

**BUILDING THE NEW BEACHY HEAD LIGHTHOUSE.**

BY HAROLD J. SHEPSTONE, LONDON, ENGLAND.

The new lighthouse which the Corporation of Trinity House are erecting off Beachy Head, on the English south coast, is an interesting piece of work on account of the scientific manner in which it is being carried out. The lighthouse is being erected in the sea, some 550 feet from the base of tall cliffs. There is a lighthouse on the famous promontory, but owing to the encroachments of the sea at this particular spot, and the additional fact that the light from the present lighthouse, some 400 feet above the level of the sea, is frequently capped by fog, the Corporation decided, as far back as 1899, to abandon the present station and erect another structure in lieu of it on the fore-shore beneath the famous cliffs.

The coast was thoroughly surveyed and at last a site was chosen. Curiously enough, a large steamer was wrecked not many months ago on the very spot selected and became a total wreck. The site is some 550 feet from the toe of the cliffs and at high tide is covered to a considerable depth. This makes the work doubly interesting, for there is a wonderful difference between erecting a structure on a wave-washed rock and on land.

First of all a temporary staging was erected close to the selected site and this, in turn, was connected with a workyard at the top of the cliff by a wire cableway, which was built from designs prepared by Mr. Thomas Matthews, chief engineer to the Corporation of Trinity House, and Mr. W. T. H. Carrington, engineer to Messrs. Bullivant & Co., who supplied the necessary material for the erection of the cableway. The ropeway is constructed on Bullivant's system No. 5, in which the descending load draws the ascending load up, a system which can easily be carried out when there is a gradient of at least one in fifteen. In the case of the line under notice the arrangement was necessarily modified in order to provide for bringing up workmen when no materials are ready to send down. Steam power is then resorted to, connected in such a way that the brake gear can be moved around by it.

Our illustrations convey a good idea of the ropeway and what it is capable of accomplishing. There are two fixed ropes, stretched parallel between the two points, 860 feet apart. One has a circumference of 6 inches and the other 5½ inches. The former has a breaking strain of 120 tons, and the latter 100 tons. These ropes terminate at a massive wooden trestle erected in the workyard on the cliff tops, carrying tension bars fitted with thimbles suitably supported in brackets on its summit, to the outer thimbles to which the ropes are attached. The strain is transmitted through tension bars to tiebacks in the rear of the structure, so that the fixed ropes, at the point where the strain is most severe, are not subject to any bending action.

The ropeway is carried back some little distance to the rear of the structure and anchored in the hard chalk in the sea bottom. It was found that the staging was not strong enough to take the necessary strain. The tightening is accomplished by an arrangement of two screws combined, so that when the tightening is effected by one screw the other acts as a fulcrum and reduces by one-half the strain necessary to apply on the screw for tightening purposes. This tightening gear with a drift of about 8 feet is carried on a strong wooden frame placed on the staging, and advantage is also taken of this frame to carry suitable lead-on pulleys and a turn-round wheel, round which the return hauling rope passes.

This unique aerial ropeway has now been working efficiently for some twelve months. It is used every day, and during the early stages of the work often at night. Some heavy pieces of machinery, such as pumps, a steam engine, crane, etc., as well as large quantities of cement, shingle, etc., have been safely sent down to the temporary landing stage. The stones, the heaviest loads, always descend on the 6-inch rope, and on the parallel rope a balance load is run which the stones descending draw up, thus considerably reducing the necessary brake power. This arrangement is necessary only in the transport of the stones and very heavy loads; for the transport of lighter loads, each rope is used indiscriminately.

The brake gear consists of two 8-foot diameter wood grooved wheels, each fitted with a brake sheave. As it is desirable that the brakes shall be worked by a man who has a full view of the movement of the carriers, chain wheels are fitted to the screw spindles

which operate the brakes, and other chain wheels with hand wheels are fitted to the trestle frame, communication between the two being effected by a chain which is provided with tightening gear. The hand wheels are placed close to one another, so that when the brakeman is operating the ropeway with one brake he has another immediately in reserve should anything fail. The hauling rope, passing round the upper brake wheels, returns and passes round a tension wheel 8 feet in diameter, then again returns to the brake gear, passes round the lower brake wheel, and in its turn is led to the head wheel and down to the carrier, to which it is connected. A portable railway has been erected to bring the stones from the depot to the cableway, and a moving platform has been devised to assist in the operation. As soon as the blocks of granite are shackled to the carrier, the moving platform with its truck descends into a pit to allow the stone to pass down without touching it.

The lighthouse site is a little to the left of the base of the temporary staging, and the first thing the authorities did was to erect a dam around the foundation, in order that work could go on for a considerable time after the tide had commenced to rise. The moment the water begins to overflow the dam the men take shelter on the temporary staging. They can resume work long before the tide has receded from the surrounding shore, by pumping out the water. All tools and movable machinery are, of course, transferred to the landing stage the moment the water commences to flood the dam. It is interesting to note that the foundations of the new lighthouse are laid at a depth of 10 feet under low water in hard chalk, which is entirely different in character to the



MASONRY OF THE BASE AND LANDING OF BEACHY HEAD LIGHTHOUSE.

friable chalk of the cliff. A comparison with charts fifty years ago shows scarcely any difference in the formation of the shore.

