
On Kumatology: Discussion

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Source: *The Geographical Journal*, Vol. 13, No. 6 (Jun., 1899), pp. 626-628

Published by: geographicalj

Stable URL: <http://www.jstor.org/stable/1774413>

Accessed: 27-06-2016 06:54 UTC

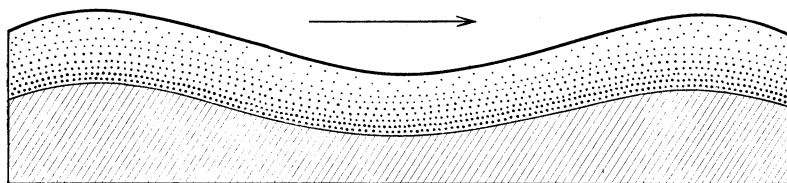
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and every particle of water travelled down-stream. By the subsidence of water from temporary channels, "ripple-drift" sand-structures were sometimes perfectly preserved, as shown in Fig. A, Plate II. Mr. Cornish then showed photographs of ripple-marks mimicking organic forms, and of rippled clouds, and the ripple-ridging of hillsides, and went on to deal with the rippling of sand by wind (Fig. B, Plate II.). A table of measurements was exhibited, which proved that the shape of these ripples was approximately constant for wave-lengths from 1 to 145 inches. The shape was the same in desert sand as in the sand of the seashore to within 4 per cent. He had succeeded in reproducing these ripples by the action of a steady artificial blast upon ordinary heterogeneous sand, but artificially assorted sand containing



UP-STREAM WATER-WAVE AND SAND-WAVE. TRUE SCALE: WAVE-LENGTH 9 INCHES.
(MEASURED BY THE AUTHOR.)

no fine particles was not thrown into ripples. For this it was necessary that there should be particles fine enough to be tossed away by the eddy which forms in the lee of the larger grains. Sand-dunes were built up by the wind on similar principles. Photographs of desert sand-dunes were shown, one of which exhibited the recent encroachments of sand which have buried the road between Karachi and Clifton (Fig. c, Plate II.). The sand-dunes here are advancing as a train of waves before the south-west monsoon.

The slides shown, upwards of forty in number, were from part of the collection of photographs which Mr. Cornish has made during the past four years. The value of this collection is not merely for purposes of exposition and illustration, but also as evidence and record of the phenomena of kumatology, many of which are illusive and difficult to observe.

After the reading of the paper, the following discussion took place :—

Captain WILSON BARKER: I am afraid I am hardly prepared to make any remarks to-night. My own investigations have chiefly had to do with a comparison of wave-disturbance by the varying motions of a vessel in the first instance; and in the second, with a comparison between the disturbance caused by a vessel and that due to the movements of fish and cetaceans; but I think Mr. Cornish might well devote his attention, with valuable practical results, to the neutral zone on the coast-line. I believe the matter has been investigated by some foreign observer, who found that the advancing wave carries stones up the beach, while below a

certain depth it carries them away from the beach. The line of no movement he calls the "neutral line." The position of this neutral line is a matter of considerable importance in the building of harbours, as was lately exemplified in the new harbour at Dover, which has been inaccessible at certain times owing to the fearful turmoil of the sea produced by some deflection of the waves. This harbour difficulty might possibly have been avoided by a better knowledge of wave-action.

Mr. Cornish's very interesting observations, and his study of these special wave-actions, should lead to a better understanding of this most important subject.

Dr. H. R. MILL: We have this session been favoured with a number of papers dealing with physical geography, but this is the first which has broken entirely new ground, has presented a new aspect of geography, and given a new name to it. It is not many years since the name of limnology was created; shortly afterwards we had speleology, both of these being departments of minute specialization; but kumatology, which Mr. Cornish proposes to introduce, is, in a sense, a more important subject than these, because it is not a minute specialization, but one of those generalizations which makes geography so distinctive as a science; it embraces not only air, water, and land, but the sand that drifts over the surface of the land. We remember the extremely brilliant but unfortunately unpublished paper by Prof. Lapworth some years ago, in which he proposed to explain the origin of continent and ocean basin by a theory of the crest and troughs of great waves vibrating round the world. We can thus see that the wave-idea runs through the whole field of geography, from the upper limit of our atmosphere down to the inner core of the Earth. There is one thing that has curiously escaped my memory when I have spoken to Mr. Cornish—that is, the singular appearance of water-waves under a thin sheet of perfectly elastic ice. When a steamer is running through a thin layer of ice, resting uniformly on a still surface of water, one sees the waves from the propeller proceeding unchecked under the ice, the surface of which responds to the movement of the waves without breaking. At the time I observed this phenomenon, fourteen years ago, I had no camera, and was unable to take photographs.

