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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TUNNEL TUBES IN SOFT MATERIAL.

It has now developed that the engineers of the East River Rapid Transit tunnel are engaged in sinking piles through the silt and sand which lie below the tunnel, in order to provide a firm support for the two tubes throughout some 2,000 feet of their length. The chief engineer of the company which holds the subcontract for the construction of the tunnel believes that these piles are necessary to insure the stability and permanence of the two tubes. The chief engineer of the Rapid Transit Commission considers that the piles are unnecessary, but is willing to have them put in, saying that they can do no harm and will increase public confidence in the tunnel.

We doubt if we could find among the larger and more serious engineering works, one in which there is more divergence of opinion among engineers than that of tunnel construction by the method of driving tubes through the soft material of river bottoms. When the question of tunneling the East and North rivers came up for consideration, the problem was in some respects a new one; for although the Greathead shield system had been employed many years before in building a tunnel beneath the Thames, the material under that river differed so widely from this below the two rivers of New York, where the bottom consists largely of a semi-fluid silt, that the New York problem had to be treated quite independently and subject to its own special conditions.

When a cast-iron tunnel is driven through the sand and gravel or the stiff clay of London, there is no question of its subsequent stability—where it is placed it will remain for all time. But when the suggestion was made to drive from 2,000 to 4,000 feet of cast-iron tube through the comparatively soft and semi-fluid mud at the bottom of our rivers, the question of permanence became all-important and called for careful consideration. So serious did it appear to Mr. Jacobs, chief engineer of the various tunnels under the North River, that he decided to sink massive piling clear across the river, build a track structure from pile to pile of sufficient strength to carry unaided the load of the moving traffic, and treat his tubes as a mere envelope, whose duty it was, not to support the load, but merely to provide an air-tight tube through which the trains might run. He carried this idea of separating the weight-carrying and the enveloping elements in his tunnel so far, that he provided sliding joints in the bottom plates of the tube where the piles passed through, the idea being that any slight movement of the tubes might take place independently of the piles and track structure.

The success of the work under the Hudson and East rivers proves that it is entirely possible to build as many tunnel tubes as may be desired. But the question which has yet to be proved, and which is exercising the minds of some of the ablest engineers in this city to-day, is, how far will the vibration set up in the metal tubes by the passage of the trains tend to agitate the surrounding material sufficiently to cause its displacement and a consequent settlement of the tubes? If such a settlement did occur to any great extent in a rigidly bolted-up member, less than 20 feet in diameter and from 2,000 to 3,000 feet in length, and rigidly supported at the ends, there would be bending stresses developed which would be far in excess of the resisting power of the tubes, and fracture must ensue. But whatever theory may indicate, time alone can tell whether the vibrations of the trains will have any disturbing effect upon the surrounding mud and silt. Personally, we are of the decided opinion that it will, and that in all portions of the various tunnels now under construction which lie in material of less than a certain density and compactness, the piles should be sunk through the bottom of the tubes until they reach rock or some other sufficiently firm bearing. Moreover, with all due deference to Mr. Jacobs's theories, we believe that the piles should be anchored securely at their upper ends to the shell of the tunnel.

In the case of the East River Rapid Transit tunnels, the piling is being driven by the jet process at intervals of 50 feet over a stretch of about 2,000 feet, where the tunnel passes through soft mud. But if the piles are to be used, they should be driven closer together; for the reason that the wide spacing will tend to set up undesirable bending stresses between the rigid points of support. Twenty-foot, or at the outside 25-foot, intervals would have been better.

The experience had with the Brooklyn tunnel proves that in future subaqueous tunnel construction it would be advisable, where the route lies through soft silt and mud, to increase the depth of flanges, diameter of bolts, and general resisting strength of the cast-iron shell. The frequent breakages in the lining of the Rapid Transit tubes, both during construction and since construction was completed, afford, to say the very least, a strong presumption that the lining is not any too strong for its work. It is claimed by the Rapid Transit engineers that these fractures of the plates were caused by wrong methods of construction. This may well be true; but what about any fractures of plates which may have taken place since the tubes were completed, and the last of the lining plates inserted? If there have been such fractures, public safety and the prestige of everyone concerned demand that a most careful system of tests with loaded trains be carried out for a reasonable length of time, and the effects noted, before the tubes are thrown open for public travel.

THE PROBLEM OF RAISING AN EXISTING DAM STRUCTURE.

The parliamentary paper recently issued on the subject of irrigation in Egypt and the raising of the Assouan dam, will be disappointing to engineers because of the meager amount of information which it contains as to just how the feat of lifting the crest of the dam some 22 feet is to be accomplished. Although it was stated at the time of the opening of the structure that its proportions were such as would permit it to be carried up 20 feet higher without impairing its stability, the illustrations of the finished work indicated that the width and thickness of the dam were not sufficient to enable the structure to withstand the increased stresses which would be due to such a great increase in the head of water.

In a memorandum in the parliamentary paper above referred to, Sir Benjamin Baker gives some interesting information on the subject, although he fails to make clear in what way the enlargement of the dam is to be carried out. He states that two years ago plans were submitted to him for the increase of the dam, and that, after careful consideration, he stated that further experience was necessary as to the practical working of the existing structure, and further investigation of the mathematical problems involved, before a satisfactory design could be prepared. This statement alone would indicate that the existing portion of the dam was built to withstand only its present head of water, and that the proposal to raise that head by 22 feet involves the construction of what is practically a new dam, built around the present structure as a nucleus.