As previously stated, the new lighthouse will be of the same kind of granite that was used in the construction of the present Eddystone Lighthouse, and also in such notable structures as the Tower Bridge, Blackfriars Bridge and the Thames Embankment. Before the granite is dispatched to Beachy Head it is not only cut to size, but built up in sections to see that the blocks fit into one another. This is the course generally adopted in the erection of all lighthouses in the sea. The course is what is termed dry-fixed on a platform specially prepared for it. In the present case it is built up in sections at the quarries and inspected before it is sent on to Beachy Head. The top course is then refixed on the platform and courses built upon it, this process continuing until the whole of the lighthouse has been temporarily erected on shore.

To the top of the masonry the new lighthouse will measure 123½ feet, and to the top of the lantern 153 feet. Altogether there will be seventy-six courses. Up to the twenty-sixth course the stones have a depth of 1 foot 10 inches, while after that they are only 1 foot 6 inches deep. The whole of the stones are dovetailed wherever they meet, and these joints are filled in with cement, thus making the tower as firm as if it were in one solid piece. The same unique system of dovetailing is being carried out as was resorted to in the erection of the present Eddystone Lighthouse. Before the stones are dispatched to Beachy Head they are numbered—say 13/5, which means that it is the thirteenth block in course No. 5 from the bottom. The system of erection and numbering is shown in the accompanying cut. Altogether

50,000 cubic feet of granite will be required for the new lighthouse, and 1,300 cubic yards of concrete hearting will be required to fill the center of the lower courses.

At its base the tower will have a diameter of about 47 feet and will be solid for about 48 feet, with the exception of a space required for the storage of water. Where let into the chalk the tower is cylindrical in form and continues so for a height of 9 feet 2 inches. Above this level it is a concave elliptic frustum, the generating curve of which has a semi-transverse axis of 158 feet and semi-conjugate axis of 44 feet. Outside of a portion of courses 5 to 19 is fixed the ashlar which forms the landing. There are nineteen of these courses with sixteen steps up to the top. This will be all filled in with concrete and paved with granite sets with a strong granite curb fixed all round the top.

Above the solid portion are the necessary rooms, eight in number. They commence at course No. 26, the entrance room. Then come the oil-room, crane-room, store-room, living-room, bed-rooms, and service-room. The four upper ones are 14 feet in diameter. The living-room will be fitted up with every convenience for the men, while they will also be able to pump up water to the tank in the living-room.

A dioptric apparatus will be installed in the lantern, giving flashes of about 83,000 candles' intensity. Steamers will easily recognize the light by its two white flashes every fifteen seconds. The beam of light will be visible for seventeen miles out at sea, which is the average distance to which the lights of all British lighthouses now penetrate. The clock to regulate the flash is wound by hand, the weight rising and falling in a tube in the center of the lighthouse. The apparatus will rotate in a mercury trough of the usual modern pattern.

At the time of writing this article the work has reached what is known as course No. 20. It is being rapidly pushed forward, although it is doubtful if the station will be finished before next season. Considering the nature of the undertaking, the work has gone on very smoothly, principally no doubt through the scientific manner in which the builders went about their task. When completed the Beachy Head lighthouse will be one of the finest on the English coast.

#### Scent.

It should be remembered that the basis of all perfumes is an essential oil of some kind, derived either naturally from flowers or leaves or artificially by a synthetic process, says The Lancet. In either case the essential oil is a powerful antiseptic and possesses disinfecting properties not less in degree than those of carbolic acid itself. As is well known, the essential oils absorb atmospheric oxygen, forming an unstable compound easily lending oxygen for

the work of purification. Pine oil, eucalyptus oil, and turpentine act readily in this manner—a fact which probably accounts for the salubrity of the air of pine forests and eucalyptus woods. The use of scent by many women is excessive, and by men is looked upon as effeminate—a prejudice that we confess to sharing—and yet the question naturally arises: As we study our environment to please the eye by color and natural effects and to please the ear by musical notes, why should we not make similar endeavor to please the nose by agreeable and fragrant odors? Each sense may suffer offense and there is no reason why each sense should not be equally defended in this regard. And the use of scent on the pocket-handkerchief, which is where we commonly find it, is calculated to exercise a higher office than merely to please the sense of smell. The handkerchief may easily prove a source of infection, for it is made to be the common receptacle of secretions from the nose and mouth, and the employment of an antiseptic handkerchief is perfectly consistent with the dictates of common bacteriological evidences. The liberal use of scent on the handkerchief is calculated to make it antiseptic and to destroy the germs in it, owing to the action partly of the spirit of the scent and partly of the essential oils dissolved in the spirit. Before, therefore, we condemn the persons who use scent upon the handkerchief for practising a foppish or luxurious habit we should remember that they may actually be doing good to their neighbors by checking the distribution of infectious materials.

There is a large and increasing consumption of mica in the United States. Clear sheets 4 by 4 inches in size and upward must be provided for the mica to be worth a good price.

