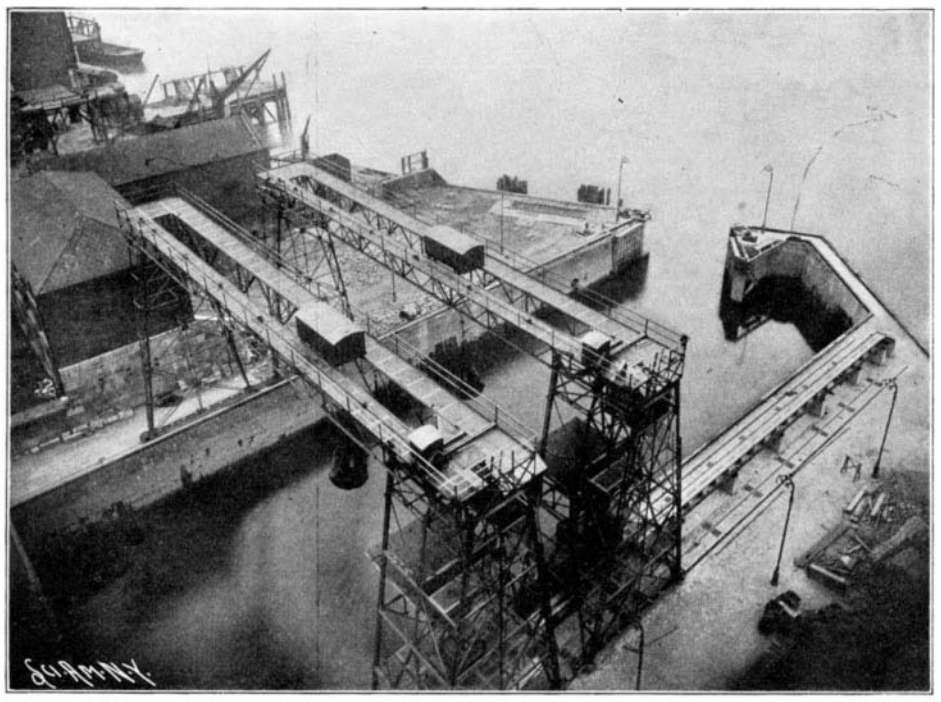
THE GREAT LONDON POWER STATION.

BY HAROLD J. SHEPSTONE.

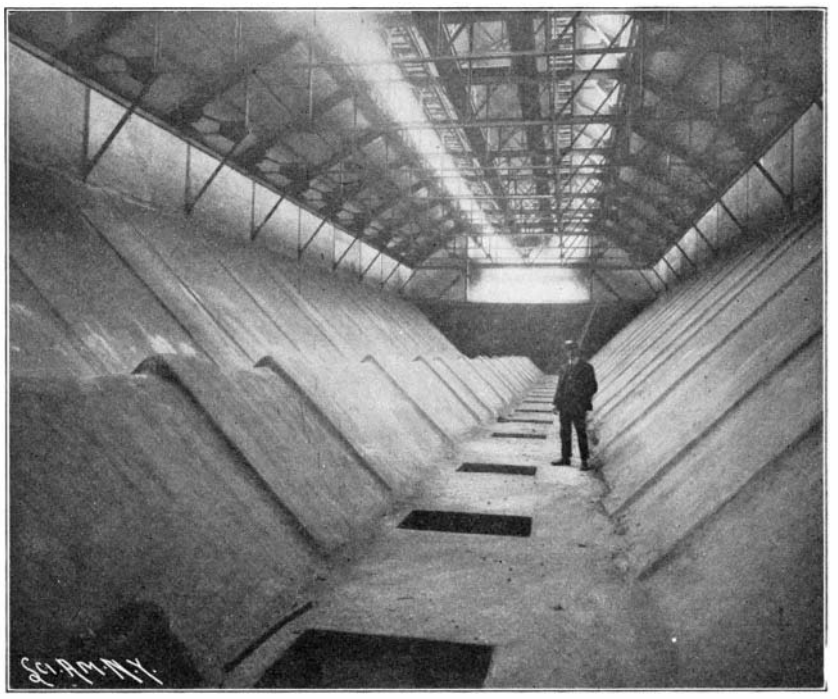
The great generating station at Chelsea, London, which has been built by Mr. Charles T. Yerkes to furnish the necessary power for working the Metropolitan District and other London railroads, has now reached a stage in its erection when a reference to the undertaking cannot fail to be of interest. Its rapid erection, coupled with the fact that several of its engineering features are entirely new, single it out as no ordinary feat in the electrical and engineering world.

