SAND WAVES IN THE NORTH SEA

Synopsis of a Study by

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In the summer of 1934 the Dutch Waterstaat Surveying Ship *Oceaan* visited Dover and Calais in order to investigate the sand movements which were supposed to exist in the Channel. The authorities of the Waterstaat wished also to ascertain whether the Channel between Cap Gris Nez and Dover is being scoured out or not.

Firstly the southern portion of the North Sea (roughly south of the line from Lowestoft to Helder) was found to possess a remarkable bottom of a wavelike structure. For miles the regular shaped sand waves or sand dunes appeared on the graphs of the echo-sounding gear, an instrument which is essential for this kind of research work. The instruments used were the British Admiralty machines for shallow or super shallow water made by Messrs. Henry Hughes & Son, London. Fig. 1 gives a registration of the newest type, the so-called " Dutch model," which was made specially for our needs. The vertical scale of it is 1 cm. = 1 metre. This scale may be altered to 1 cm. = 4 metres.

The heights of these submarine sand dunes were often 10 *metres* (33 ft.) *or more*, the highest being found at the " Tail of the Falls " where their size was 13 *metres* (42.6 ft.) (see Fig. 2). Generally these waves attain heights of 8 *metres* (26.2 ft.) and lengths of about 200 *metres* (220 yds.). Their tops were notably sharp so that it is almost impossible to discover the highest parts with an ordinary lead-line. When a flat bottom starts to wave like this, the tops may become dangerous for passing ships. The same may occur when the sand waves develop in places between the buoy lines, and a special study of them is required since they are likely to change their forms and positions fairly quickly, especially during a storm. There is one case, where a shallow point on the hydrographic chart—probably the top of one of these submarine dunes, as was proved later when an echo-sounding, machine became available—could not be found again : after much seeking, the hydrographer removed the shoal from his chart, with the result that a ship ran aground. Now the top of the dune may have been too small to find with the lead or else the top may have disappeared temporarily, but in either case it illustrates the fact that one has to be careful with waving soils.

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The modern echo machines are a welcome help for detecting these treacherous kinds of shallows and for keeping an eye on them.

Another point which is of practical importance is that these kinds of " top " shallows seem easy to dredge away, but in reality they may prove to be very stubborn.

The total amount of material which has to be dredged may be small, because only part of the tops may obstruct (see the shoal off the entrance to Boulogne harbour, Fig. 3), yet these tops might reform quickly because the causes which are responsible for them may not have been removed. No experience is yet available on this subject, because until recently the structures were hardly known.

Waves of this size were firstly described by Lüders (*Senckenbergiana* 1929) as being found at a spot in the Outer Jade (the entrance of Wilhelmshafen) and having heights of about 8 metres. Lüders detected them with his " Schlepplot," a manometer device which was towed over the bottom.

Fishermen working in the North Sea are more or less acquainted with these waving soils. They call them *ridges* (English), *ridens* (French), *ongelijkens* (" irregularities "), *hompels* or *ribben* (Dutch). These ridges produce the " strong ripples " on the water surface, some of which are indicated on the hydrographic charts.

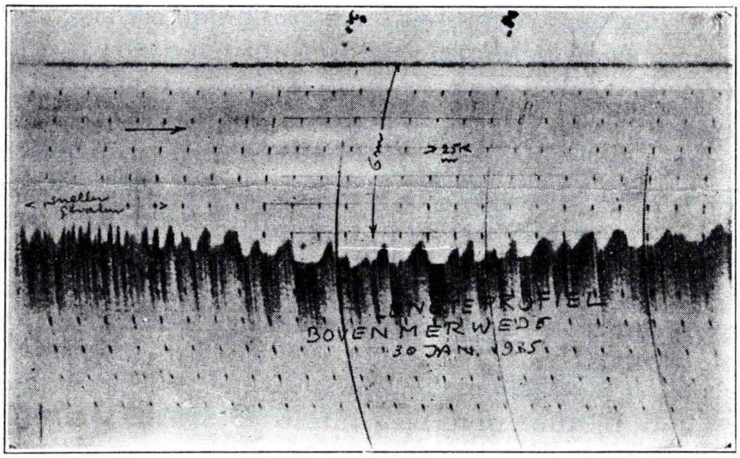


FIG. 1

Bottom waves in the river Merwede, recorded by super-shallow water echo machine (so called " Duch Model "). Vertical Scale 1 cm. = 1 metre.

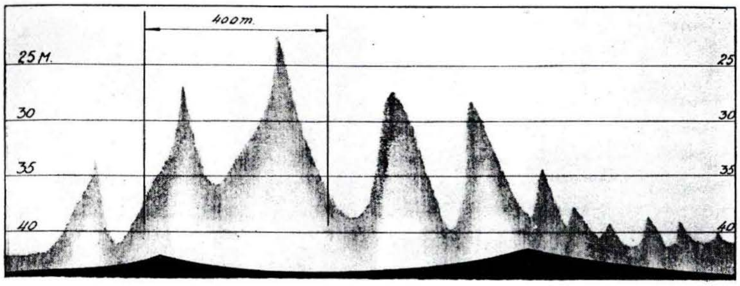


FIG. 2.
High sand-dunes at the "Tail of the Falls." Maximum height 13 metres.

