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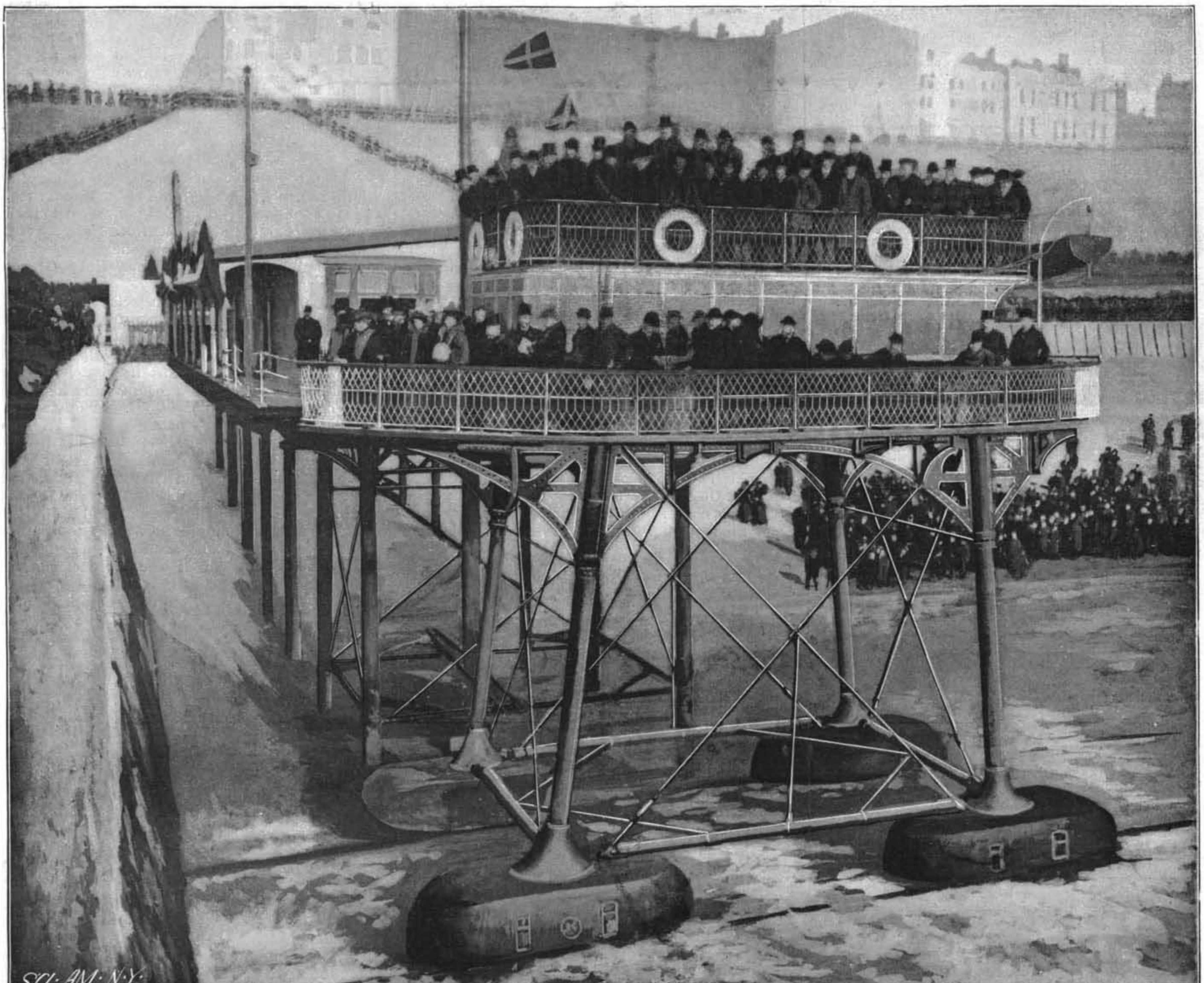
A RAILWAY THROUGH THE SEA.