The work was started in the autumn of 1902, and although the station will not be completed until the beginning of next year, the amount of work accomplished in the two years that have elapsed is notable. In that comparatively short space of time a vast structure has arisen, twice the size of the one at Niagara, and on ground that had to be cleared of wharves and other obstructions to make room for it. The station is situated in Lots Road, Chelsea, the entire site occupying nearly four acres of land. It boasts of a water frontage on the River Thames and on Chelsea Creek of 1,100 feet, and a frontage on Lots Road of 824 feet. The building proper is rectangular in design, 453 feet long by 175 feet wide, and 145 feet high to the peak of the roof. It has four large brick chimneys, two abreast, each 275 feet high. Being situated close to the river's bank, the huge shafts are very conspicuous, and may be detected for miles around. A popular writer with an imagination, describing the building recently, likened it to an elephant lying on its back with its four legs in the air. A small army of German bricklayers was imported to erect the stacks, and throughout their entire length they were built up from the inside. No exterior scaffolding of any kind was allowed. Each chimney has an internal diameter of nineteen feet. Germans were also largely employed in the erection of the steel work, nearly the whole of the 20,000 tons used in the edifice having been imported from that country.

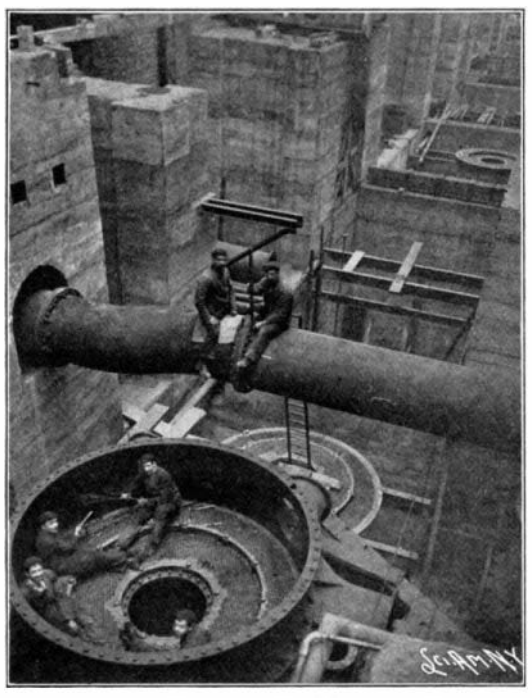
Naturally, great care was taken in securing the foundations. Two hundred and twenty concrete piers were



