# THE DREDGE OF THE WOODS HOLE OCEANOGRAPHIC INSTITUTION

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The only solution lies in using a dredge which will secure as representative a sample as possible under existing conditions. Roughly, dredges fall into three groups and all have drawbacks. There is the coring tube, the snapper or grab variety, and various forms of scraper dredges. The coring tube, although excellent for soft bottoms, will not take a sample in hard-packed sand or gravel. Scrapers and snappers have two major faults in common, which render them unsatisfactory except in shallow water. First, the sample is never uniform, i.e. the dredge digs to varying depths below the surface depending upon the character of the bottom, and, secondly, the container is not water tight and selective washing of the material occurs on the trip to the surface. This is particularly true of the snapper variety in which the jaws are always held apart to a varying degree by sand and pebbles. If one goes to the trouble of making a mechanical analysis, it seems worth while to use a dredge which will eliminate these faults, so that additional errors may not be super-imposed on the already existing sampling error.

Accordingly, with C. O'D. Iselin the machine was designed which appears in Fig. 2. When the apparatus is first lowered over the side the whole weight is carried by the bail (a) into which the release (b) is hooked. The wire from the winch is made fast to a shackle in the upper end of the release, and the wire from the drum (c) is made fast to the lower end. When the dredge reaches the bottom the hoisting wire goes slack and the release is tripped. It was found advisable to solder a rectangle of sheet zinc (d) at right angles to the release arm, for when any considerable length of wire was out, a sharp roll of the vessel was often enough

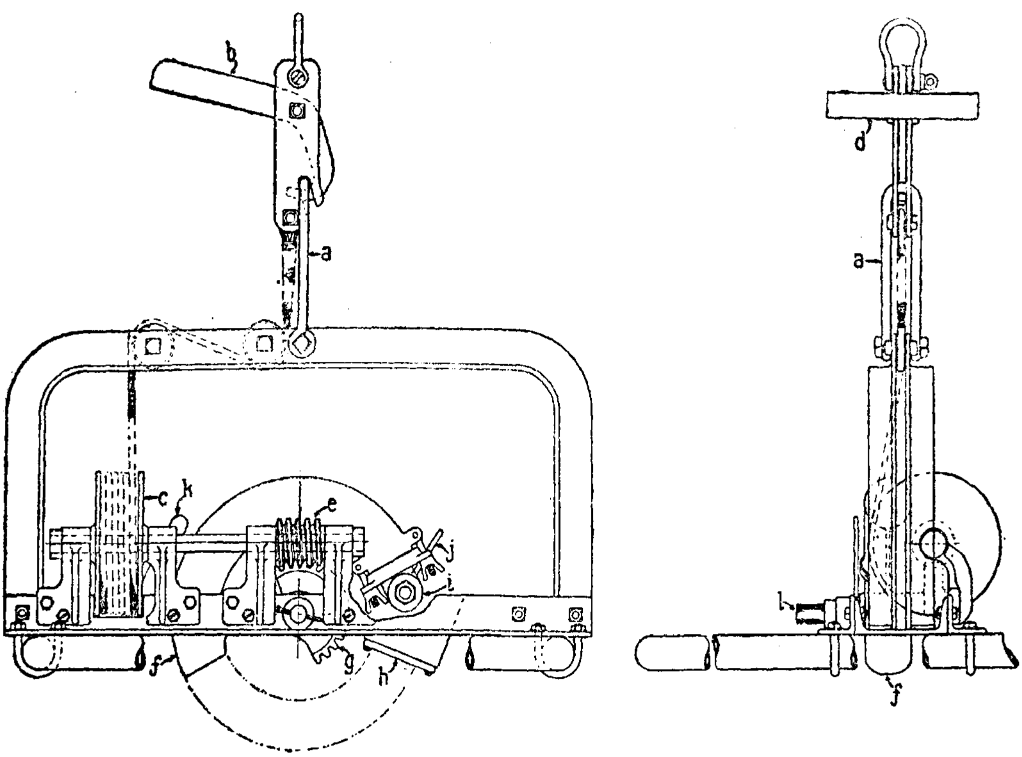


Fig. 2.

to slacken the wire sufficiently to allow the release to operate prematurely. The resistance offered by the water to this plate while the dredge was sinking was sufficient to keep the release in place until bottom was reached.

