SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter.]

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

Vol. LXXIV.—No. 21. ESTABLISHED 1845. | NEW YORK, MAY 23, 1896 | $3.00 A YEAR. WEEKLY.

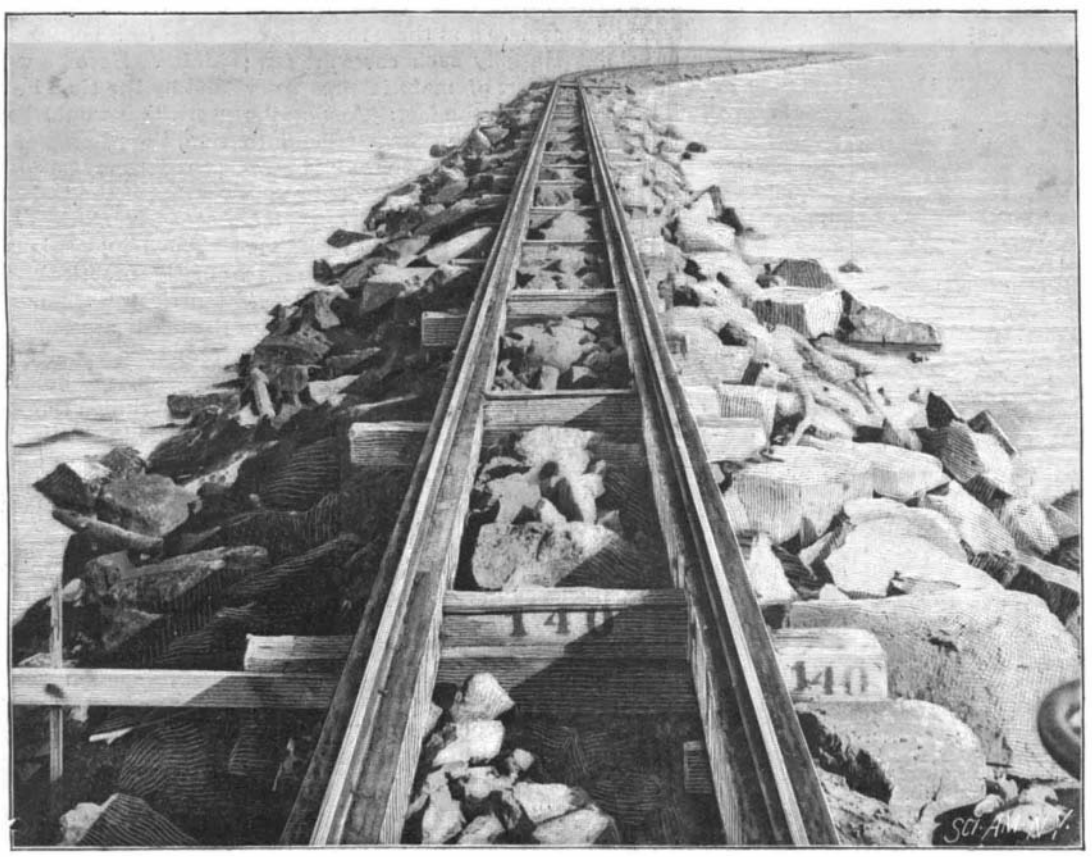
THE JETTIES AT GALVESTON HARBOR.

BY WALFRED WILSON.

There are four places on the Gulf coast of Texas that have each been trying for years to be designated as the harbor of the Gulf, by acquiring and maintaining deep water at their ports. For but one of the places, however, has the United States appropriated a sufficient sum of money to build jetties long enough to extend beyond the outer bar, that the action of the tide flowing in and out through the jetties may wash away this bar of sand and thus maintain a sufficient depth of water to admit the entrance of the largest vessels afloat. This place is Galveston, for which the government has appropriated $7,000,000, made a contract with J. H. O'Conner and E. H. Smoot, of Dallas, Texas, and the work is now being pushed to completion as fast as money and labor can push it.