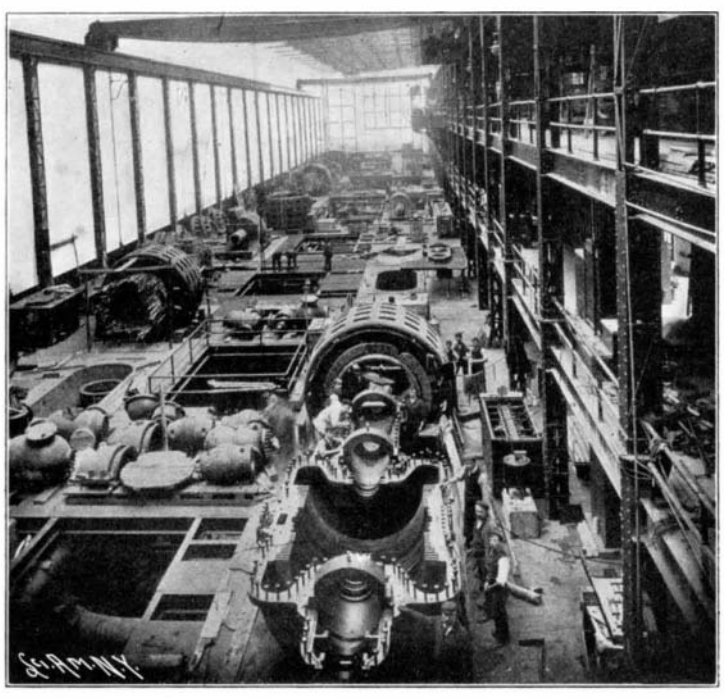
The Wharf, Showing the Traveling Cranes and Conveyors for Handling the Coal.



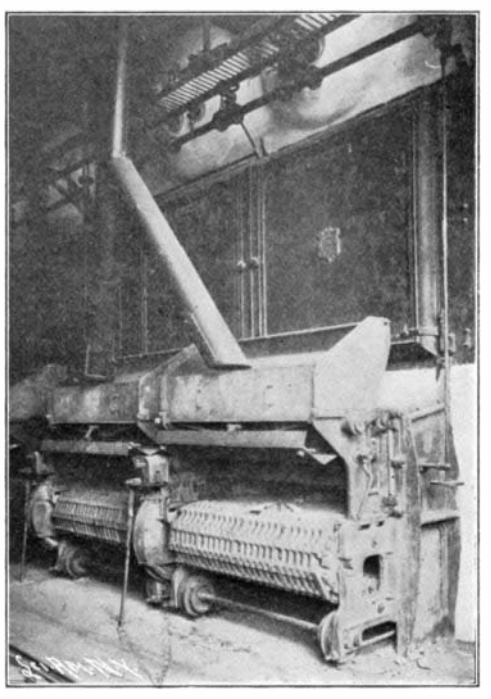
One of the Great Concrete Coal Bunkers. There are Three in all, Having a Total Storage Capacity of 15,000 Tons.



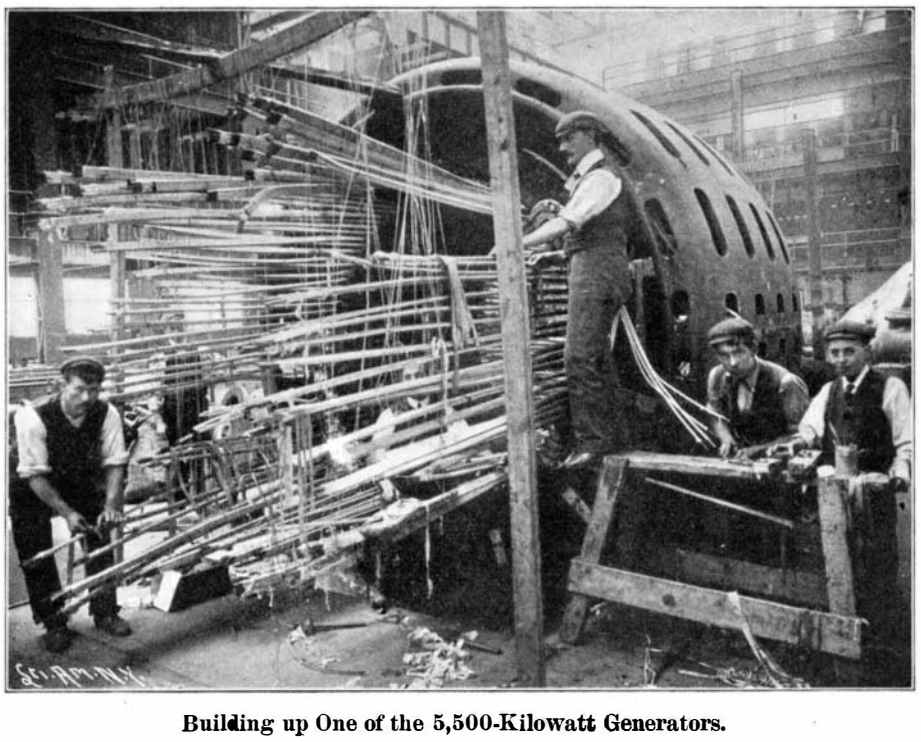
The Condenser Pits in the Engine Room.



