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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.

FOR A HIGH-LEVEL LOCK CANAL.

The letter of President Roosevelt, transmitting to Congress the report of the Board of Consulting Engineers on the Panama Canal, together with the report of the Isthmian Canal Commission and letters from Secretary Taft and Chief Engineer Stevens, marks an important step in the settlement of the vexed question of the type of canal which is the best suited to the conditions at the Isthmus of Panama. The letter of the President leaves no doubt whatever that he is strongly in favor of a high-level lock canal. Furthermore, an analysis of the vote taken both by the Board of Consulting Engineers and by the Isthmian Canal Commission, to say nothing of the individual opinion of the Secretary of War, and the present Chief Engineer of the Canal, establishes the fact that the judgment of the majority of American engineers is in favor of a lock canal.

On the other hand, we must not lose sight of the fact that, if we take toll of the strictly engineering opinion of the many able minds that have been requested or appointed by the President to give their ripe judgment on this question, we find that a majority have given their vote in favor of a canal at sea level.

Thus, of the thirteen members of the International Board of Consulting Engineers, eight report in favor of a sea-level and five in favor of a lock canal; while of the six members of the Canal Commission, five are in favor of a lock canal, and one in favor of a sea-level canal. This, on the face of it, would show a balance of nine for and ten against a canal at sea level; but of the five members of the Canal Commission that voted against the sea-level canal, two, namely, the chairman, T. P. Shonts, and the governor of the canal zone, Charles E. Magoon, are not engineers. Therefore, the strictly engineering vote will stand nine in favor of a sea-level canal, and eight against it; and of these nine three are American engineers. Among the American engineers the opinion stands three in favor of the sea-level canal and eight in favor of a high-level canal with locks.

The majority report of the Board of Consulting Engineers recommends a canal at sea level with one tidal lock, having a bottom width of 150 feet, enlarged to a bottom width of 200 feet where the slopes are nearly vertical, and with a depth of 40 feet. The estimated cost is $247,000,000, and the estimated time of construction twelve to thirteen years. The minority report, which is indorsed by the Canal Commission and by President Roosevelt, calls for the construction of a lock-and-lake canal, embodying many of the features of the Lindon W. Bates plan as published in the SCIENTIFIC AMERICAN, February 3, 1906. It contemplates the erection of an enormous dam at Gatun, 7,700 feet in length, 135 feet in height, and to contain 21,200,000 cubic yards of material. There will be a 500-foot wide channel at sea level from the Atlantic to this dam, where there will be built a double flight of three locks, by which vessels will be lifted into the huge artificial lake, 85 feet above sea level, formed by the dam. The waters of the lake will spread over a vast area, and will back up through the valley of the Chagres, affording unrestricted navigation (that is, navigation independent of the channel) for a considerable part of its length. Its waters will extend through the Culebra divide, in a cut 200 feet wide, to Pedro Miguel, where descent will be made by a lock with a 30-foot lift to another lake formed by the creation of a dam in the valley of the Rio Grande. From this lake, which will be at level 55, descent will be made by a double flight of two locks to Panama Bay. The canal will have a minimum depth of 45 feet, and it is estimated that it can be built in nine years at a cost of $140,000,000.

The majority of the board of Consulting Engineers in their report say: "First and foremost, it is essential that the Panama Canal shall present not merely a means of inter-oceanic navigation, but a means for safe and uninterrupted navigation. It is therefore evident that the canal ought to be formed in such a manner that the course thereof shall be free from all unnecessary obstructions, and that no obstacles shall be interposed in that course, whether temporary or permanent, which would by their nature be an occasion of peril and of detention to passing vessels, and more particularly to vessels of the great size which the Panama Canal is (in accordance with the provisions of the law of Congress) designed to accommodate." It is because the majority of the Board consider that locks and locking operations present risks and delays, that they favor, in spite of its greater cost and longer time of construction, the sea-level canal. The minority of the Board favor a lock canal, because they believe it would have a greater capacity for traffic; would offer greater safety and speed for ships because of the deep-water navigation in the lakes; and would involve less time and lower cost of construction.

There is no denying that the economy and quickness of construction of the lake-and-lock canal, and the fact that much of the navigation would be in deep water, render the lock project decidedly attractive. But—and we wish to draw the attention of everyone that shall discuss or vote upon this all-important subject during the next few months, to the serious nature of the doubt—is any one able to state with certainty that an earth dam, 7,700 feet long and with a head of 85 feet of water back of it, can be built to stand on the treacherous foundation of the alluvial substratum of the Chagres valley at Gatun? We have just completed the reading of the late Chief Engineer Wallace's examination before the Senate Committee of Investigation, in which he gives it as his opinion, based upon the elaborate borings, that the conditions for dam foundations at this point are unsuitable, the substratum being an alluvial deposit, in places pervious to water, and extending down 256 feet before firm bottom is reached. Before any final appropriations are made by Congress for a canal whose existence will depend absolutely upon the integrity of this colossal dam, it must be proved beyond a shadow of a doubt that so unsuitable a foundation can carry such a stupendous structure under the great head of water proposed, and do so, not merely for the present generation, or the next, but for all time to come.

THE TRENCH METHOD OF TUNNEL CONSTRUCTION.

It is not unlikely that the well-known method of excavating subaqueous tunnels by means of the Greathead shield will, under certain conditions, be abandoned in favor of a new method which offers very material advantages both from the constructive and the operative point of view. We refer to what is known as the trench system of construction, which was first adopted in a modified form by Mr. McBean, the contractor for the Harlem River tunnel on the easterly branch of the New York Rapid Transit Subway. By reference to the illustrated article published in the SCIENTIFIC AMERICAN of October 31, 1901, it will be seen that the tunnel was built by dredging a trench in the river bottom and building within it a water-tight chamber, from which the mud was removed by the usual pneumatic method, the concrete tunnel being built within the rectangular prism thus provided.