The obstructions to deep water navigation at the harbor of Galveston have been the outer and inner bars. On the former the natural depth was 12 feet and on the latter about 13 feet, both at mean low tide. The present project for the improvement at this locality was adopted in 1874, modified in 1880 and again modified in 1886, the object being to deepen the channel so as to admit seagoing vessels of the deepest draught. The projects prior to 1874 related to dredging operations on a small scale only. The projects of 1874 and 1880 contemplated the constructing of two jetties to extend into the Gulf of Mexico, to concentrate the ebb flow upon the outer bar in the Gulf, and also effect deepening on the inner bar at the entrance to Galveston channel, these jetties to have their origins respectively at Boliver Point and Fort Point. The project of 1874 was with a view of obtaining a depth of 18 feet. More or less work was done under these pro-

(Continued on page 327.)



THE GALVESTON JETTIES—LOOKING TOWARD LAND.

CONSTRUCTION OF JETTIES AT GALVESTON TEXAS.

THE JETTIES AT GALVESTON HARBOR.

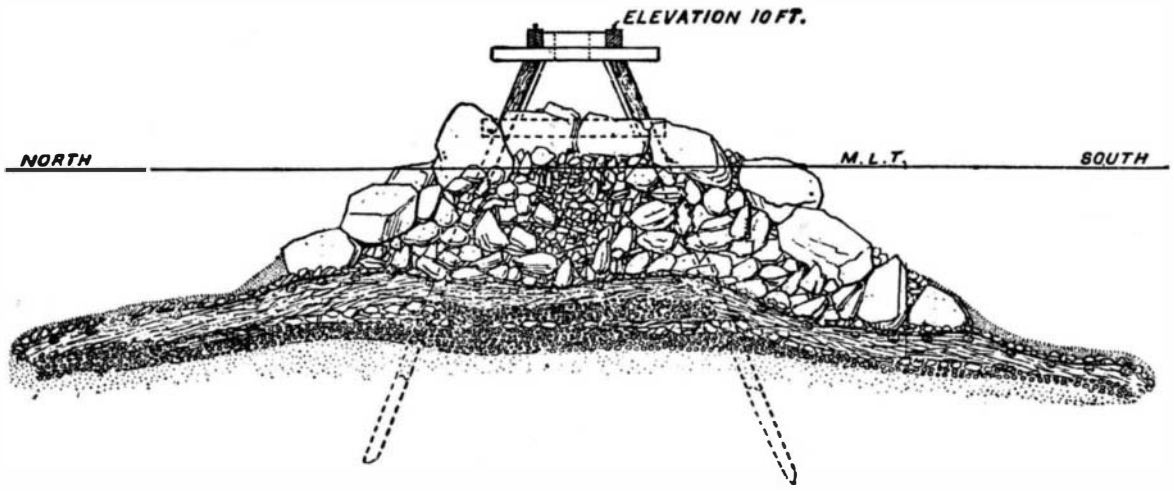
(Continued from first page.)

jects. Under that of 1880 a jetty was built from Fort Point, the east end of Galveston Island, to the crest of the outer bar, but it was not fully completed.

The modification of 1886 (now in progress of execution) was with a view to a possible depth of 30 feet, by means of jetties, to be supplemented, if need be, by dredging. These jetties were to be of rock and to be built to a height of 5 feet above mean low tide, extending if necessary to the contour of the 30 foot depth in the Gulf, their sea ends to be 7,000 feet apart, and the south jetty to follow the line of the jetty of 1881. But it was decided to connect the inner end of that jetty with the relatively high ground upon which the city of Galveston is built by a stone dike known as the shore branch.

The cost of the modification of 1886 (the present project) was estimated at $7.000,000. The total amount expended under the foregoing plans to December 12, 1895, was $4,846,105.08, in addition to which there was expended $100,000 subscribed by the city of Galveston in 1883. The total work done since operations began in 1887 is represented by 33,820 feet of south jetty, of which 32,000 feet is completed, and 23,600 feet of north jetty, of which 21,200 feet is completed. Both jetties are beyond the bar, in about 23 feet of water.

The general construction of the jetties has been modified from time to time as the exigency of the work demanded, but in general it has been carried on as shown in the accompanying illustration. The trestle is driven from 600 to 800 feet in advance over the old mattress work and the caps, stringers and rails properly secured by straps, bolts and spikes. Then large sandstone riprap is unloaded on each side of the track. In the center and between the mounds thus formed there is unloaded small sandstone riprap to the same height as the mound, the whole forming an apron with a base of about 20 feet on top of the old mattress work. The trestle and apron are continued in advance and the work which was before an apron is now brought up to mean low tide with large riprap, the small riprap being filled in as before. This riprap slope is straightway protected with granite blocks to a little above mean low tide. A bracing gang then comes along and secures the bearing piles above the ravages of the Teredo navalis by a system of bracing, which also acts as an anchor and underpinning. Then the crest between and around the bents and underpinning and underbracing is filled with large and small riprap as before. Then over this riprap crest is laid selected granite block so as to conform as nearly as possible to the required cross section. The spaces between the blocks are then filled with large and small riprap, properly wedging and leveling off the crest, the whole presenting a comparatively smooth and even surface to the waves.