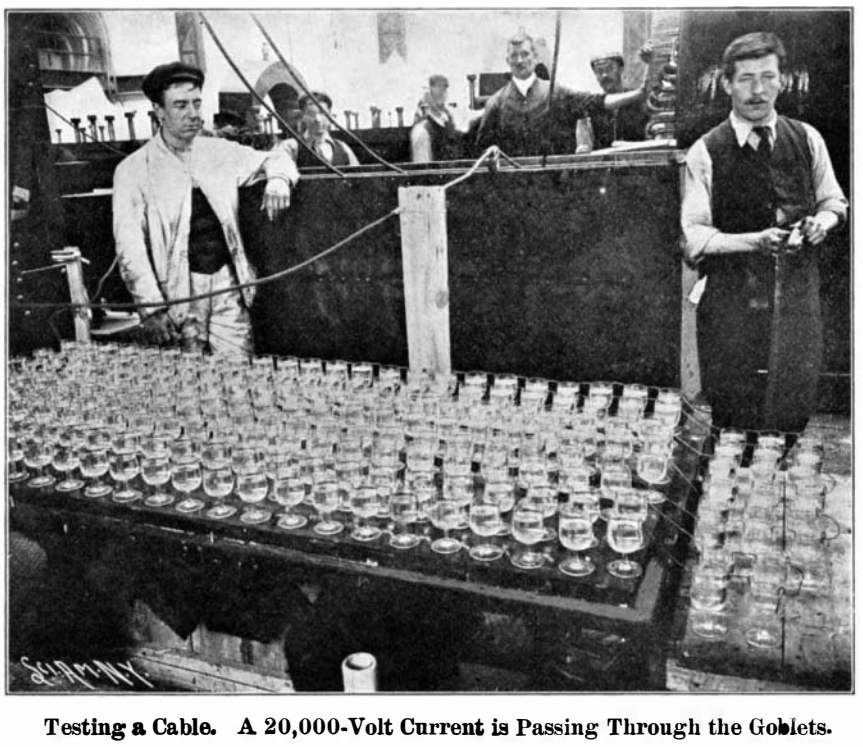
General View of the Interior in Its Present Condition.



The Mechanical Stokers.



Building up One of the 5,500-Kilowatt Generators.



Testing a Cable. A 20,000-Volt Current is Passing Through the Goblets.

sunk to a depth of 35 feet in the London clay. The foundations for the shafts are 42 feet square, and 35 feet below the ground floor level. Over 2,000 cubic yards of concrete were used in each of these foundations. The steel framework of the building, which has a total weight of 5,800 tons, is self-supporting. After erection, this frame was closed in with bricks and terra-cotta, the roof and most of the floors being of concrete. No attempt has been made at relief of the exterior of the building in the shape of ornamental decoration, thus giving it the appearance of a huge factory. Adjoining the main building are the offices, which occupy three floors, the lower of which forms the machine shops. This structure measures 81 feet by 25 feet. It is interesting to note here that the capacity of the whole edifice at normal load is 57,000 kilowatts. On this basis the cubic feet per kilowatt (including office building) is 139, and the square feet per kilowatt is 1.36. It will be seen from these figures that considerable economy has been resorted to in the matter of floor space.

