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Drifting Sand in the Sea

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The sand drift in the sea must occur most conspicuously in the stormy weather. But there is no means to measure the amount of drifting sand with absolute exactitude as the apparatus to catch the drifting sand is very likely to be destroyed by the storm. Since several years ago bamboo sticks of a diameter 5cm to 8 cm have been used and proved to be the most convenient apparatus for this prupose. Though the results indicate only the approximate quantity of the drifting sand, the relative distribution of the drifting sand with respect to the three dimensions can be obtained. Moreover the cost of bamboo is very little; we can place them at so many positions that the results of the observations may not be influenced even if some of them are lost in the storm. By this method it is possible to learn

(1) The boundary where the sand drift seems to appear.
(2) The distribution of the amount of the drifting sand with respect to the distance from the bottom of every position.

Moreover we can judge from where the sand drifted by measuring the size and density of the particles caught in the joint of bamboo.

I Introduction

There are many, extensive sand beaches in the coast of Japan, the erosion of sand beaches and sedimentation of sand in the harbours or the river mouths are troublesome problems of civil engineering. The state of the sand drift in the sea must be known as a first point in the investigation of these problems. But the sand drift must be most conspicuous in the stormy weather. As the apparatus to catch the sand drift or to record the amount of the sand drift is quite likely to be destroyed by the storm, it seems that there is no exact means to deal with these problems. However, since several years ago, a convenient apparatus has been used by us and proved to be satisfactory for this purpose. The apparatus consists of bamboo sticks* and some weights to anchor

* The method of measuring sand-drift in the open sea by means of bamboo stick is originated by Yoshiiku MORITA, civil engineer of government of Hokkaido.

them. Sometimes some units of the apparatus are broken and carried away by the storm. But the cost of each unit is very low and they can be placed at so many positions that the result of observation may not be influenced even if some of them are lost in the storm.

II Apparatus

A bamboo stick 5 cm–8 cm in diameter, 4 m–5 m in length is used for this purpose. Elliptical holes 5 cm in major radius and 1 cm in minor radius are bored through out diametrically in all alternate joints. These joints play the role of traps to catch the drifting sand while the remaining joints not bored play the role of buoys to make the bamboo stick stand vertically. A block of concrete of about 15 kg is used as a weight to anchor them, and the bamboo stick is loosely attached by thick wire as shown in Fig. 1. In the deep sea several bamboo sticks are used connected in series with thick wire. As there is some distance between the lower end of the lowest bamboo stick and the bottom of the sea as shown in Fig. 1, a short stick about 1 m in length having holes in every joint is added and fixed one end to the block of concrete and the other to the lowest bamboo stick standing vertically.

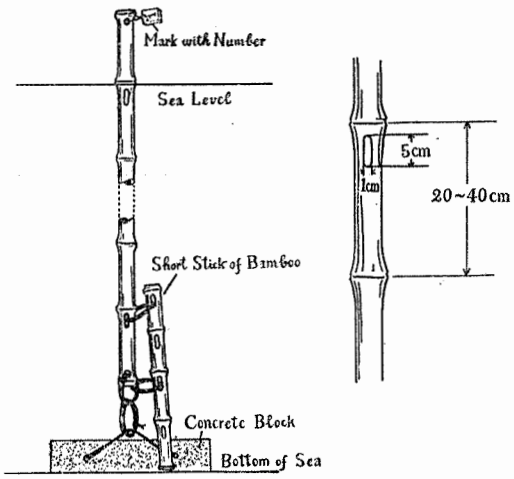

Fig. 1.

III Instruction for procedure

At first, we measure the depth of the sea where we are going to place the apparatus, and next cut the bamboo stick or connect the separate sticks so as to be about 50 cm longer than the depth of the sea at that position. Finally we throw the concrete block attached to the bamboo stick, or sticks, into the sea. Then the bamboo sticks will stand vertically. As the bamboo sticks are swung incessantly by the wind or waves, the height of the holes is not exactly constant, but even if we neglect the fluctuations of height due to the inclination of the bamboo stick, we shall have a tolerable value, unless the sea is very shallow. After several weeks, we search for the bamboo sticks and draw them out of the water by hand. Sometimes the concrete anchor block is so buried in the sand that it can not be drawn out by hand. In such a case, we wind up the hanging wire attached to the concrete block by winch. Drawing the bamboo sticks vertically out of water we cut them carefully in short sections of about one meter so that the contents in the bamboo joint may not pour out, at the same time black tape (ordinary electric insulation tape) is wound around the bamboo stick so as perfectly to cover each hole. These bamboo sticks are taken to our laboratory where particles sedimented in the bamboo joints are taken out for study.

All these processes can be carried out in a calm sea, but the contents of the sections may include the sand drifting in the storm. As the hole is bored in one direction, it may be considered that the drifting sand is caught only from the same direction as the hole is faced. But by laboratory experiment it is found that the drifting sand can be caught even where the direction of the drift is not directly toward the holes. Moreover, since the connection of the bamboo sticks is loose, they are vibrated and rotated by the waves and the mean result will show nearly reliable value. In fact this method can not strictly give the exact amount of the drifting sand, but the mean relative amount of the drifting sand during the required interval can be obtained. Thus the distribution of the amount of the drifting sand can be obtained rather inexpensively, only at the cost of bamboo sticks and black tape as the concrete anchor blocks can be used repeatedly.