JETTIES AT GALVESTON HARBOR, TEXAS—SECTIONAL VIEW.

The sandstone riprap has been procured from Ledbetter, Quarry Station, and Heber stone quarries, Texas, and the granite comes from Granite Mountain, Burnet County, Texas. The minimum weight of the blocks of granite used is five tons, and on the arrival of the stone in the contractor's yard at Fort Point it is inspected as to its hardness, toughness, weight and durability. The hardness and toughness is determined by the hammer, the weight by specific gravity, viz., immersing a large sample of stone of known weight dry in a tank filled with water, then catching and weighing the displaced water and reweighing the sample wet, the amount of water imbibed by the sample is also noted; using the specific gravity data and the stone's general appearance, durability is determined, supplemented by immersing samples in sea water and carefully noting disintegration or change of any kind. The stone is also subjected to "M. Brard's method" of testing.

The jetties when finished will make Galveston the export and import harbor of a large section of country.

I am indebted for data to Major A. M. Miller, U. S. A., engineer in charge, Mr. E. M. Hartrick, assistant engineer, and Mr. C. H. McMaster, secretary, Galveston Chamber of Commerce.

DR. FICK has shown that winking is more frequent as the retina becomes more fatigued, and it has been found that in reading at a distance of 30 centimeters the number of winks per minute is 1·8 with electrical illumination, 2·8 with gaslight, while with weak illumination which only permits reading at 18 centimeters the number is 6·8 per minute.

The Nicaragua Canal and Its Competitors.

The report of the board of engineers appointed by the President to examine and report on the Nicaragua Canal project places the probable cost at $133,472,893 as against the $69,893,660 estimated by the canal company's engineers. In spite of the fact that it nearly doubles the estimates, the report is by no means fatal to the ultimate success of the scheme. Coming just now with its strong note of warning, it will prevent hasty action in an enterprise the gravity of which calls for mature deliberation; and far from delaying, it will probably, in the long run, promote the successful completion of the canal.

It has been proved repeatedly that estimates of the cost of engineering works which involve the excavation and removal of large masses of earth, gravel, rock, etc., especially in the construction of waterways, are liable to run far below the actual cost of construction. The Panama Canal is a notable instance of this, and the Manchester Ship Canal Company had outrun the first estimates long before the completion of the work, and were only saved from collapse by the liberal assistance of the city of Manchester. The cause of this discrepancy, particularly in canal excavation, is to be found in the uncertain nature of the material, the failure to make sufficiently thorough subsurface examinations by boring, and in unexpected interruptions by storms, floods, and other natural disturbances, which are liable to interfere with the execution of the work. It is evident from the report that the commissioner is of the opinion that the estimate of the canal company's engineers was based upon a too rapid and superficial survey of the route, and that the data was too incomplete for a reliable estimate of the quality and amount of the material which would have to be moved. The report, moreover, lays great stress upon the fact that the rainfall along the route of the canal is exceptionally heavy. At Greytown, the proposed Atlantic terminus, a record extending over three years showed a mean rainfall of over twenty-two feet, and on the west coast the mean for fourteen years was five feet five inches, varying between eight feet nine inches and two feet eight inches. In view of the fact that the proposed canal involves "the construction of numerous dams and embankments of magnitude, some of them without precedent in engineering practice, and all involving serious hydraulic problems," the necessity for obtaining accurate local records of the rainfall is apparent. As an instance of the discrepancy between the figures of the engineers of the company and those of the government engineers, it is sufficient to state that at a point a few miles below the Ochoa dam the former estimated the maximum flood discharge of the river at 42,000 cubic feet per second, whereas the latter estimate this discharge at 150,000 cubic feet.

The great Ochoa dam, in some respects an unprecedented undertaking, is estimated by the company to cost $977,000 and by the board of engineers to cost $4,000,000; and throughout the whole route, from Greytown to Brito, the estimates of the company are largely increased by the President's commission.