The main building is to be divided into two distinct compartments, the near-river half holding some eighty boilers arranged in two tiers. This is regarded as quite a distinct departure so far as Eu[illegible] is concerned—the erecting of boilers in tiers. The boilers are of the Babcock & Wilcox famous water-tube type. Each boiler has 5,212 square feet of heating surface and 672 square feet of superheating surface. The boilers are already in place. They are piped in groups of eight, each group supplying the steam for one electric generating set and one feed pump, there being no steam connections between the several groups, except that a supplementary header at one end of the building is connected to two groups. This header supplies the exciter engines, or compressors, house pump, etc. Every economical device for reducing labor has been resorted to. Under each boiler there is a chain-grate stoker. They have each 83 feet of surface. Coal is fed automatically direct to the furnaces, and, after being used, passes through chutes to the basement, where it is caught in self-dumping buckets and conveyed to the ash pocket.

The other portion of the building is given over to the turbines and generators, and may therefore be regarded as the most interesting department. One of our photographs depicts the present appearance of this room, from which it will be seen that although a considerable amount of work has been done, there is still much to do. Down the entire length of this room, and along one end, are three galleries given over entirely to the switchboards, from which the currents to all the sub-stations, of which there are twenty-three, are controlled. When all the generating sets have been put in place, it will be a magnificent sight to stand in the galleries and view the machinery below. In all there will be ten sets, each consisting of a Westinghouse steam turbine running at 1,000 revolutions per minute, and a four-pole, three-phase generator, which is wound for a pressure of 11,000 volts at 33⅓ cycles per second. This is the highest pressure yet employed for traction purposes in Great Britain. The periodicity will be thirty-three and one-third per second. It is interesting to note that the steam turbines, which are the largest ever built, are each—that is to say, nine of them, the tenth being about half the size of the others—29 feet long over all by 14 feet wide and 12 feet high. The normal rating of each generator is 5,500 kilowatts, but they will carry an overload of fifty per cent for two hours at practically the same steam consumption per kilowatt hour. There are also four 125-kilowatt, 125-volt steam-driven exciter sets, which will run at 375 revolutions per minute.

In the pits between the engine foundations are the condensers. They are designed to work on the dry vacuum principle, while all the pumps are electrically driven. They have each 15,000 square feet of cooling surface, and the circulating water will be siphoned from the River Thames through pipes 66 inches in diameter. This water and also that intended for all the other machinery will pass through specially erected filters, to prevent the possibility of the boilers getting "furred." There are no less than four miles of wires about the switchboard. All the high-tension switches are motor-operated, and the feeder system is being erected in duplicate.

Before leaving the engine-room, it may be noted that the turbines are being supplied by the British Westinghouse Company, and are of the Parsons type with Westinghouse modifications. As already stated, the speed will be 1,000 revolutions per minute, while mounted on the same shaft is the three-phase generator of 5,500 kilowatts. In full working order the total horse-power available from this one station, therefore, will be slightly over 80,000 horse-power, or 120,000 horse-power at 50 per cent overload. The boiler-house portion of the station fronts Chelsea Creek, from

Triumphal Arch of Caracalla.

which barges could unload. This piece of water being the property of a railroad company, a charge of one penny (two cents) a ton is demanded. As the daily coal consumption in full working order would amount to 850 to 900 tons, a penny a ton in the course of a few years would naturally reach a respectable sum. The directors therefore decided to construct a dock of their own. This occupied a considerable time, chiefly on account of the immense amount of blasting which was found necessary. It is now completed, and barges can enter it at any state of the tide. It is spanned by two traveling cranes, each working a one-ton grab. The coal, after being weighed, is dropped through a hopper on to a belt conveyor, and carried up an incline elevator 140 feet in length to the top of the building immediately over the boilers, where the three giant coal bunkers are situated. They have a total capacity of 15,000 tons.

Ruins of the Constantine Aqueduct.

ROMAN REMAIN3 IN NORTH AFRICA.