# SCIENTIFIC AMERICAN

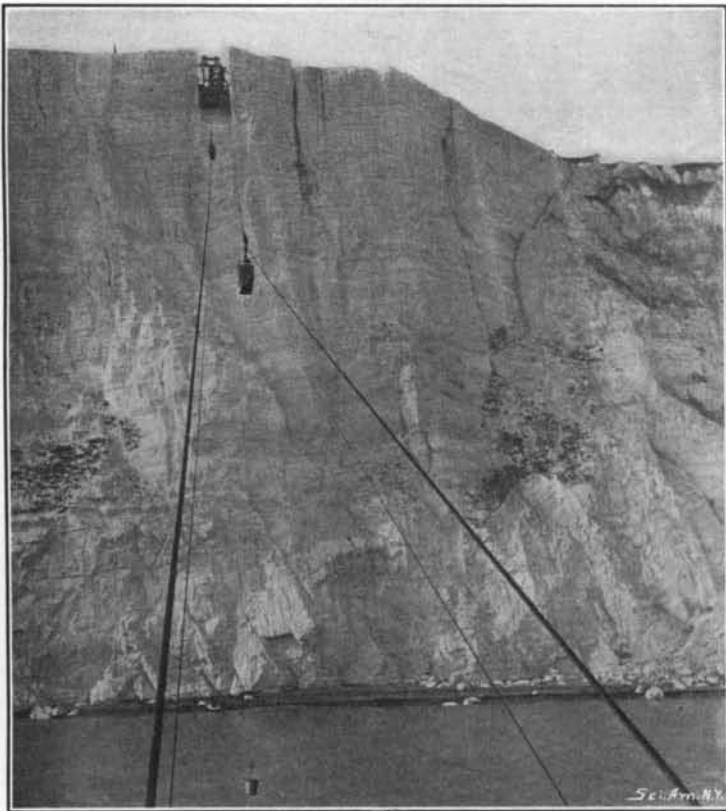
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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

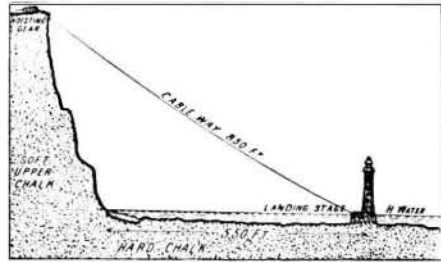
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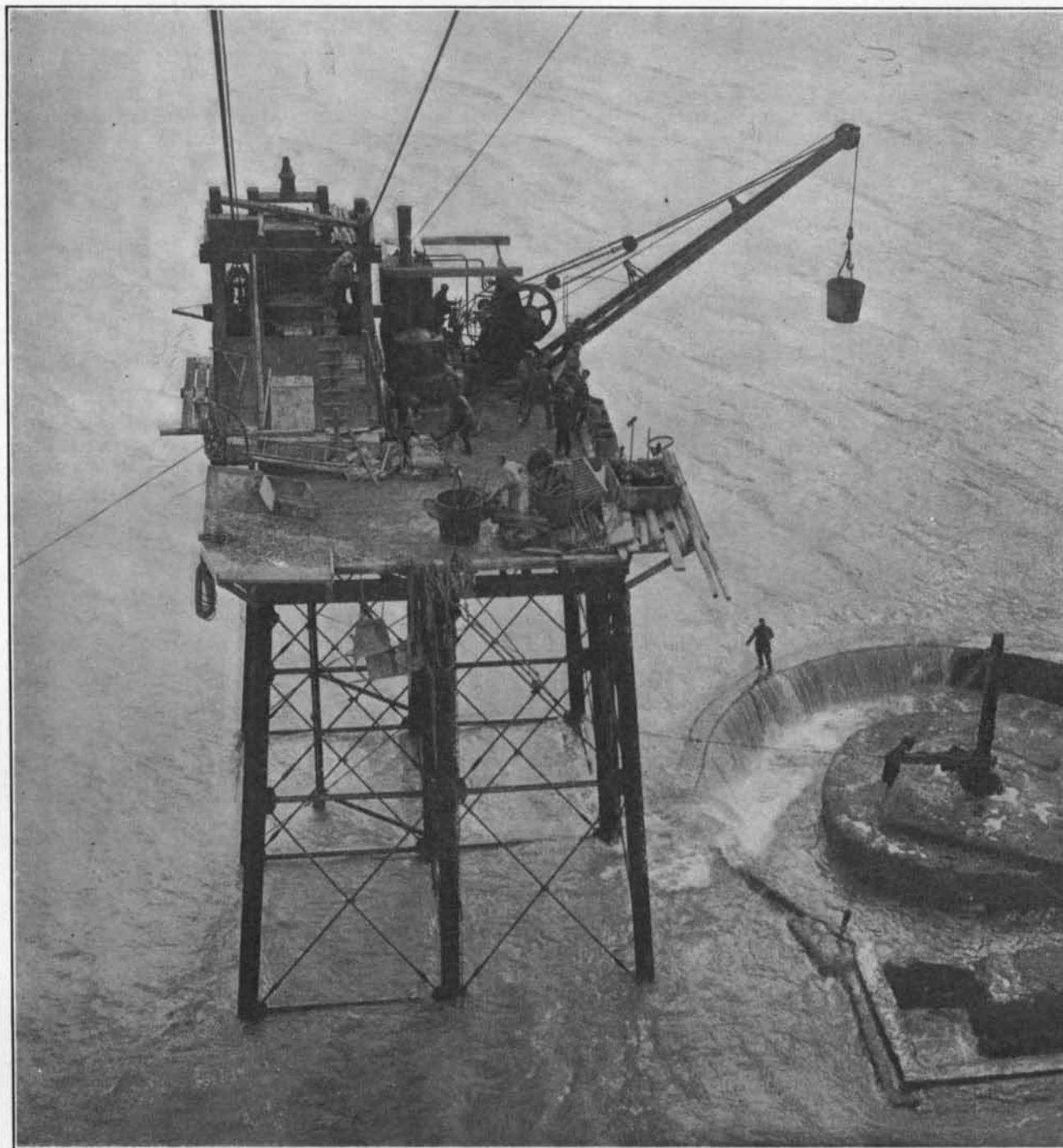
Beachy Head Chalk Cliffs, from the Erecting Stage; Height, 460 Feet.



