

SCIENTIFIC SURVEY IN WINYAH BAY

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This discussion supplements the previous report on this project in «Basic Surveys for Beach and Harbor Studies», pages 21-32, the International Hydrographic Review (Nov. 1958).

The 77-foot Coast and Geodetic Survey vessel *Gilbert* completed early in 1959 the second and final phase of the survey of the currents in Winyah Bay, South Carolina. The study was carried out in conjunction with the Charleston District of the U.S. Army Corps of Engineers to determine causes of the heavy rate of shoaling in the navigational channels and to develop remedial measures to reduce maintenance dredging requirements. Speed and direction of currents were determined, both surface and subsurface, as well as their variation with the changing tide and with differences in the discharge from the Pee Dee, Waccamaw, and Sampit Rivers. Two tide gauges were operated throughout the survey, one at Georgetown near the head of the bay, and another near the mouth of Winyah Bay. The first phase was accomplished during the spring and late fall of 1958. Both phases were conducted specifically for the collection of data to accomplish the purposes of the survey.

The results of this survey are required by the Army Engineers in an extensive investigation to determine the feasibility of deepening the channel in Winyah Bay. Shoaling has been a problem here for many years. The ordinary depth is about 19 feet, with a depth of 27 feet maintained by dredging. If the presently anticipated deepening of about 15 feet, increasing the channel depth to a maximum of 42 feet, is feasible then the way is opened for the development of a variety of industrial enterprises. The question of depth in this area is considered of multi-million dollar significance. Facts revealed during this survey will represent the first plateau in solving engineering problems basic to industrial expansion along the shores of an important South Atlantic coastal area.

Nine stations distributed along Winyah Bay channel were occupied during the first phase in the spring of 1958, while the river discharge was high. During the second phase a resurvey was made at these same nine stations to determine how the currents are affected by the lower discharge rates of late fall. These field surveys, under the direction of Commander C.A. Schoene, USC&GS, will provide data which will eventually become usable information for the Corps of Engineers in their study of silting in the Winyah Bay-Georgetown Harbor area.

The Coast and Geodetic Survey of the United States Department of Commerce has over the years developed the equipment and techniques for accurate measurement of currents in our coastal waters. At each station where measurements are needed a boat-like buoy, 10 feet in length, is anchored. Beneath each of these buoys three current meters are suspended one near the surface, one at mid-depth, and one near the bottom. A small propeller, turned by the current, makes electrical contacts that are radioed from the buoy to the survey ship. These " pips " are recorded on long rolls of tape, together with time " pips " from a chronometer. Direction is also recorded by these " pips ", depending upon the angle between the orientation of the meter as it streams with the current and a small compass mounted inside the meter.

During the survey operations in Winyah Bay, the *Gilbert* monitored three such buoy stations simultaneously. Every half hour for 100 hours an observation was taped from each of three meters suspended below the three buoys. The officers and men of the *Gilbert* kept round-the-clock watches as the radio signals came in over the radio. The time, direction, and speed of the currents, together with weather data, were recorded in log books. These, along with the original tapes, were sent to the Washington headquarters of the Coast and Geodetic Survey for checking, verification, processing, and analysis.

The currents in Winyah Bay are primarily reversing tidal currents. That is, they flow into and up the bay on the flood tide and six hours later they flow out on the ebb tide. Superimposed on this tidal flood and ebb is the nontidal, down-bay movement of fresh water supplied by the Pee Dee, Waccamaw, and Sampit Rivers.

While the Coast and Geodetic Survey vessel was making current measurements, the *Winyah Bay*, a vessel belonging to the Corps of Engineers, was occupying stations to study the variation of water temperature and salinity with relation to depth and time. The salinity, or amount of dissolved salts, shows how much of a given sample is river water and how much is ocean water. This is dependent upon the amount of mixing that has taken place and is as valuable clue to the over-all water circulation pattern in a bay.

In general, when river runoff is very low, a bay is composed almost entirely of salt water which has come in from the ocean. Under such conditions fresh water from tributary rivers flows out on top, as it has a lesser density than the saline ocean water. When the flow from tributary rivers increases, the mixing of the waters in the bay increases correspondingly. At times the estuary may be of the stratified type with fresh water on top, a mixed layer between, and high salinity water on the bottom. On the other hand, it may be so completely mixed at high river stages that the water is what Coast and Geodetic Survey oceanographers call *isohaline*, of equal salinity from top to bottom.

These are the problems of Winyah Bay circulation that personnel of the ships *Gilbert* and *Winyah Bay* have been attempting to solve. The circulation must be known in order to evaluate the causes of the deposits of silt which are accumulating in parts of Georgetown Harbor and at certain places in Winyah Bay.

Survey data are necessary to determine the cause of shoaling and will

provide the basis for Corps of Engineers planning to cut down the annual cost of maintenance. In addition to aiding in the solution of dredging problems the data will provide for improved predictions in the Coast and Geodetic Survey annual tidal current tables.