A small seashore tramway has for some years been in operation at Brighton, a center rail being employed to carry the electric current. Mr. Magnus Volk is the proprietor of this small tramway, and its success led him to seek means of extending it to Rottingdean. The distance of this place from Brighton may be only three miles to a crow, but to an ordinary mortal it is a goodly four. There were difficulties in the way of extending the system as it stood. Owing to the foreshore between Brighton and Rottingdean being for the greater part of 24 hours covered by water, it appeared that the best many ingenious features which are interesting to engineers.

The chief peculiarity of the track is the employment of four rails, and when the tide is down, and the lines uncovered, it has the appearance of double lines of exceedingly narrow gage. The line consists of four rails of 54 pounds to the yard, the distance between the two outside rails being 18 feet, which gives an idea of the width of the car. In laying the track there were many difficulties to overcome, the fact that work could only be done when the tide was down, coupled with the possibility of the incoming tide undoing what had been gage of 18 feet, ought to give sufficient stability. The tops of the main legs carry lattice girder work, on which the main deck is erected, the whole structure being braced together by means of cross ties. Before passing on to speak of the means of driving, it will be interesting to refer to the upper part of the structure. The idea of Mr. Volk and his assistants has been apparently to reproduce, as far as possible, the special features of a pleasure yacht, for the main deck appurtenances and erections are carried out as one would expect to find them on a model steam yacht. Indeed, they go so far as to carry a small boat and a supply of



THE NEW ELECTRIC SEA RAILWAY BETWEEN BRIGHTON AND ROTTINGDEAN, ENGLAND.

way of constructing a line would have been to take it over the cliffs. After careful consideration, however, Mr. Volk determined to use the foreshore at a point slightly above low water mark, but some 14 feet below the sea at high water. As it was proposed to run the cars irrespective of the condition of the tide, it was necessary to provide a vehicle of very special construction. It will be seen from the illustration that the projectors of the line have succeeded in building a car that is totally unlike any other form of movable structure, not excepting even the ark. The important characteristic of the vehicle is a structure half boat and half car, which is mounted on four long legs, at the end of which are the wheels.

Although the railway which has been just completed at Brighton will have no important bearing on the question of electric traction, still the system presents done, gives an indication of the nature of the operations. The rails are securely fastened to concrete blocks placed every few yards, by means of steel clips and bolts, the bolts passing through oak blocks placed between the rails and the concrete. Tie rods are used every ten feet on the straight and every five feet on the curves, heavy angle fish plates being used for the rail joints.

The feature of the system is the car, which is furnished with 16 wheels. Each leg of the car is mounted on a four-wheel bogie, and the wheels of the bogie run on the narrow gage line. It will be noticed that the bogie trucks are shaped like a double-ended boat, to facilitate passage through the water, besides removing obstructions from the lines. The four bogies are firmly held together by steel tubular struts. The wheel base is about 28 feet, and this, combined with the effective life buoys. The main deck is about 50 feet in length and 22 feet in width. There are iron railings round the deck, provided with wire netting. The center of the deck is taken up by a saloon, which is 25 feet long and 12 feet wide; the interior being furnished and upholstered in a very handsome manner. A second deck has been made on the top of the saloon, and, altogether, the carrying capacity of this car yacht must be approaching 200. As an easy means of enjoying sea breezes without drawbacks, this railway ought to be unrivaled.

Coming to the means of propelling this structure, it ought to be observed, first of all, that electrical energy is conveyed to the car by means of overhead wires, the necessary collection of current being performed by two trolleys of a special type, devised by Mr. Philip Daw-

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A RAILWAY THROUGH THE SEA.