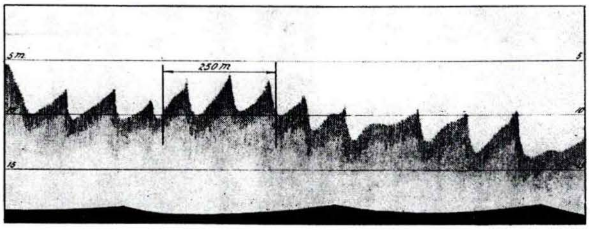


FIG. 3.
Progressive Waves at the "Baas" near Boulogne.

THE SUBMARINE DESERT IN THE NORTH SEA.

While passing through the southern part of the North Sea with the echo machine running, one is strongly reminded of passing over a submarine desert.

The difference is, that in most deserts the winds may blow from different directions, whereas in the sea the currents are more regular. So the sand-forms in the sea may be found to conform to laws more than those in the desert, but finely shaped barchans (results of currents of one direction only) are not likely to be found in the sea.

The southern portion of the North Sea possesses a couple of long sand-banks which have a fan shaped position. These are also to be found in the Channel (Varne, Ridge, Baas, etc.).

Many people have wondered how these banks came there and why they remain more or less stationary (see Fig. 4). When making a study of them it is found that their profiles are more or less triangular in shape (sometimes a catback shape) whereas their longitudinal section is bow-like (see Fig. 5). They appear to be heaps of sand lying on a fairly flat pebble bottom which is more or less swept clear of sand. The lengths of these are sometimes 30 kilometres (16 n.miles) or more (The Falls 60 km., 32.5 n.miles). The tops are mostly covered with sand waves of moderate height, whereas the banks themselves may reach heights of about 20 or 40 metres (65 or 130 ft.) above the surface of the deeps. One gets the impression that nearly all the available sand is stored in the sand-banks. This is not so remarkable because the only lee places are to be found behind the banks.

When going further north the sand masses grow larger so that the hard layer of pebbles is no longer swept clean but there is no sharp separation of these two regions. Near Dover practically no sand at all is to be found except in the banks ; but further north sand becomes profuse.

Either in the desert or in the sea it may be taken to be true that, in places where a sufficient amount of sand is available, regular sand waves may be produced (complicated when the currents change their direction, simple when they do not) ; and that in places where the hard layer is swept clean and where little sand is available, barchans or other remarkable shapes are found. When an alternating current moves the sand from north to south and back again later, no barchan can be formed but instead a cigar shaped "Libyan dune" may appear. The first are transversal, the latter longitudinal forms.

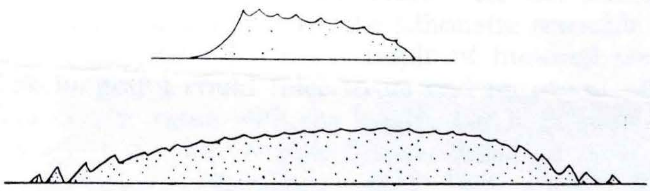


FIG. 5.

General form of the sandbanks.

