On the Distribution of Sand Grains at the Beach of Iwanai

By

Katuhiko YONETA

In the autumn of 1937, the author collected sand on the surface of the beach running northward from Iwanai to Riyamunai. These samples of sand were collected at every 200 m. Where dunes occurred samples were collected at three points: at the sea shore, at the foot (sea shore side) and at the summit of the dune. These samples were mechanically analysed in laboratory by the standard sieves. The results thus obtained lead to the following assertions.

(1) The grain size of the sand corresponds to the angle of the slope of beach toward sea shore.

(2) The apparent specific gravity of the sand is greater at the summit of dune than that at the beach.

1. Mechanical Analysis

The sand can be analysed into several groups by using standard sieves. This result shows that the larger part of the sand belongs in a group which will pass through a mesh with opening greater than 0.15 mm and smaller than that of 0.6 mm.

The volume of grains outside this group which passes through an opening 0.6 mm and does not through that of 0.15 mm is very small. Therefore the grains contained in the two groups of the ranges 0.6–0.3 mm and 0.3–0.15 mm are considered to comprise all sand grains. The ratio of the weight of sand grains contained in these two groups is considered as the measure of the size of the sand grain and hereafter the following formula will be defined as the grain ratio.

$$\text{grain ratio} = \frac{wt_{0.3-0.6}}{wt_{0.15-0.3}}$$

In the case of large grain ratio, large grains are abundant in weight in the sample, while in the case of small one the matter becomes the opposite.

2. The Distribution of the Grain Ratio

The distribution of the grain ratio can be known from Table 1. Let the position where sample is collected take the abscissa and its grain ratio the ordinate, the relation between these two quantities will be shown in Fig. 1. Fig. 1. a. shows the mean value of the grain

Table 1.

No. of Station	θ°	GRAIN RATIO	
		Mean at sea-shore and foot of dune	At summit of dune
1	0	0.30	—
2	0	0.32	—
3	1	0.36	—
4	4	0.49	—
5	3	0.27	0.53
6	3	0.22	0.18
7	4	0.71	0.30
8	3.5	0.64	0.94
9	3.5	0.50	0.80
10	3	0.44	0.19
11	3	0.61	0.64
12	4	1.00	0.62
13	7	1.40	0.86
14	4.5	1.02	1.08
15	3.5	1.20	0.85
16	4	1.35	0.54
17	5.5	1.33	3.02
18	4	1.27	0.35
19	6	1.81	0.71
20	3.5	0.98	1.81
21	4	1.10	0.40
22	3	0.83	1.02
23	0	0.54	1.00

ratio at the sea-shore and the foot of dune. Fig. 1. b. shows the value of that at the summit of the dune.

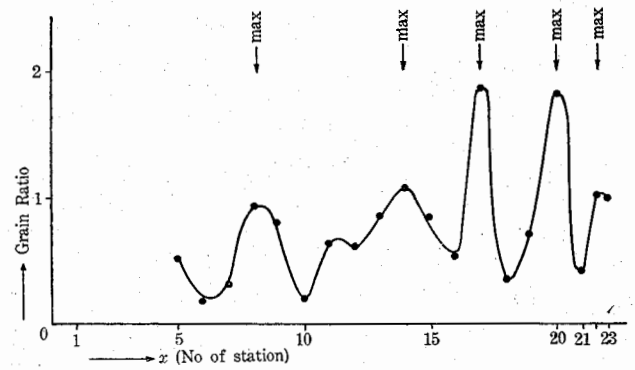

Fig. 1 a.

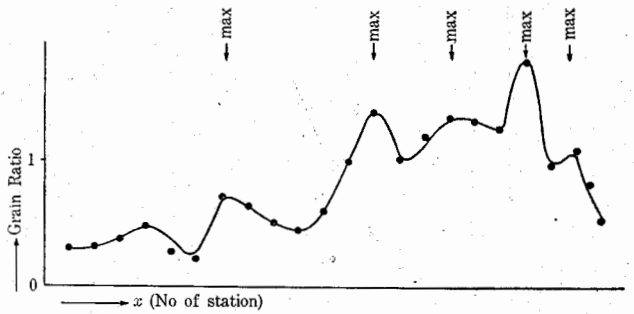

Fig. 1 b.

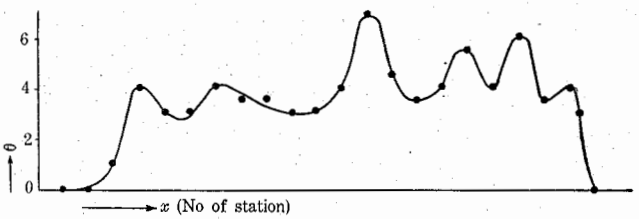

Fig. 2.

Maximum points of the curve of grain ratio at beach correspond perfectly to that at dune, while the latter is bodily only displaced to the former to the north about 200 m. This effect can be explained

by and expected from the fact that winds from SW at this place are generally stronger than those from NW.