The power station has been built by the Underground Electric Railways Company, of London, Limited, of which Mr. Charles T. Yerkes is the principal figure. It will supply the necessary power for working the Metropolitan District Railway and the three "tubes" now under construction, namely, the Baker Street and Waterloo, the Charing Cross, Euston and Hampstead, and the Great Northern, Victoria and Brompton lines. The total length of these lines is over sixty miles, the District Railway alone accounting for about forty. The work of laying the two conductor rails for the District system is now practically completed. Electric trains are expected to run over this line early in the coming year. The Baker Street and Waterloo Railway will be ready probably about the same time, but the services of the Chelsea station for the other tube lines of the group will not be required for some time, as the construction of these is not so far advanced. The total cost of the power station has been put down at $7,500,000.

ROMAN REMAINS IN NORTH AFRICA.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Among the Roman remains which are to be found in Northern Africa, those of Tebessa are among the most remarkable and best preserved. Tebessa is the *Thevesta* of the Romans, according to different inscriptions which have been found there. It appears for the first time in history in the geography of Ptolemy. Later on, with the title of *Colonia*, it is mentioned in the voyages of Antoninus. It is probable that it commenced to flourish in the time of Vespasian and Titus. It was founded about 71-72 A. D. and perhaps commenced as a Roman camp, at first only temporary, which then became fixed and grew in size. The camp was transformed to a city by the decree of Vespasian and was afterward raised to the rank of a Roman colony. Tebessa reached the height of its prosperity and was a flourishing city at the beginning of the third century under Septimius Severus. The principal monuments, some of which are here illustrated, must be dated from this period. The city no doubt continued to grow until the time of the Vandal invasion, when most of the Roman cities of North Africa were laid waste. Later on, it was raised from its ruins by Solomon, the successor of the general Belisarius, in 543 A. D., as we are told by an inscription found on the Arch of Caracalla. The Arab historians relate that it was taken by Aboud-Yezid in 945, and it has been occupied by the Arabs down to the present time.

The ruins of the city, which are quite extensive, show the traces of these successive occupations. The fortifications which Solomon erected in the midst of the immense ruins of the Roman city are still standing, and serve to inclose the Arab town which now contains but few inhabitants. The walls are from 35 to 50 feet high and are over 6 feet thick in most parts. They are flanked by twelve towers of two stories each. Three gates now lead through the walls. One of these gates dates from the Byzantine epoch, but the most interesting is the gate which is formed by the ancient Triumphal Arch of Caracalla. This is one of the Roman ruins which escaped destruction. The arch, which is shown in one of our engravings, is one of the most important of the Roman remains in Northern Africa. Its mass forms a cube measuring about 35 feet on a side. The arch is of the form known as *quadrifrons*, and each face represents a triumphal arch with one entrance. It seems probable that it was originally placed in an isolated position, and no doubt stood in the middle of a public square. Only one side of the arch is in a good state of preservation. Mounted on the top will be observed a small edicule with four columns. No doubt this was designed to receive a statue which set off the arch and could be seen from a great distance. This structure was built in 211-213 A. D., and was dedicated to Septimius Severus, his wife and his son Caracalla.

When the city of Tebessa was abandoned by its inhabitants at the end of the fifth century, and was then sacked by the Moors and other roving bands, the monuments suffered greatly, and it is no doubt at this time that the arch was partially demolished. In later times when Solomon re-built the walls of the ancient city, he used the arch to form one corner of his construction. He closed up the openings on two sides by rough masonry and also the upper part of the northern side and transformed it into a city gate and tower. The side which is shown here is sufficiently well preserved to give an idea of its original appearance.

Another remarkable construction which is left from Roman times is the Temple of Minerva. As will be observed in one of the engravings, this handsome structure is in a fairly good state of preservation. The temple has undergone many vicissitudes since the fall of the Roman empire. In more recent times it served as a soap factory, a military bureau, a prison, and then a Catholic church. It is a very fine monu-