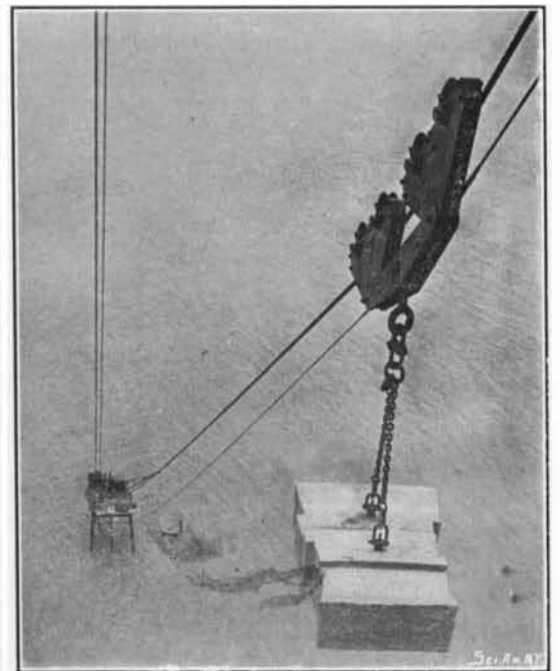
The Cliff, Cableway and Lighthouse.



The Cableway Hoisting Gear at Edge of Cliffs.



The Erecting Stage and Foundations.



Four-Ton Block Descending Cableway.

BUILDING THE NEW BEACHY HEAD LIGHTHOUSE ON THE ENGLISH CHANNEL.—[See page 294.]



**Automobile News.**

The Peugeot automobile which has lately been put into service in Tunisia for passenger transportation has made a good record on its trial trip. The route lies along the coast from Sfax to Sousse, passing by the towns of El Djem, Ksoursef and Mehdiya, and presents considerable difficulties in some parts, especially between El Djem and Ksoursef, where it is nothing more than a camel track. The automobile, however, has been able to cover the whole route in a relatively short time. For instance, from Mehdiya to Sousse, or 48 miles, it took only 2 hours 40 minutes, and besides, the trip was made on a dark night with but insufficient lighting. On the return trip it covered the distance from Sousse to Sfax, by a different road, or 78 miles, in 6 hours 50 minutes. On these trials the total distance of 180 miles was accomplished without the least accident.

We have received a communication from a subscriber in Peru, A. Wertheman, relative to his automobile. Mr. Wertheman is the superintendent of the Tarica Mining and Smelting establishment, which is located 11,466 feet above the sea, and the mines are 14,714 feet above sea level. A rather good cart road connects Tarica with the mines. Last year Mr. Wertheman visited the Paris Exposition and had a steam automobile of 5 horse power built by Serpollet. The machine had to be brought into Tarica in pieces on the backs of donkeys. The roads were very difficult, and only 60 pounds could be loaded on the back of any one animal. The machine was finally put together and does perfect service, running three times a week between the mines and Tarica, a distance of 13 miles. Part of the road has a 10 and 12 per cent grade. At first there was some trouble experienced with the burners because of the elevation of the mine, at which the water boils at 85 deg. C., as the atmospheric pressure is a third less than it is at the level of the sea. It is interesting to know that this is the only automobile in Peru, and the only one in the world that travels at such a height.

The recent accident to the celebrated French chauffeur, Fournier, and a party of friends during a run in his automobile on Long Island, when the vehicle was struck by a locomotive, brings once more before the public the ungarded condition of the railroad crossings of the Long Island Railroad. In this particular case there was no signalman, no gate, nothing indeed beyond an electric bell to give warning that a locomotive was approaching. M. Fournier states that he was quite unable to hear the bell, the sound of which was entirely drowned by the noise of his own vehicle. This statement will be readily believed by the owners of gas-propelled automobiles of the type used by Fournier. It is well understood that when the clutch is thrown off, as in approaching a crossing, the impulses of the engine shake the whole car, and there is more noise than when the impulses are absorbed in driving the vehicle. The erection of an electric gong at railway crossings may be a very cheap and convenient method of protection from the Long Island Railroad point of view, but it is extremely perilous to the traveling, and especially to the automobiling, public.

**The Building Edition for November.**

It seems as though each successive issue of this unique periodical contains more beautiful examples of houses and grounds than the preceding issue. The cover and two entire pages in the inside of the paper are devoted to the extensive grounds of the residence of E. C. Benedict, Esq., at Greenwich, Conn. There are a number of low-priced houses in this issue, also two stables and a page of modern colonial stairways. The tenth in the series of "Talks with Architects" is with F. R. Comstock: "Some Suggestions for Moderate Priced Houses." The editorial is devoted to the "Suburbs in Winter." The "Monthly Comment" is very interesting, and the second of the technical articles on "Heating the House" is devoted to "Warm Air Furnaces."

**The Current Supplement.**

The current SUPPLEMENT, No. 1349, has a number of articles of unusual interest. "Some Celebrated Long-Span Stone Arch Bridges" illustrates three of the most beautiful achievements in the whole range of civil engineering. "Enameling" is the first installment of a series of articles on this subject. "General Specifications for a Gasoline Motor Car" is by H. Ward Leonard. "Petroleum from the Beaumont, Texas, Field," is by Clifford Richardson and E. C. Wallace. "The Roze 'Aviator'" illustrates one of the most ambitious designs ever put into operation. It is accompanied by a number of engravings. "Anthropology" is one of the British Association addresses, and is by Prof. D. J. Cunningham, M.D. "Sorghum Sirup Manufacture" is by A. A. Denton, and is well illustrated.