3. The Relation between the Grain Ratio and θ

Let the angle of the slope of beach toward the sea (shore) take θ and the distance of the position, where the sample was collected, measured from the original point be x.

If θ be plotted against x, the result can be shown in Fig. 2. From this curve, one can imagine the close relation between θ and grain ratio. Therefore if the grain ratio be taken against θ, the relation between these quantities can be as shown in Fig. 3. The similar relation between θ and grain size of beach sand has already been reported by Mr. G. TOYOHARA.

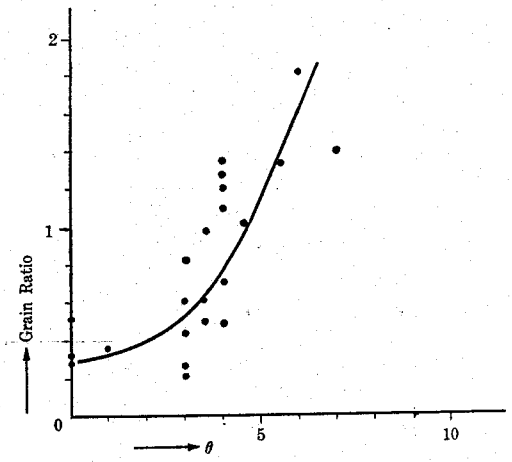

Fig. 3.

4. Apparent Specific Gravity of the Sand

The present observations show that the apparent specific gravity of sand is not simply related to its grain ratio. However if the frequency of specific gravity be reckoned on every 0.1 for beach and dune, their results can be shown in Table 2. The values shown in Table 2 are graphically represented in Fig. 4. It is shown, as is evident from these figures, that the apparent specific gravity at dune is generally greater than that at a beach. The maximum frequency of specific gravity of sand at beach and dune are respectively

Table 2.

Apparent sp. gravity	At sea shore		At foot of dune		At sea shore and foot of dune	At summit of dune		Sum Total
	0.50 -0.30	0.30 -0.60	0.15 -0.30	0.30 -0.60		0.15 -0.30	0.30 -0.60	
1.0—1.1	0	1	0	1	2	2	0	2
1.1—1.2	2	6	0	5	13	1	2	3
1.2—1.3	13	8	9	9	39	2	6	8
1.3—1.4	4	3	5	3	15	8	10	18
1.4—1.5	2	3	3	4	12	5	0	5
1.5 - 1.6	1	0	4	0	5	2	1	3
1.6—1.7	0	0	0	0	0	0	0	0
1.7—1.8	0	0	1	0	1	0	0	0

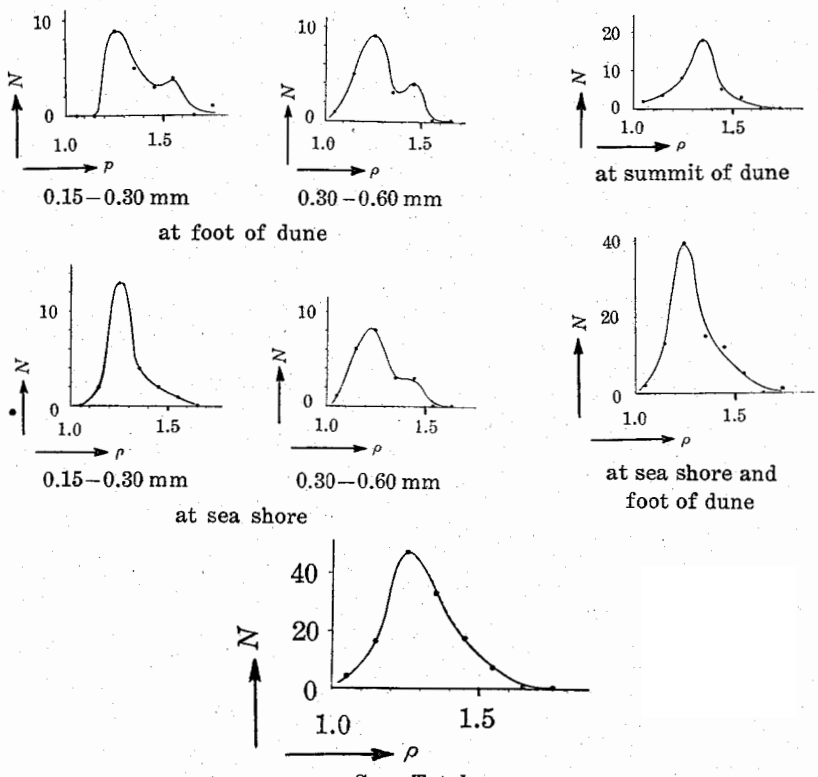

Fig. 4. Frequency curves

distributed between 1.2–1.3 and 1.3–1.4. These data are tabulated in Table 2 and the frequency curves are indicated in Fig. 4.

In conclusion, the writer wishes to express his best thanks to Professor Y. IKEDA for his kind guidance and also to Messrs A. MATSUNAGA and K. ÔKAWARA who carried out the mechanical analysis of these samples of sand.