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son. On the car are two 30 horse power motors of the G. E. 800 type, which have been supplied by the British Thomson-Houston Company. The motors are placed vertically over two of the main legs, the armature being connected through bevel gearing to a vertical shaft, which at the bottom is geared through bevel wheels and single reduction gearing on to the axles of the wheels. A reference to plan and section of the gearing arrangements will make the working clear. The controlling devices which are placed on the main deck are very similar to what one finds on a modern tramcar, a G. E. controller being fixed at each end of the deck; the brakes are operated by rods passing down the two unoccupied legs. The generating machinery is erected at the Rottingdean end of the line, the plant being located on a specially constructed iron pier, which serves also as a landing stage; piers have been, of course, rendered necessary at each end of the line. The plant consists of a General Electric Company four-pole railway generator, direct coupled to a high speed double acting engine, made by Messrs. W. Sisson & Company, of Gloucester.

The engines have cylinders 7½ inches and 13½ inches by 7 inches stroke, and are designed to give a maximum speed of 550 revolutions, developing 110 B. H. P. as a maximum; but it has been found that ample current is developed when the engine is running at 525 revolutions.

The engine is supplied with steam at about 120 pounds, through a reducing valve from a marine return tube boiler, W. P. 150 pounds. The object of this arrangement is to allow for the large fluctuation of work, and to permit the boiler to act as a reservoir by means of increase of pressure, and at the same time a heavy draught of steam occurring through sudden and large increase of load is less likely to cause priming.

In the engine house is a switchboard on which an automatic circuit breaker and the usual measuring instruments are arranged. An electric current of 500 volts pressure is delivered direct into the overhead wire, which is suspended partly on steel and partly on wooden posts. At low tide the return is by the rails, and at high water the sea is used, which calls, however, for no special bonding.

We believe the total cost of the line is about $150,000, this sum, however, including the construction of the two piers. Mr. St. George Moore has been the consulting engineer in the undertaking. The severe gales in the early part of December resulted in the complete wreck of the car, the destruction of one of the jetties, and great injury to the track. The damage inflicted by the storm amounted to more than $20,000. The railway had only been opened a week. For our engraving we are indebted to the Illustrated London News, and to Electrical Review for the particulars.

Chicago Main Drainage Canal.

The Chicago Main Drainage Canal, which is now nearing completion, will always be celebrated for the vast amount of machinery for excavation which has been designed and successfully operated during its construction. American ingenuity has never shown itself to better advantage. We have from time to time given some details of this important work, and we will merely recapitulate a few of the leading facts: The canal is being built for the purpose of carrying the sewage of Chicago into the Mississippi River. It is designed so that the waters of Lake Michigan will flow through it at the rate of ten thousand cubic feet per second, and it is expected that the sewage will be so diluted that no possible harm can occur to the towns by which it will flow. It will be twenty-eight miles long, and where it passes through alluvial ground it will be two hundred and two feet wide at the bottom. The material to be taken out is of a widely varying character, ranging from a soft mud, so soft that it can be taken out by pumps, to a mixture of sand, gravel, clay and bowlders which is cemented so firmly as in some cases to require blasting. Much of the excavation, also, is through solid rock. The estimated quantities to be removed are 4,500,000 cubic yards of wet soil, 23,000,000 cubic yards of alluvial and hard soil, and 12,000,000 cubic yards of solid rock, making a total of 39,500,000 cubic yards of excavation.

The excavation of the soil has been carried out almost entirely by the use of steam shovels, the material being carried to the dumping ground by some form of inclined plane or by continuous belts or conveyors. When the material had to be carried farther than 1,000 feet the locomotive was found to be more economical than the stationary engine. After the rock had been blasted, it was taken out by stationary cable inclines, by traveling cable ways, or by cantilever hoists. The traveling cable ways, of which there were nineteen in all, consisted of two wooden towers running on trucks upon the banks, the space between the towers being about 700 feet. Buckets were lifted to the main cable, drawn along and dumped at the sides. The main cable was 2¼ inches in diameter and the buckets were capable of holding about 2 cubic yards of rock. The cantilever crane consists of two connected cantilevers carried on a tower which is arranged to travel upon a track at the side of the canal. The trusses are inclined at 12½°, one arm of the crane projecting over the cutting while the other extends upward over the dumps. The buckets can carry 1¾ cubic yards, and they are suspended from a car which runs along the crane, and is worked by a hoisting engine on the car. This machine can handle about thirty buckets an hour or two hundred and twenty-five loads a day. Perhaps the most effective machines of all were the hydraulic dredges. These were provided with suction pipes which carried vertical telescopic joints and a revolving cutter, which loosened the material at the bottom of the pipe so that the pump could bring it up. The dredger is swung backward and forward by means of ropes attached to the bank.