We now learn that an improved application of the trench method is likely to be employed on the important two-track tunnel, which is to carry the main line of the Michigan Central Railroad beneath the Detroit River. The work will be of a magnitude and importance that will rank with that of the tunnels which are now being built by the Pennsylvania Railroad beneath the North River. The new method of construction, however, which has been proposed by Mr. W. J. Wilgus, the vice-president of the New York Central Railroad, differs from that of the North River tunnel in the fact that while the former is being driven by the Greathead shield, the Detroit River tunnel will be constructed entirely in a dredged trench. Moreover, the plan that is proposed will be a marked advance upon the one used for the Harlem River tunnel, inasmuch as the twin concrete tunnel will be built immediately in the trench, without the use of any form of cofferdam or the driving of a single foundation pile. The extreme simplicity, security, and low cost of the system, coupled with the fact that it is proposed to apply it on a work of such magnitude, will constitute this one of the most interesting pieces of subaqueous tunnel work ever attempted.

In the specifications upon which bids will be asked, there are four alternative designs presented, three of which are modifications of the trench method, while the fourth is the usual shield system. The profile of the crossing shows that for nearly 3,000 feet the twin tunnel will extend below the Detroit River, with approaches on easy grades at either end, which together will aggregate a length of about 10,000 feet. The trench method of construction will be adopted upon the stretch of tunnel lying immediately below the river. Briefly stated, it will consist in dredging a huge trench through the mud and clay of the river bottom, and filling it with a monolithic mass of concrete, the tunnels being formed in the mass by means of temporary timber tubes, which are knocked down and removed after the concrete mass has set. In more detail the proposed method is as follows: The bottom of the trench will first be covered with an 18-inch layer of large stones and rock. Upon this will be deposited, from the temporary working platforms, a two-foot bed of concrete which supports, in turn, two lines of saddles, one on the axis of each tube. On the saddles are placed, end to end, large timber cylindrical forms 22 feet in diameter and from 50 to 500 feet in length. These forms are closed at their ends, and when they are placed in line upon the saddles, a space of about four feet is left between each section, for the purpose of dividing the tunnels into separate chambers. When the two lines of forms have been completed for a specified distance, concrete will be deposited in the trench and around the tubular forms until it has been brought up to a level corresponding to a depth of 41 feet below mean water level. The wooden forms will be surrounded with a waterproof covering, either of ¾-inch sheet steel, or of some of the well-known types of waterproofing. After the concrete has had time to thoroughly set, the end chambers will be entered and the forms knocked down and removed, leaving two circular tunnels 22 feet in diameter, whose length will be determined by the position of the first of the diaphragms or division walls of concrete, by which the tube is divided into working chambers. The inner concrete tubes of the tunnel proper, about two feet in thickness, will be then built in place, these walls being formed with steel reinforcement in the usual well-known manner. When these inner linings or tubes have been completed to the first bulkhead, the latter will be broken through and the work of lining carried into the next section, this being repeated until the whole distance below the river has been traversed.

The advantages of the proposed method of tunnel construction are very material, and affect practically every side of the question. There is, in the first place, a large saving in the time of construction and in the first cost of the work. The risks incidental to all tunnel construction are also reduced to a minimum. Finally, from the standpoint of subsequent operation, there is the great advantage that the tunnel can be built very much nearer to the surface of the river bed, and, therefore, the traffic does not have to be lifted from so great a depth, as the trains are hauled up to surface grade. If the great Detroit River tunnel be successfully carried through on the lines indicated, we shall look to see a very extended application of the trench method. Indeed, it seems to us that, as an alternative method of constructing tunnels beneath the North River, it will become, if it is not already, a subject for careful consideration.

DISTILLATION OF GOLD.

Gold has long been considered one of the most difficult metals to vaporize; in fact, the only known means of accomplishing this is the use of the electric spark.

Prof. Henri Moissan, however, showed as early as 1893 that gold is rapidly set boiling in the electric furnace, as much as 40 grains of the metal being distilled in the time of a few minutes. He recently resumed his experiments in this direction, and an account of these is found in a communication to the French Academy of Sciences. The metal is shown to boil readily in the furnace at a temperature of 2,400 deg. C., 100 to 150 grains being converted to the gaseous condition within two or three minutes. By condensing the vapor on a cold body, either filiform gold or small cubes of crystallized gold are obtained. Like copper, gold at its boiling temperature is found to dissolve a small amount of carbon, which is freed again in the shape of graphite at the moment of solidification.

Gold is, however, less volatile than copper. In fact, when heating both metals under the same conditions, the latter is found to boil in a much shorter time than gold. The chemical properties of distilled gold are identical with those of hammered gold or of melted metal reduced to a fine powder. There is thus no indication of the existence of an allotropical modification of this metal.

Moissan also investigates alloys of gold and copper. There being no definite compounds of these, the copper is found to distill before the gold, and the same is true of gold-tin alloys, which were next studied. When collecting a large amount of the vapors given off from a boiling gold-tin alloy, the tin is found to burn at contact with the atmospheric oxygen, yielding tin oxide of a purple color, due to the fine gold dust condensed at its surface. This is nothing else than powder of Cassius. The same method can be used to obtain purples with different oxides, such as silica, zirconium, or magnesium oxide, lime, and alumina. The boiling point of gold, while higher than that of copper, is found to be lower than the boiling point of lime.