IV Result

By this method the present authors have observed the drifting sand at many points of the Hokkaido coast: Ishikari, Tomakomai, Higashishizunai. Teshio, Haboro and Shimoyûbetsu. From the results of the observation, we could determine the boundary of the area where the drifting sand is obvious, and we could also obtain the distribution of the amount of the drifting sand with respect to the distance from the bottom of the sea and from the shore. Thus may be obtained not only some valuable data for the construction of harbours or sea walls, but also many interesting geophysical and oceanological data by analysing the drifting particles. We shall show some examples.

EXAMPLE I. At the beach about 2 km distant from the mouth of the Ishikari River, we placed the apparatus in the summer of 1949 in a line at points from 200 m to 2200 m, from the beach. They were taken out after 40 days. In the interval, there came Tyhoon "Kitty", and some pieces of the apparatus were lost. The distribution of drifting particle at each point in shown by the curves in Fig. 2.

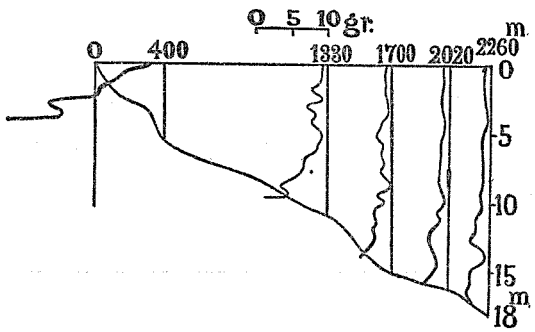

Fig. 2.

It is remarkable that at off shore points a considerable amount of drifting particles was found in such deep positions. As the particles were too small to be separated from each other, their size could not be measured even by microscope, and they could be classified only by the velocity of sedimentation. On the other hand the sand particles at the bottom of the same positions were measured. Their size decreased with the distance from shore and the mean value of the diameter was 0.001-0.003 cm. The drifting

particles were evidently different from the sand at the bottom, and they could remain, being suspended in the water for a long time. Moreover in the calm sea, we could not recognize such dense drifting particles. Therefore it may be natural to think that the drifting particles must be carried with a large circulation such as occurred in consequence of the Tyhoon "Kitty". At that time the direction of wind was from shore to sea, therefore the circulation must be caused by the stream which flowed from shore toward the sea through the upper part of the sea and from sea to shore at lower levels. Judging from the velocity of sedimentation of the drifting particles, it is concluded that there are different strata of water. This has often been observed.

EXAMPLE II. At Tomakomai, the sand at the beach consists of volcanic matter and the inclination of the bottom of the sea is so gentle that the depth at the position 600 m from shore is only about 6 meters. Observations by this method were made three times in the summer of 1950, and two times in the summer of 1951.

About a hundred sets of appartus were used. Only a few of them were lost by storm. In fig. 3 we show one of the results which were obtained along a line from shore to seaward.

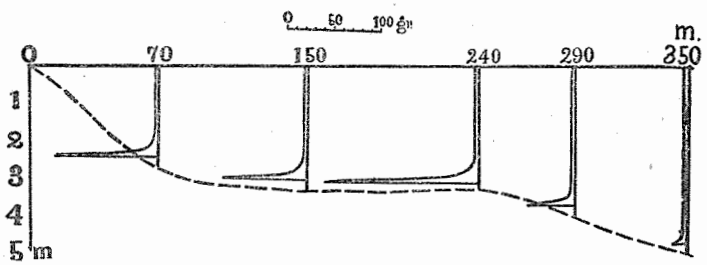

Fig. 3.

From these results, it can be concluded that: 1) there was only a negligibly small amount of drifting sand at a position 6 m in depth (600 m from shore), 2) between the first sand ridge and shore there was a conspicuous occurrance of drifting sand at any part from surface to bottom, 3) over the ridge, there flowed a considerable amount of drifting sand near the bottom of the sea and a thin stratum of drifting sand near the surface, and 4) most movable sand which was able to flow over the ridge was of the

150–200 meshs diameter.

EXAMPLE. III. The small harbour of Higashishizunai was filled with sand. By boring the harbour, it was found that the sand consisted of the three sorts, large type whose grains measure a few mm in diameter, white light type which is easy to flow and small type about 0.3–0.4 mm in diameter. At the east side of the harbour there is sand which consists of the three sorts, and at the west side there is only small grained sand. Therefore people thought the drifting sand came from the east side only, but the observation showed that both the white light sand and the small type was drifting all over the sea at both sides of the harbour. Therefore it may be natural to think that the large grained type of sand was thrown into the harbour by wind and waves, and that the other two sorts might come drifting from both sides of the harbour. In fact, by the method explained in the next article by OSAMU SATÔ, the direction of the drifting sand near the bottom of the sea was determined.

V Conclusion

In short the apparatus is cheap and easily available in Japan. It is most probable that the apparatus will remain unharmed by any storm. Moreover it may be the most convenient one to yield the direct measurement of the relative amount, size and density of the drifting sand.

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