The excellence of the excavating machinery is shown by the fact that, of the vast total of nearly 40,000,000 cubic yards, the earth is being taken out at a cost, including the contractor's profit, of 29 cents per yard, and the solid rock for 77 cents per yard.

When the long talked of Nicaraguan Canal comes to be built, it will feel the benefit of the magnificent plant which has been designed for the Chicago canal. It is only in the possibility of handling huge earth and rock quantities quickly and at small cost that the great undertaking has any promise of being carried through.

Explorations in Central Asia.

The scientific expedition of M. Clementz, under the patronage of the Russian Imperial Geographical Society, left Urga, in Chinese territory, on May 24, 1895, to explore Mongolia. In June, 1896, they ascended the Otkhon-Tengre, the highest peak of the Hangai range, up to 13,000 ft. or 14,000 ft. above sea level.

Dr. Sven Heding, the Swedish explorer, left Kashgar on December 14, 1895, and made his way by Yarkand and Karghalik to Khotan. Starting from the latter town, he spent nearly five months in exploring the surrounding country, and discovered the ruins of two ancient towns. One of these, of vast size, contains some remains of monuments, the architectural style of which seems to indicate that they are of Indian origin. Then crossing the desert as far as the banks of the Kiria-Daria, the expedition fell in with a small nomadic tribe to the north of this river, so isolated from the rest of mankind that its members did not know whether Yakup Beg still existed or whether they belonged to China. Whole herds of wild camels were also met with, two or three of these animals falling victims to the rifles of the party. On reaching the extreme confines of the desert Dr. Sven Heding found a series of lakes and marshes, which in all probability covered the former bed of Lake Lob-Nor, though the formation of these lakes, as it would seem, only dates from nine years back.

Captain Deasy, of the 16th Lancers, who set out from Kashmir in April last on an expedition to explore the sources of the Mekong and Irawadi, has returned to Leh, in Kashmir, owing to deficiency of means of transport. Captain Welby, of the 18th Hussars, and Lieutenant Malcolm, of the Argyll and Sutherland Highlanders, who started at the same time, have, it is reported, arrived at Lan-chau.

How Much Water Should we Drink.

According to Prof. Allen, says The Medical Times, we should drink from one-third to two-fifths as many ounces as we weigh in pounds. Therefore, for a man weighing 168 pounds, there would be required fifty-six to sixty-four ounces daily, or from one and one-half to four pints. This The Journal of Hygiene regards as a very indefinite answer. The amount of water required depends on the season of the year, the amount of work done, and the kind of food eaten. In hot weather we require more than in cold, because of the greater loss through the skin, though this is in part made up by the lesser amount passed away through the kidneys. If a man labors very hard, he requires more than if his labor is light. A man working in a foundry, where the temperature is high and the perspiration profuse, not infrequently drinks three or four gallons daily. If the food is stimulating and salty, more water is required than if it is bland. Vegetarians and those who use much fruit require less water than those who eat salt fish and pork, and often get along on none except what is in their food. In most cases our instincts tell us how much water to drink far better than any hard or fixed rule. For ages they have been acquiring a knowledge of how much to drink, and transmitting that knowledge to descendants, and if we follow them we shall not go far out of the way. It is of more use to us to know that pure water is essential, and that impure water is one of the most dangerous of drinks, than to know how much of it is required daily. If one lives in a region where the water is bad, it should be boiled and put away in bottles well corked in an ice chest, and in addition, one should eat all the fruit one can, if fruit agrees. Fruits contain not only pure water, but salts which are needed to carry on healthfully the functions of life.

Alfred Nobel.