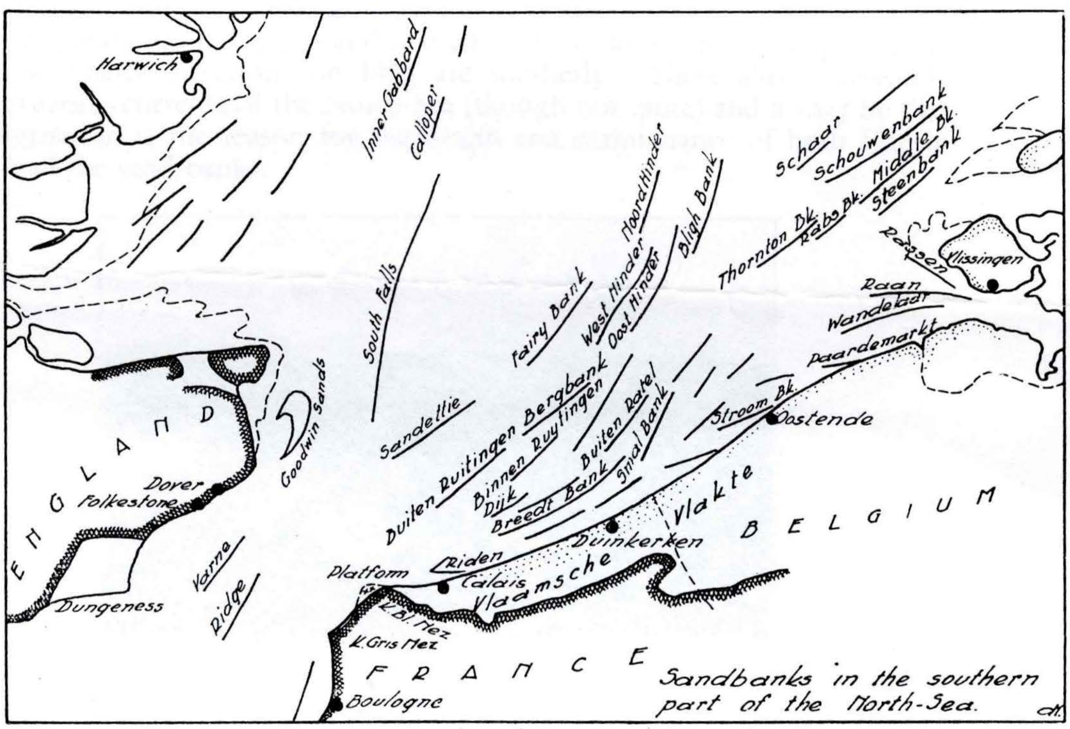


FIG. 4.

Sandbanks in the Southern part of the North Sea.

This name was introduced by Dr. Ladislas Ladar in his article of June 1934, *A study of the sand sea in the Libyan desert* (*Geographical Journal*). Others call them " seif " dunes. Their characteristic feature is that they are parallel to the direction of the prevailing winds. Dr. Kadar describes these dunes as follows : " The plan is of an oval shape (Fig. 5) which is more slender the longer the dunes. The tranverse section is usually an isosceles triangle and the longitudinal section has the form of an elongated bow mildly sloping on the windward side and rather steep to leeward. Such uninterrupted forms, however, are rare. Small barchans (dunes) are not infrequently found on the top of these dunes and they make the silhouette resemble waves. The length of these dunes may extend from a couple of hundred metres to several kilometres. The longest I could trace to its end measured 140 kilometres (75 n.miles), their height varies with the length, but is generally about 30 or 40 metres (100 or 130 ft.). The regular Libyan dunes sit close on the soil and their edges are sharply distinguished through their yellow sand from the black-brown pebbles of the soil. Between the dunes the soil is bare for several kilometres."

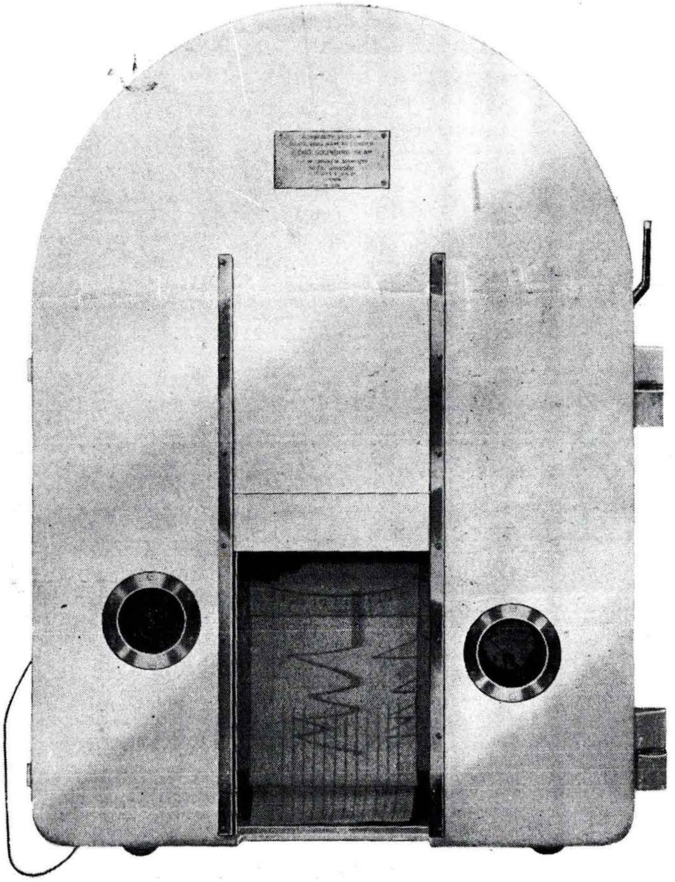
Except for a few items this description might be suitable for the southern banks of the North Sea also. One of these exceptions is that the cross sections of the latter are not isosceles triangles, but Kadar writes that with a change of wind direction these profiles change accordingly.

Figure 6 shows one of Kadar's photographs of a Libyan dune. It may be seen that one side of the dune is steep but the top is covered with irregular forms. The cross section is, therefore, not an isosceles triangle but resembles perfectly that of a North Sea sandbank. The figure might serve also for one of the submarine sand-banks as well as for a Libyan dune.

It is interesting to note that Kadar lays stress on the fact that these Libyan dunes are parallel to the winds and that 63% of the winds in the Libyan desert have a northerly direction and 14% are southerly. These almost resemble the alternating currents of the North Sea (though not quite) and it may be that this alternation is the reason for the origin and maintenance of both Libyan dunes and the sand-banks.

FIG. 6.

Libyan dune : photograph by Kàdàr.



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