

metres from E. to W. and 8 kilometres from N. to S., is a volcanic mountain, the edge of the crater rising to a height of 935 metres on the northern side. It is entirely covered with ice, which comes down to sea-level, and presents a steep wall to the sea: it would seem from this that in this region a tongue of polar cold projects northwards, a conclusion supported by the serial temperature observations. No trace of vegetation could be recognised with the telescope, and animal life appeared to be exceedingly scanty. No definite information was obtained as to the existence of Thompson Island.

(2) Enderby Land was not visited, as the course was again turned northward at lat. 64° S., but the samples of the sea-bottom yielded evidence that the land is not volcanic. Along the edge of the pack-ice the bottom was covered with diatom ooze, mixed with a larger proportion of clay the nearer Enderby Land was approached. In lat. $63^{\circ} 17'$ S., long. $57^{\circ} 51'$ E., material from ground-moraines, carried to sea by icebergs, was obtained; this consisted of gneiss, granite, schists, and one large piece of red sandstone.

(3) *Climate*.—The zone of fresh westerly winds and low barometer extends south of Africa only to lat. 55° S., and of Kerguelen only to $56\frac{1}{2}^{\circ}$ S.; south of this a belt of calms and light variable winds extends to 60° S., and beyond 60° S. the prevailing winds are easterly. In other parts of the Southern Ocean, the westerly winds extend further south, to 60° and 64° S. latitude. Hence it may be supposed that the position of the Antarctic anticyclone is towards the western part of the Indian Ocean, and not directly over the pole.

In November 1898 the limit of drift ice was found in long. 7° E., to be in lat. $56\frac{1}{2}^{\circ}$ S. On the voyage from the most southerly point in the neighbourhood of Enderby Land, no icebergs were met with north of $61^{\circ} 22'$ S.

(4) *Oceanography*.—Amongst the most important achievements of the *Valdivia* expedition is the making of a large number of new soundings, with the discovery of an extensive deep-water area. It has hitherto been assumed that the sea-bottom rose rapidly towards the south from the Eastern Atlantic and the western part of the Indian Ocean, but it now seems likely that deep water extends from both these basins into Antarctic latitudes. Kerguelen, and the Crozet and Prince Edward Islands were regarded as projections on the margin of a supposed Antarctic plateau, and this idea had obtained so strong a hold that both V. v. Haardt (1895) and Fricker (1898) simply ignored the soundings of the *Challenger* in their maps, although these had shown depths of over 3000 metres in the Indian Ocean between long. 80° and 95° E. and lat. 60° and 66° S. In the regions sounded by the *Valdivia*, between 7° and 53° E. long., the depth has been found to exceed 5000 metres.

South of the fifty-sixth parallel, the bottom temperature was everywhere below 0° C., but nowhere below $-0^{\circ}5$ C. The serial temperatures in 63° S. lat., 54° E. long., in the month of December, gave the following distribution: (a) a surface layer, 120 metres thick, with temperatures between 0° C. and $-1^{\circ}7$ C.; (b) an intermediate layer, about 2200 metres thick, with temperatures above 0° C., and rising to $1^{\circ}7$ C.; (c) a bottom layer of equal or greater thickness with temperatures below 0° C., but never colder than $-0^{\circ}5$. Temperature fell from the surface down to 80 metres, then rose to 1200 metres, and then again fell slowly to the bottom. The same arrangement was found further to the west, but the temperatures were somewhat lower, and again to the east, in the track of the *Challenger*; but in the latter case the cold surface layer is thicker, and the warm layer usually reaches to the bottom (3000 to 3300 metres), the cold under-layer being only met with in a sounding of over 3600 metres. The lowest temperature observed by the *Challenger* was $-1^{\circ}7$, the highest only $1^{\circ}4$. The sea in the region of Enderby Land would thus seem to be favoured by relatively high temperatures, and it remains to bring this into direct relation to the warm Kerguelen stream: this must be done by more observations to the south of Kerguelen.

(5) *Marine Biogeography*.—The quantity of plankton increases down to about 2000 metres, diminishing rapidly at greater depths, although no level is destitute of animal life. The quantity of vegetable plankton, on the other hand, reaches its lowest within 300 or 400 metres of the surface. The characteristic of the Antarctic plankton is the abundance of diatoms, and the occurrence of special forms: the appearance of the Antarctic type begins as far north as 40° S., but in 50° S. the presence of forms belonging to warmer seas is still noticeable.

THE WEARING AWAY OF SAND BEACHES.

THE rate of erosion of cliffs and land bordering on the sea, caused by the action of the waves, has been the subject of frequent investigation, and numerous records exist as to the rate at which the land is being encroached on by the sea. On low flat coasts the means of ascertaining the result of the contest between the sea and the land is more difficult to ascertain. The ordinary means of measurement is by a comparison of old charts, which are seldom trustworthy for this purpose. These charts being for navigable purposes, the depth of the water and the position of objects on shore forming sea marks were the subjects for which accuracy alone was required. The same remarks apply to old plans of estates and manors which were intended to delineate the property of the owners, the sea shore below high water not being a matter requiring trustworthy accuracy.