**Engineering Notes**

For the navy yard at Charlestown, Mass., a very large anchor has just been made; it is 16 feet long.

The Pennsylvania Railroad is to enlarge its Brooklyn annex ferry, and the improvements include two large piers for the use of ocean steamers, which are controlled by the railroad interests. The piers will be two stories high and 700 feet long.

The British War Office is experimenting with a new field gun invented by Sir George Clark. It is a light weapon and is to be attached to the British Field Artillery. The most salient characteristic of this new arm is the long trail with which it is provided, and the under portion of which forms a storage, thus dispensing with the use of a limber.

Very high steam pressures are used on some English launch engines. One shown at the Glasgow Exhibition works under 375 pounds per square inch, and, as a consequence, together with high rotative speed, gives great power in a small space—140 horse power at 1,200 revolutions per minute. This engine is of the four-crank, quadruple-stage expansion type, and has cylinders  $3\frac{1}{4}$  inches for the high pressure, 5 inches,  $7\frac{1}{2}$  and 11 inches for the other cylinders. There is a feed pump attached, which is driven by a worm on the main shaft.

The port of Berehaven, at the southwestern corner of Ireland, which it is intended to convert into a terminus for a transatlantic fleet of liners, is now brought within the same stringent regulations that prevail at all the other dockyard ports of Great Britain, and the whole anchorage within certain limits is reserved for defense purposes. This port is to be rendered a first-class naval base, and will be the headquarters of the Channel Squadron. The waters are to be deepened at certain points, and heavy artillery is to be installed to adequately protect them in case of emergency.

The Russian and French navies, satisfied with the utility of the balloon for military purposes, have established a similar aeronautical section for service with the navy. The balloons are held captive in the ordinary manner, and are connected by telephone with the battleship below. A balloon section has been attached to the Mediterranean squadron of the French navy for some time past, and has been employed for scouting purposes with conspicuous success. The Russian experiments are to be carried out in the Caspian Sea, and if the balloon establishes its utility for naval scouting, a balloon is to be provided with each ship.

It has become the fashion to sneer at submarine vessels in some quarters, but English technical journals do not indulge in the practice, for they see in the growing fleet of French submarine vessels a distinct menace to English commerce. There are twenty-nine submarine boats now, of the electric type, in France, and five of other kinds, and they are constantly increasing in numbers. Engineering says that if 100 of these vessels were let loose at night in the Channel, they would be capable of establishing themselves in favorable positions before daylight and do incalculable damage to British commerce; it thinks that the submarine boat has increased the dangers from torpedoes tenfold.

The new armored French cruiser "Léon Gambetta," which has been constructed at the Brest dockyard, will shortly be launched. She is the largest vessel in the French navy. Her length between perpendiculars is 450 feet; beam, 65 feet, and displacement, 12,550 tons. She is to be fitted with tubular boilers, and three triple expansion engines of the vertical type, driving triple screws, and developing 27,500 horse power, capable of producing a speed of 22 knots. She will carry four heavy guns in pairs, mounted in turrets, fore and aft, forty quick-firing guns of various calibers, and five torpedo tubes, two of which will be under water. Her officers and crew will number 730 men. The cruiser will not be commissioned until 1903, and by that time over \$6,000,000 will have been expended upon her.

It was supposed that the new yacht for the King of England was in first-rate condition when she left the dockyard at Portsmouth recently and that all the defects and troubles that had arisen from time to time had been successfully surmounted. Such, however, is not the case, and it appears that her usefulness is as remote as ever. She sailed on a trial trip to Gibraltar and back, and she displayed considerable unsteadiness. She rolled very heavily in the slightest beam sea, and occasionally the list was very dangerous. To overcome these defects it is stated that extensive alterations are necessary, but are almost impossible to carry out owing to her structural arrangements. At least an increased draught of four feet is required, but as her lower portholes are now only a few feet above the water-line, this requirement can only be fulfilled by removing the port-holes, thus depriving the lower apartments of natural light. It has been stated by experts that the cheapest means of solving the difficulty is to construct a new yacht. At any rate, she will have to be almost entirely reconstructed.

**Electrical Notes.**

A new system of recutting files by electricity is being established near London.

A 30-ton armature which fell into the Sheffield Canal has had to be rebuilt and reinsulated.

The Pennsylvania Railroad is to experiment with the Delany telegraph system, by which it is possible to transmit 8,000 words a minute, while a commercial rate of 2,000 words a minute off a single copper wire is said to be possible. Perforated tape is used, and the characters are recorded electrolytically on chemically-prepared tape.

