, and in the manufacturing districts, owing to freightage upon them being much cheaper than upon the railroads, they constitute the principal means of transit. Mr. Frank Hawley, the vice-president of the Traction Company, has also been surveying the canals of Holland, Belgium, and France, and has sought powers to introduce electric traction thereon. He has traversed over 3,000 miles of canals in all, and the concessions for this radical change have been granted in Belgium, where it is anticipated that the installation will be completed by next year. The whole of the plant is coming from this country. In England the scheme is only in an embryo stage; but in view of the great success which has attended the introduction of electric traction for other purposes, there appears every probability of the company receiving the necessary permission. The company guarantees an economy of 40 per cent in the cost of motive power. They will also sell power to manufacturers, and supply the neighborhoods through which the canals extend, with a cheap source of electric lighting. It is also explained that another advantage of the system will be that the position of any particular boat will always be known, so that the goods will not be lost sight of by the shipper from one end of the journey to the other. Under the present system of horse traction, owing to the location of the boat not being known, goods are often lost sight of for days.