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STUDIES OF MEAN SEALEVEL

IN a former issue of this journal[1] there appeared a brief account of sealevel studies undertaken in New York waters to test the theory, advanced by the writer, that along an irregular coast mean sealevel is an irregular surface the precise elevation of which varies with changes in the form of the shore. The studies were carried on under the direction of the division of geology and geography of the National Research Council and have recently been completed. The ultimate success of the undertaking must be credited to several agencies which generously cooperated with the National Research Council to make the study possible, particularly the U. S. Coast and Geodetic Survey, which bore the major burden in the joint effort. A full report will be published in the near future covering (a) the theoretical considerations upon which the whole study was based; (b) the tidal observations, including full field data, prepared by Mr. Paul Schureman, of the Coast and Geodetic Survey, for possible use by those who fifty, a hundred or more years hence may wish to make similar observations for purposes of comparison; and (c) the interpretation of results of the tidal observations, especially in relation to problems of more than local interest.

The outstanding results of the tidal observations to be described in the report are as follows:

(a) The tidal range within Jamaica Bay is greater than at Fort Hamilton near the head of the more open Lower (New York) Bay.

(b) Mean sealevel at all three stations in Jamaica Bay is higher than at Fort Hamilton.

[1] "Shoreline Investigations on the Atlantic Coast," SCIENCE, n. s., 65, pp. 4–7, 1927.

(c) Even within the bay the plane of mean sealevel is not level, but is higher at the northeastern station than at the southern and western stations.

(d) Tidal observations at Fort Hamilton extending over a period of thirty-five years indicate no appreciable change in sealevel at that point during the period of observations.

Let us consider the significance of these points in the order named.

(a) Jamaica Bay was selected as the site of the tidal study here described, in part because it was believed that the breadth and the depth of the inlet would admit tidal waters freely and that the relatively small size of the bay, combined with the fact that much of its area is occupied by marshes and mud flats, would prevent the entering waters from spreading far. Hence it was not expected that this locality would present those extreme conditions encountered where a narrow and shallow inlet into a broad and deep bay or lagoon favors a very small tidal range and at the same time a distinctly higher mean sealevel inside the embayment. The fact that the tidal range in Jamaica Bay exceeds that at Fort Hamilton is sufficient indication that the tidal waters do enter and leave the bay *with great freedom and show that* the locality was well chosen as an example of moderate rather than extreme conditions favorable to variations in the height of mean sealevel. In this connection it should be noted that not only does high water in the bay rise higher than at Fort Hamilton, but that low water also falls lower, showing that the outflowing waters are not unduly impeded by an exit channel greatly restricted in breadth in its lower levels.

(b) That mean sealevel within Jamaica Bay should at all three tide stations prove to be appreciably higher than at Fort Hamilton, despite the relatively

free ingress and egress of tidal waters, and other conditions generally unfavorable to the development of sealevel differences, is most significant. The shape of the inlet channel may account for part of the observed difference in sealevel height, and there might thus be a higher mean sealevel in the bay if no other factor than the tidal régime as affected by the shore form entered into the picture. But other factors are doubtless involved. Some fresh water from the surrounding land enters the bay, although the locality was selected in part because the quantity of this water was believed to be small. Partial impounding of this water, and its lower density as compared with the sea water, would both tend to raise sealevel slightly within the bay. Winds from a westerly direction have in this region a greater average intensity than those from an easterly direction, and due to the form and position of the mouth of Jamaica Bay westerly winds should be more effective in blowing water into the bay and holding it there than would be the case at Fort Hamilton. Just as the shape of the entrance channel may distort the position of mean sealevel, so also the form of channels, shoals and bordering island and mainland shores within the bay may have their effect. None of these factors should produce a great effect in the Jamaica Bay region but each may play a minor rôle. The observed differences in mean sealevel are thus presumably the resultants of a combination of causes, each producing a very limited effect because of the physiographic conditions of the locality.

The quantitative values of the observed differences in mean sealevel are quite as great as, if not greater than, were anticipated. From the physiography of Jamaica Bay and its surroundings it was predicted that the differences found would be "very small, at most a very few inches and possibly only fractions