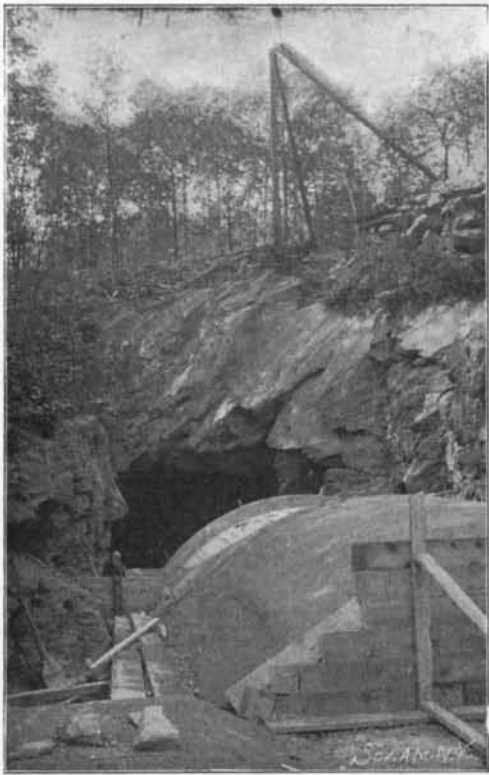
A method of supporting osmium filaments has been devised by Mr. O. Imray, of London. These filaments, as is well known, are heavy in proportion to their strength, even when cold, while when heated they become very soft. To remedy this disadvantage, appropriately shaped bodies of refractory oxide chemically inert in reference to osmium are employed. These supports are made of thorium and magnesia, mixed into a paste, in the proportion of ten parts of the former to one of the latter, with a suitable organic binding material. They are then molded to the requisite shape, burned in air until the organic matter has been wholly consumed, and afterward fritted or sintered together.

A system of wireless telegraphy, the messages of which it is stated cannot be tapped, or received by any instrument other than that for which they are destined, has been invented by a London electrical engineer, Mr. Johnson. Each transmitter in this system has differently tuned reeds, and when it is desired to send a message, the tune of the receiver to receive the same must first of all be ascertained, and the transmitter must be adjusted accordingly. Each receiver has a different tune, thus rendering it absolutely impossible for messages to be tapped. The Admiralty has examined the system, and are so impressed with its advantages that three battleships are being fitted with it for the purpose of carrying out experiments.

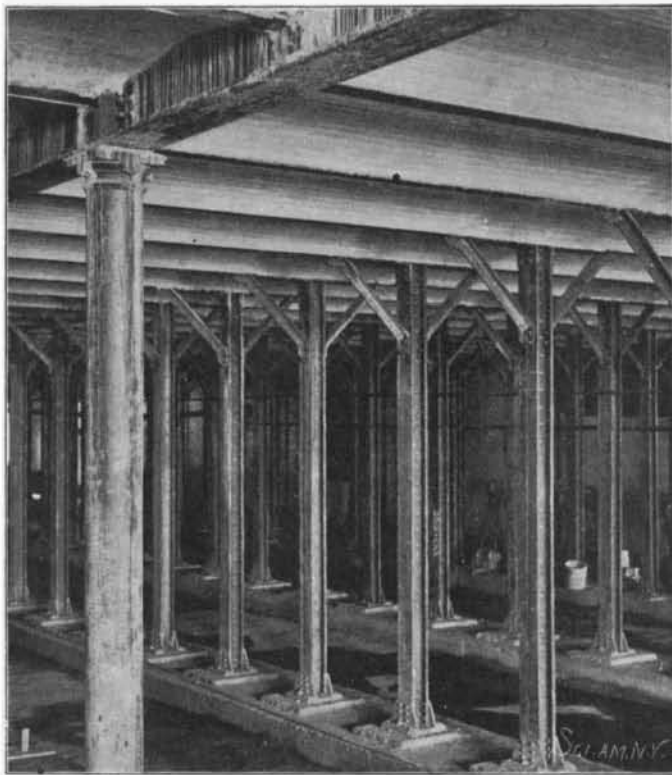
A process of rendering the Nernst incandescent lamp more durable has been devised. By this means the temperature of the light-emitting conductor is raised to a degree higher than is attained in actual use. To accomplish this heating it is essential that the conductors should be passed across and through an arc, produced between two carbons separated by a distance of  $\frac{3}{8}$  inch. One peculiarity of the Nernst conductor is that if made cylindrical it rapidly becomes tubular, owing to the more intense heat developed in the interior of the conductor. It is desired that the shape should be other than tubular, and to accomplish this purpose various cross sections are utilized in which the surface is extended and the thickness of the material reduced.

In Italy the Lecco-Sondrio and Colico-Chiavenna lines will be entirely propelled by electricity, the latter line, about 70 miles long, being capable of carrying freight trains of over 250 tons. On the Milan-Porto-Ceresio line of 63 miles, electric traction will be employed for passenger traffic, at a speed of 54 miles per hour, says The Railway Review. In France a commission has been appointed for investigating the problems connected with electric railway traction. It is hoped to be able to make much use of water power for generating purposes, the Riviera district especially offering natural facilities for this method of driving. In Austria and Norway similar projects are being prepared. A syndicate of Russian bankers proposes to connect St. Petersburg and Moscow with trains running at 93 miles per hour, at 10 minutes' intervals, from each end, each train consisting of five 35-passenger cars.