I should like to call attention to the great interest and originality of many of the photographs, some of which were obtained with great difficulty, and not without a little danger. The photograph of the crossing of two waves, strikes me as one of the most beautiful I have seen upon the screen.

Dr. ARTHUR HAYDON: There is one important point to which Mr. Vaughan Cornish in his most excellent paper has, however, not referred. This is the curious action of the waves on "a boat that propels itself." This boat has no engines, does not go by steam, electricity, or man-power, and yet as you sit quietly in her and do nothing, she will move of her own motion against wind and wave at a speed of from 3 to 4 miles an hour—the rougher the sea, the faster she moves. The fact is, the boat is propelled by the action of the waves, as in perfectly still water she would not move at all.

The cause of her propulsion can be explained in the following manner: Two pieces of apparatus, something like gridirons, are fixed one at the bow and one at the stern, about on a level with the keel; they are strips of hardened steel, with their free ends pointing in the reverse direction to the course of the boat. Each frame holds four of these. They are 20 inches long, and 10 inches wide; they are $\frac{7}{10}$ of an inch thick at their union with their frames, and taper off to $\frac{1}{10}$ of an inch at their free ends. The dimensions of this boat are: length, 13 feet; breadth, 3 feet; depth, 20 inches; weight, 400 lbs. The two sets of steel fins weigh about 80 lbs., and from their position act effectually as partial ballast.

The explanation of the action of the waves on the above is as follows: When

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the boat is rolling and pitching, every roll and pitch moves these steel fins, and they are constantly returning to their original position by their own elasticity. The consequence is that as long as the rolling and pitching of the boat continues, they act like the fins and tail of a fish, and push and pull the boat along. I shall be glad to hear some scientific explanation of these phenomena.

The PRESIDENT: With reference to the ripples on the sand caused by the wind, I cannot help hoping that Captain Egerton will consent to describe to the meeting the phenomenon of sastrugi, of which he has had great experience in the arctic regions, as it has some analogy to this movement of the sand.

Captain EGERTON: I really don't know what I have to do with sand; I didn't realize that the sastrugi of the snow was the same thing. I have no doubt it is due to the wind. I can't say much about it, except that I know it curves the snow up very much like the photographs we have seen of sand, and at certain times in the spring it becomes very uncomfortable stuff to travel over; it makes a hard crusty surface partially hollow underneath, and as you are tramping along with the sledge you put your foot on it, the other follows, and down you come and bite your tongue. I really don't know anything else about it.

The PRESIDENT: It only remains to thank Mr. Vaughan Cornish. It has struck me that this paper is essentially an educational paper; it reminds us of how much there is of scientific interest in phenomena which are quite of everyday familiarity. We cannot go out of our own doors without seeing objects of interest if we choose to think; even the worn-out flagstones before our areas give food for reflection, thought, and study. I should not be in the least surprised, when I go to study duck waves to-morrow in St. James's Park, to find many of my friends here this evening studying them also. I shall be still less surprised if, when Mr. Vaughan Cornish proceeds, on the same scientific basis, to give us an account of his study of deep-sea waves at one of our afternoon meetings, he has a very large audience amongst those who have heard the interesting and suggestive paper this evening. I will now propose to you a very cordial vote of thanks to Mr. Vaughan Cornish for his paper.

EXPLORATION IN SARIKOL.*

By Captain H. H. P. DEASY.

LEAVING Yarkand on November 3, 1898, I went *via* Kosharab, the Arpatalak Dawan, and Khandar Dawan to the upper part of the valley called Wacha by Kirghiz, and Uchi by its inhabitants. Here several days were spent in obtaining the correct longitude of my starting-point by means of triangulation. As soon as the sub-surveyor, whom the Survey of India had most kindly lent me, had finished the topographical work, a start was made for the country erroneously called Mariom Pamir. The real name of this narrow valley, inhabited by Tajiks, is Mariong, and it extends in latitude from 37° 23' N. to 37° 19' N., at the junction with the Yarkand river, in long. 75° 55' E. From Nosh Tans, the largest village in Mariong, I tried to find a route to the west end of Raskam along the valley of the Yarkand river, but its tortuous course,

* Dated "Kashgar, March 7, 1899."