The scientific world in general and the engineering world in particular has lost a conspicuous member in the death of Mr. Alfred Nobel, the distinguished Swedish engineer, which occurred recently at San Remo, Italy. It would be difficult to find anything which has done more for the world of civil engineering, especially as it is concerned with large and heavy earthworks, than the great variety of explosives which owe their existence directly or indirectly to the genius of Mr. Nobel. In the year 1847 Sobrero discovered that by acting upon glycerine with a mixture of nitric and sulphuric acids a highly explosive substance was formed. Nobel was the first to make use of this liquid in its original state; but it was extremely dangerous in operation, and very soon fell into disuse. After careful experiment, the author of this sketch, in 1864, patented an explosive, which is known by the name of dynamite, and in this substance he rendered nitro-glycerine safe for transportation as well as for blasting.

His patent says: "The invention relates to the use of nitro-glycerine in an altered condition, which renders it far more practical and safe for use. The altered condition is effected by causing it to be absorbed in porous, unexplosive substances, such as charcoal, silica, paper, or similar materials, whereby it is converted into a powder which I call dynamite, or Nobel's safety powder. By the absorption of the nitro-glycerine in some porous substance it acquires the property of being in a high degree insensible to shocks, and it can also be burned over a fire without exploding."

The substance commonly used for absorbing the nitro-glycerine is an infusorial earth. Mr. Nobel erected very extensive works at Ardeer, in Scotland, which for many years were the chief source of supply for the new explosive.

Following upon the invention of dynamite came the gelatine explosives, in which a soluble form of guncotton or nitro-cellulose is dissolved in nitro-glycerine. The first patent for this kind of explosive, which was known as blasting gelatine, was taken out by Nobel in 1875. This explosive was stronger than dynamite in the relation of 1·4 to 1. Nobel subsequently took out patents for various mixtures of blasting gelatine with wood pulp, nitrate of potash, etc., which are known as gelignite, gelatine dynamite, etc., and these later compounds have almost entirely taken the place of dynamite for general blasting operations.

It is estimated that there are considerably over one hundred different kinds of dynamite to-day whose base is derived from nitro-glycerine, and all of these are derived from Mr. Nobel's original dynamite, or from blasting gelatine.

Mr. Nobel next invented ballistite, first of the nitro-glycerine smokeless powders. This was composed of a mixture of the soluble and insoluble forms of nitro-cellulose, together with nitro-glycerine, the composition of this explosive being now given as one-half soluble nitro-cotton and one-half nitro-glycerine. Ballistite is of darkish brown color and usually is made in the form of small squares. It is used in Italy as the service powder, and it has a good reputation among the artillerists.

Mr. Nobel was a prolific inventor, and he did not confine himself to the production of new explosives. Among other things, he experimented with aluminum as a material for boat building. The industry which grew out of this invention has assumed exceedingly large proportions, and the factories of the Nobel Company, at Ardeer and at Polmont, are spoken of as being the largest in the world, a great variety of explosives, such as dynamites, blasting explosives, and both ballistite and cordite, being extensively manufactured. The Nobel Company also own several factories on the Continent of Europe.

Death of R. W. Fenwick.

Mr. R. W. Fenwick was stricken with apoplexy in a Washington, D. C., street car on December 28, dying immediately. Mr. Fenwick, when sixteen years of age, began the study of mechanical drawing and engineering with William P. Elliott, the architect of the Patent Office. He studied the patent business in the offices of Munn & Company, and eventually became the manager of the Washington branch. In 1861 he started a patent law and soliciting business of his own. He was associated with Judges Lawrence and Mason. In his long practice Mr. Fenwick had charge of many important cases and he was an acknowledged authority upon the history of patent laws. When the centennial of the American patent system was celebrated, he was chairman of the committee of arrangements. He also held important civic offices.

Capt. Mahan Retired.

Capt. Alfred T. Mahan, U.S.N., who is known as one of the foremost writers of the world on naval topics, has been placed on the retired list of the navy at his own request, under the law permitting retirements after forty years' service. Capt. Mahan desires to devote his entire time to the literary work in which he has been so successful.