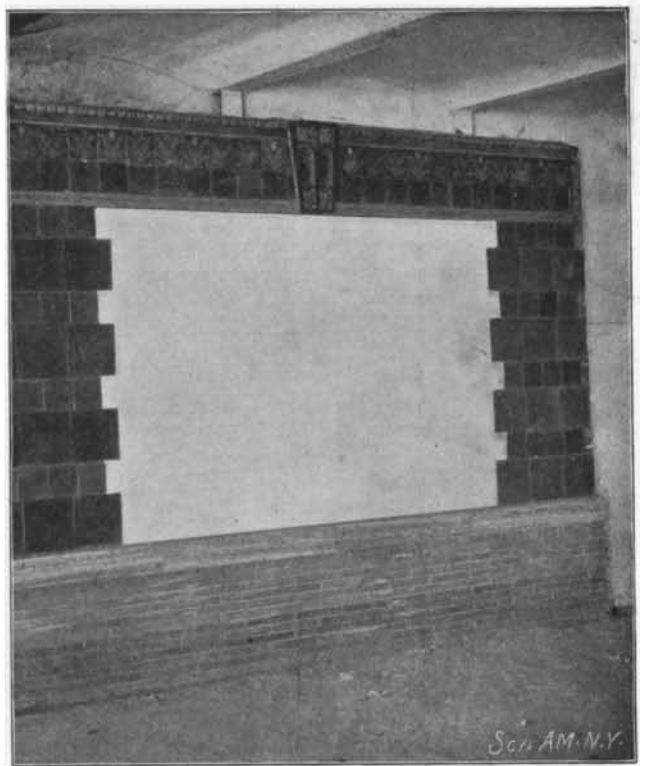
Mr. Peter Cooper Hewitt has recently had ten patents issued to him on his vapor lamp, which attracted such widespread attention at the Conversazione at the spring meeting of the American Institute of Electrical Engineers. The patents give most valuable information concerning the principles which underlie the construction of these lamps and disclose the fact that Mr. Hewitt has discovered some entirely new principles in electric illumination. Means for starting the lamp, for automatic regulation and the control of the character of the light emitted are all covered by these patents. Mr. Hewitt found that by introducing into the tube a small quantity of mercury sulphate or some sulphur compound, and by the use of a certain device in proximity to one or both electrodes, the starting device can be reduced to a simple form of induction coil or similar apparatus that will give a momentary increase of voltage at the time of starting, and then permit of being switched out of circuit automatically. Several types of such arrangements are described in one of his patents. Mr. Hewitt also finds that by suitably proportioning the length and diameter of the tube, and the thickness of the glass, the lamp can be made self-regulating. He has also found that nitrogen combined with mercury vapor gives excellent results as regards the quality of the light.



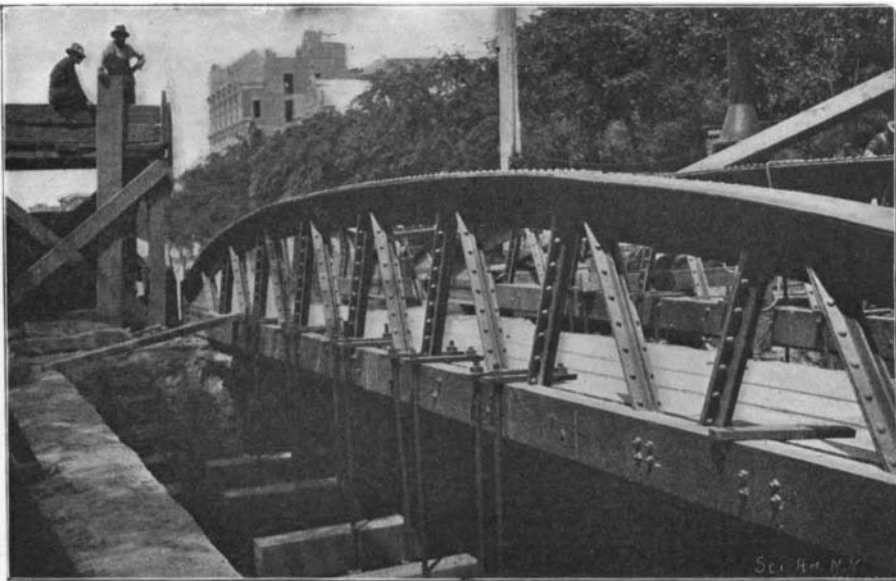
Entrance to Tunnel, Central Park.



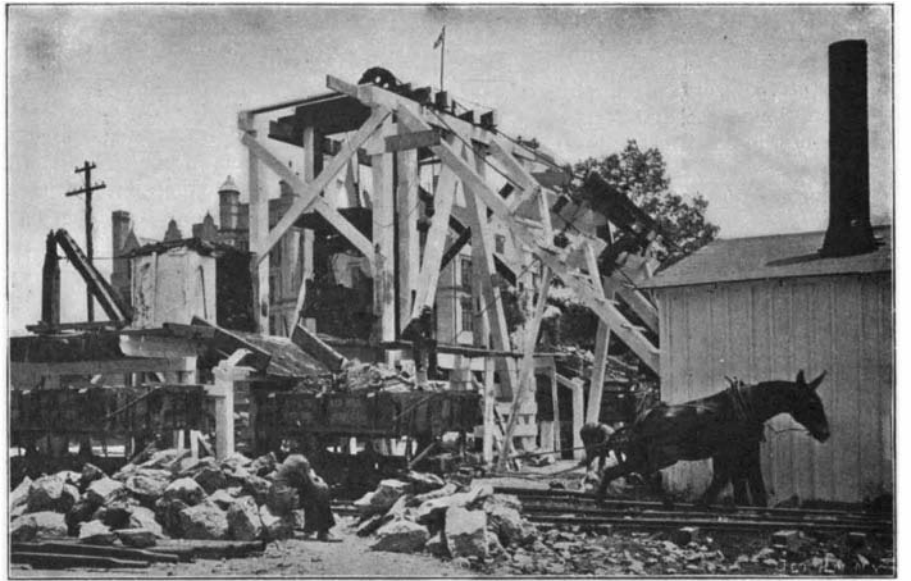
Fifty-ninth Street Station.