Sir Benjamin Baker states that the masonry aprons constructed on the downstream side during the past two years will effectually protect the bed of the river against erosion, even when the scouring action of the water rushing through the sluices is increased by the raising of the water in the reservoir. Furthermore, he gives it as his opinion that the existing dam and locks may be easily modified so as to admit of the level of the water being raised 22 feet, without introducing any element of danger whatever or impairing the present factor of safety. During the past two years the engineering staff at the dam have obtained valuable data relating to the varying temperature of the mass of masonry constituting the dam, data which have an important bearing upon the stresses on the masonry, and upon the details of any design for raising the dam. These temperature variations have rendered the designing of the new work a difficult problem, since any new masonry bonded to the existing masonry would have been of a different temperature and of doubtful utility in adding to the stability of the dam.

Judging from the above, it would seem that the enlargement of the dam is not to be carried out by thickening its whole mass, and building up the additional height in new masonry bonded into the existing structure; though we fail to see, since the building of the new work is to take six years' time, how the gradual enlargement of the dam, and the addition of block by block as the work proceeds, should prevent such differences in temperature between the old and the new as to involve undesirable temperature stresses, and prevent the whole completed dam from acting as a true monolithic mass. It is possible, however, that the plan contemplates the use of some form of movable steel dam structure of the kind that is used so widely in this country for regulating the height of water in dams and rivers; though even in this case the proper support of such a structure would require a widening of the base of the dam proportionate to the increased head, and the provision of massive abutments between the existing sluiceways to take the horizontal thrust of the additional water.

THE SHACKLETON ANTARCTIC EXPEDITION.

A new British Antarctic expedition, organized by Mr. E. H. Shackleton, who was third lieutenant on the "Discovery," and who formed one of the party which penetrated "farthest south," is to leave London in October next. On this exploration full avail is to be made of the experience gained in the former expedition, with a view to avoiding being frozen in, and to facilitate travel over the ice. The party will proceed directly to New Zealand, and will then sail to the point which constituted the winter quarters of the "Discovery" in lat. 77.50 S. A shore party will here be landed, the vessel returning to Lyttleton, New Zealand, thereby avoiding imprisonment in the ice, and the ship will return south the following summer to pick up the explorers. It is hoped that the financial arrangements will permit of a party being landed at Mount Melbourne on the coast of Victoria Land, in order to reach, if possible, the south magnetic pole, this route being the most favorable for such a journey. The principal object of the expedition, however, is to follow up the discoveries made on the previous exploration, in which mountains ranging in altitude from 3,000 to 15,000 feet were discovered. It is stated that had the last expedition been equipped with better sledge facilities, a much higher altitude might have been gained; and on this occasion the dogs will be supplemented by the hardy Siberia ponies for the haulage of the sledges, the surface of the ice and snow together with the configuration of the country being adapted to this mode of travel. The party will also be equipped with an automobile of special design to suit the unusual conditions prevailing. It is anticipated that a far more southerly point than that gained on the previous journey may be reached on this occasion.

INFLUENCE OF LIGHT ON THE CONDUCTIVITY OF ANTIMONITE.

At a recent meeting of the Dutch Academy of Sciences, Mr. F. M. Jaeger reported on some interesting experiments illustrating the peculiar behavior of the conductivity of Japanese antimonite in regard to light.

After accidentally discovering that a beam of light falling on a rod of this substance inserted in an electric circuit would produce a deflection of the galvanometer needle, corresponding with an increase in conductivity, Jaeger investigated the cause of this phenomenon, obviously due either to light or to heat.

The first experiments were made on a rod of antimonite coated with wax, which rod accordingly exerted only a relatively small effect, increasing the conductivity by 10, 20, or 200 per cent, according to the conditions of the case.

Far more intense effects were observed on an antimonite plate inserted between two insulated copper plates of considerably greater dimensions. The condenser thus constituted was suspended by a silk thread. As heat was found to diminish the conductivity instead of increasing it like light, only light could be the cause of the phenomenon.

On inserting glass plates of different colors between the source of light and the antimonite rod, the effects of differently colored lights were found to be rather different. A minimum of luminous sensitiveness was found to correspond with the ultra-red, another degree to the green, and a third to the ultra-violet, while the red and blue regions of the spectrum constituted maxima of sensitiveness.

The above phenomenon shows a striking resemblance to the luminous sensitiveness of selenium. Though the relation between luminous radiation and increase in conductivity, generally speaking, is analogous in both cases, there are a few remarkable departures. In the first place, polymorphous conversions and the resulting displacements in equilibrium are known to play an important part in the case of selenium. On the other hand, its resistance is known to decrease continually with increasing temperature, in opposition to the facts stated in the case of antimonite.

Tellurium seems to show a behavior analogous to antimonite, its resistance being likewise increased by heating and reduced by illumination.

It is intended shortly to construct antimonite cells sensitive to light on a principle analogous to that underlying the construction of selenium cells.

It is said to be extremely important to the proper setting of concrete, if the best results are to be obtained, that it be protected while the process is going on from the wind and sun, especially in dry, warm weather. The dry air will rob the sharp corners, and even the faces, of their moisture, and a later wetting will not repair the damage.