In concluding, the report recommends that a sum of $350,000 be spent in ascertaining by a thorough survey the necessary data for the drawing up of reliable plans and estimates. Such a survey would inspire confidence in the financial world, and would give a standing to the enterprise which it cannot be said to possess at present. The Nicaragua Canal Company is requesting that Congress guarantee its bonds to the extent of $100,000,000. Before any such sum is pledged to the construction of the canal it is not too much to ask that the nation shall know with some certainty what the actual cost of the undertaking will be.

Taking it altogether, if the final recommendation be carried out, the report should exercise a favorable influence upon the project; and it is likely that, when an exhaustive survey has been made, the commercial and strategic advantages of national control of the canal will lead to its being materially assisted by the government.

The abortive effort of the old Panama Canal Company to connect the two oceans is marked by a long stretch of incompleted work at the Isthmus. It is estimated that of the total sum handled by the company, about $100,000,000 was misappropriated by the promoters, and that about $150,000,000 was spent in the purchase of plant and in actual work upon the canal; while some $20,000,000 is held by the French courts and will be available should construction be carried on.

Mr. Robert T. Hill, of the United States Geological Survey, who has made a personal visit to the canal works, states that the canal commission has employed about 2,000 men during the past year, and that the plant is being kept in good order and will be available if work should be started. About twenty miles have been completed, and twenty-five miles remain to be cut. To complete the canal with six locks and a dam at San Pablo would cost $116,000,000 in addition to the $266,000,000 already spent. The work of raising this large sum of money is rendered difficult by the fact that public opinion in France demands that those who furnish the new capital shall share the dividends of the completed canal in common with the original shareholders.

Another scheme for the passage of shipping from ocean to ocean is that which proposes to build, at Tehuantepec, a ship railway capable of transporting vessels of 10,000 tons displacement. The advocates of this scheme believe that had it not been for the untimely death of Capt. Eads, who was an enthusiastic believer in the possibilities of the ship railway, it would have been built and in operation by this time. It was unfortunate, moreover, for the success of the Tehuantepec scheme that work on the Chignecto ship railway, from the Bay of Fundy to the Gulf of St. Lawrence, was shut down when it was within measurable distance of completion. Once the latter scheme is in successful operation, it is likely that an effort will be made to construct a similar road at Tehuantepec.

Elmer L. Corthell, in a recent number of the National Geographic Magazine, estimates the cost of the ship railway at $60,000,000. The relatively small cost of construction of the railway, and the fact that it would bring Atlantic and Pacific ports 1,400 miles nearer than the canal, are considerations which make it likely that if the Chignecto railway is successful, the building of the Tehuantepec line will be seriously considered.

Sustain the Vital Forces.

Sustain the vital forces! After all, this is the key to life. It is the guide to the restoration of health. It is the primary principle in the successful treatment of disease. Talk as you will about the invasion of the human body by bacteria. Sustain the vital forces, if you will render them powerless. Bacteria cannot thrive in the physiological field. The unseen enemies of this silent realm are rendered harmless in a body of perfect health. The fateful germ can only enter when its defenses are destroyed. Antiseptics may kill the germs or stop their propagation, but the main thing, after all, is to sustain the vital forces.

The old idea of battling with both nature and disease is exploded. He who depresses the system to get rid of pathological conditions is behind the time.

Germs are always with us, but they can do no harm unless through some breach they enter the sanctuary. Even then they are often rendered harmless, except it be some organism whose defensive mechanism is rendered weak through excesses or disease. Germs may produce disease, but health never produces germs. Deadly germs must live only in a pabulum homogeneous to their character; hence, so long as the strength of vital force is maintained, they are insignificant creatures.

Sustain the vital forces. In health this means to keep in health. It means good air, thorough cleanliness, good food, no excesses, labor in moderation, no mental worry.

In sickness, it means more. The flagging energies must be revived, stimulated, toned. Air, cleanliness, food, must be by special selection. Drugs can only do good when they rid the system of morbific matter and restore the function of organs. We aid in tissue building when we sustain the vital forces. We restore function by sustaining the vital forces. We drive out bacteria and render them harmless by so doing. The whole medical world is coming to this old tenet, which formed at the beginning of our reformation the keystone and head of the corner.—The American Medical Journal.