When hoisting, after the release has tripped, the strain comes on the wire which has been wound on the drum, and the dredge, which weighs 125 pounds, cannot be lifted from the bottom until all the wire (about 25 feet) has been unreeled. This turns the worm gear (e) which drives the cutter (f) by means of a segment of a beveled gear (g). The cutter, which is a hollow, bronze casting, 2 inches in diameter, rotates through a semicircle. The last turn of wire on the drum drives the mouth of the cutter against the soft rubber pad, (h) which completely seals it. Considerable mechanical advantage is secured by this system of gearing. As the sediment is scooped in, the water is allowed to escape through a stop cock (i) fitted to the cap which closes the back end of the cutter. The cap is held on by wing nuts. The stop cock is closed by its lever (j) coming in contact with an arm (k) which is fixed to the frame. For dumping the contents the whole cutter is removed from the dredge by pulling out the axle (l), the cap is taken off and the sediment washed out. It was found that a rectangle of brass pipe bolted to the frame of the dredge afforded the best sort of a base for keeping the machine upright on the bottom. Cross pieces of wood were first tried because it was thought that the apparatus would sink too deeply in soft bottoms, but the resistance offered to the water by these flat surfaces while lowering was very considerable, and the time consumed in making a station was too great. The pipe offers much less resistance and does not sink in appreciably on a muddy bottom.

## *Summary and Conclusions*

1. Eight traverses were run across the continental shelf between Cape Cod and Cape Canaveral, beginning as near the beach as possible and continuing over the break in slope. Three were taken in the Gulf of Maine beginning at the shoreline and running to the bottom of the basin, and two short ones were made crossing the break in slope south of New England. Samples were never taken more than two miles apart and frequently at intervals of a mile or even half a mile.

2. A special kind of dredge was constructed to take a uniform sample and seal it off from the water to prevent washing on the upward trip.

3. The New England lines, in general, have a common pattern for the distribution of the sediments, and although in the shorter lines from the Gulf of Maine the different zones are compressed into a fewer number of miles, they can still be clearly distinguished. In an offshore direction they occur in the following order : relatively fine, well sorted sand ; coarse, well sorted sand ; and poorly sorted silts and clays. At the break in slope is a well sorted sand. There is a remarkably close correspondence in the depth of the water at which these zones are encountered on the different lines although the topographic profile, which governs the distance from shore at which they occur varies.

4. The New Jersey and Maryland lines show fairly well sorted sands out to the break in slope, with little diminution of the median diameters.

5. The four traverses south of Cape Hatteras, in general, share the same characteristics. There is a near shore belt of fine, well sorted quartz sand, and from this point to the break in slope the sand is coarse and well sorted. The inorganic material is gradually replaced by shell fragments and calcareous cölites. Below the break in slope the Gulf Stream carries away all sediment.

6. The $CaCO_3$ content is low north of Cape Hatteras but reaches high percentages in the southern lines, particularly in samples from the outer parts of the shelf.

7. A profile of equilibrium has developed on the inner portions of some of the New England lines, as is demonstrated by the sedimentary as well as the topographic data. South of Cape Hatteras the water over the shelf is relatively shallow and the full width of the shelf may be considered as the inner part of the profile of equilibrium which has been truncated by the Gulf Stream.

8. Hydrographic data indicate that in winter the water over the shelf is everywhere stirred by the wind from top to bottom. The sedimentary data show that this stirring by wave action alone is feeble below 60 to 70 metres. Bottom scour is probably accomplished by a combination of tidal currents and wave action, and is not due to the currents which control the general oceanic circulation.

9. The well sorted sands at the break in slope are probably residual from Pleistocene conditions when the sea stood at a lower level. On the northern lines, although the water is

deep enough for the deposition of silts and clays, present sea level has been attained so recently that the finer grade sizes have not been able to work out from shore and bury them. The rounded, frosted quartz sand, which is found on the northern lines, is considered to have been derived from Pleistocene dunes which were formed on the shelf during the repeated withdrawals of the sea throughout that period.

10. Rivers are contributing little or nothing to the present sediment of the continental shelf. Off New England the sea is working with material directly eroded from the shore, as well as with a certain amount eroded from the offshore bottoms. The source is glacial debris, and to a minor degree, Cretaceous and late Tertiary deposits. From New Jersey southward the present day sediments are derived entirely from the reworking of the topmost deposits of the Coastal Plain which are now beneath the sea.

11. There is no steady gradation of the sediments from coarse to fine in an offshore direction. There is, however, a certain uniformity in their arrangement when they are considered by regions. Depth of water appears to be the controlling factor. The present depth is largely governed by warpings of the Coastal Plain and not by erosion or deposition.

12. The sediments of the continental shelf are, for the most part, becoming adjusted to present sea level ; in some places the adjustment is still in progress. The factors governing conditions of sedimentation in a major ocean are so different from those obtaining in an inland basin or an epicontinental sea, that comparison is difficult, and the arrangement of sediments in one cannot be regarded as typical for the other.

13. Coastal Plain sediments are noted for their rapid stratigraphic changes. The same diversity is found in the modern sediments covering the top of the shelf, upon which the present day ocean is directly acting. Evidently conditions of transportation and deposition have remained much the same since the Upper Cretaceous.

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