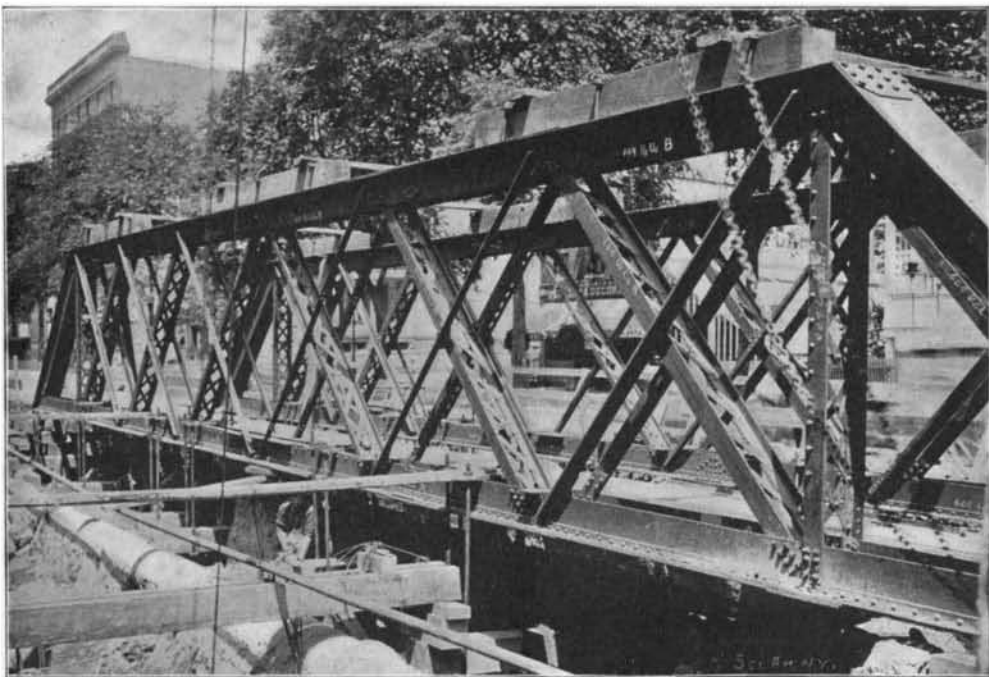
Experimental Tiling at 59th Street Station.



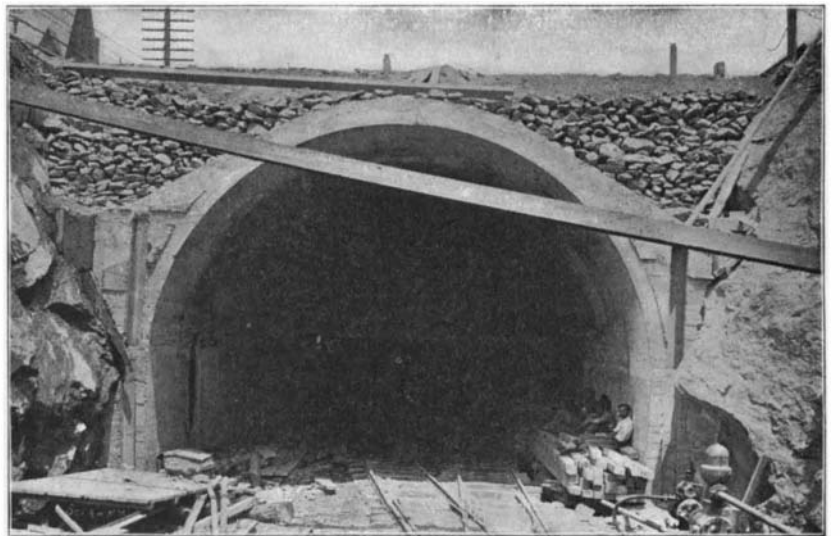
Bowstring Truss Carrying Surface Tracks at 92d Street.



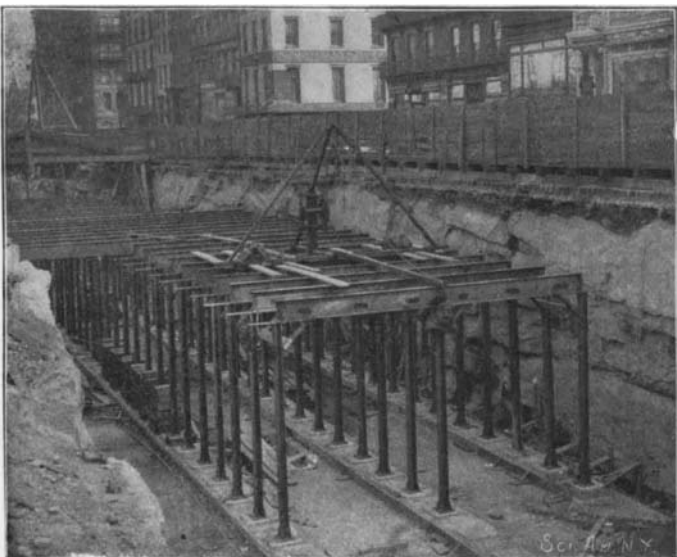
Hoisting Gear at Top of Tunnel Shaft, 168th Street.



Method of Carrying Surface Tracks During Excavat



Tunnel at 157th Street, Showing Concrete Arch Construction.



Open Rock Cut, Union Square, Showing Steel Work in Place, Before Concreting.



View at Houston and Elm Streets, Showing Brick and Concrete Covering Being Laid Over Steel Work.

SOME METHODS OF CONSTRUCTION OF RAPID TRANSIT SUBWAY.