The results obtained by the Department of the Waterstaat in Holland, from periodical measurements of the coast adjacent to the North Sea, are therefore of great interest as showing the effect of the sea on flat beaches in low countries.

Between the years 1843-46, the Department caused to be placed all along the Dutch coast, extending from the Helder to the Hook of Holland, a distance of 75 miles, at the foot of the sand hills, oak posts at intervals of one kilometre ($\frac{1}{2}$ mile) to form a permanent base line; and from these, at regular intervals, measurements have been periodically taken to the foot of the dunes on the land side, and to the low water line on the sea side.

The results are recorded in the *Proceedings* of the Dutch Institution of Civil Engineers.¹

They are also set out in considerable detail, and tables given for the different periods, in the report of a Commission appointed to investigate the shell fishery of the coast, issued in 1896.²

The coast between the two parts named forms the arc of a very large circle, the depth of the embayment in the centre being $5\frac{1}{2}$ miles. The main direction for the southern part faces about N.W., and of the northern part W.N.W. The winds which have most effect on the coast are those from the S.W., changing round to N.W.

The set of the flood tide is from south to north, the range decreasing from 5 feet at the Hook of Holland to $4\frac{1}{2}$ feet at the Texel. The coast line is bordered seaward by a sand beach extending from 300 to 350 feet to low water, lying at a slope of about 1 in 70; and on the land side by sand dunes, which vary from 1 to 3 miles in width and from 40 to 50 feet in height. These decrease in size towards the Texel.

With the exception of the detrital matter brought down in suspension by the river Maas, there is no source for a supply of material to feed the beach. The cliffs which border the French coast, from which the shingle and sand on the beach there is derived, terminate at Sangatte. The drift of the shingle and sand derived from the erosion of these cliffs extends only for a limited distance, and dies out a little beyond Calais and Dunkirk.

As regards the Belgian coast, the beach along which consists entirely of sand, from comparisons made by the Government engineers a few years ago of the various charts and plans dating from the beginning of the present century, and from a comparison of surveys of the coast made in 1833 and 1870, the conclusion was arrived at that no material alteration in the beach of the Belgian coast has taken place, so far as any means of comparison existed; and this was confirmed by measurements, taken in 1833 and 1870, of the height of the beach at the groynes at Ostend, Heyst and Wendyke, which showed that there had been no material alteration in the form of the beach.

The Dutch coast, between the periods to which the present investigations extend, has been subjected to two disturbing elements, in addition to one abnormally heavy gale in December 1894. The opening out of the new water way to Rotterdam through the Hook of Holland, and the construction of the harbour at Ymuiden for the entrance to the Amsterdam Canal, with the long piers extending across the beach, led to a considerable transposition of material at those parts of the shore; but the effect was local, and extended only over a short distance.

As a general result, the measurements show that during the last half-century, on the Dutch coast, the sea has been

¹ "Tidschrift Van het Koninglijk, Instituut Van Ingenieurs" (1883).

² "Uitkomst Van het Onderzoek of de Schelpvisserij Langs de Noord-zee kust Nadeelig Kan Zijn Voor Het Weerstandsvermogen Van Het Strand en het Behoud Der Duinen als Zeewering" (1896).

encroaching on the coast. The low water line has crept landward, and the beach has become more steep. There has also been a wasting away of the foot of the sand dunes.

For the first part of the period over which the observations extend (1843-56), there appears to have been a retreat of the low water line from the shore, and consequent increase in width of the beach, in the northern portion of the coast for the first forty miles, and this continued up to 1866 to a less extent. After this, the low water line began to advance landwards until 1877, when the northern beach began again to grow wider, but the decrease continued along the southern half. On an average there has been a loss of beach along the whole coast between 1846 and 1894, the total average loss for the forty-six years being 155 feet for North Holland and 108 feet for South Holland. The greatest change has taken place between the Helder and Petten, a distance of 12 miles, the low water line having advanced landward an average of 160 feet. Near Callangstoog, where the effect of the great gale of 1894 was most felt, the low water line is from 200 to 270 feet more inland than in 1846, and the foot of the dunes has been driven back more than 300 feet.

Near Zandvoort there has been a gain of 100 to 130 feet. Near Scheveningen the low water line has approached nearer the shore, for a length of about four miles for about 200 feet, and the foot of the dunes has been scoured away to an average of 100 feet, and in one place as much as 400 feet. The dunes have also wasted, although in a less degree. From the Helder to Egmont, a distance of 25 miles, there has been an average loss of about 150 feet. From there to Ymuiden the foot of the dunes has remained about stationary; and from Ymuiden to the Hook of Holland, excluding the part at Scheveningen, there has been an average gain of about 65 feet.

Ymuiden Harbour is situated nearly in the centre of the embayment, and the piers project about a mile out from the shore. The works were commenced in 1865, and finished in 1876. Since the commencement of the piers, sand has accumulated both on the north and south sides of the harbour, and in 1894 the accumulation had extended along the north pier seaward for a distance of about 1500 feet, and along the beach for $1\frac{1}{2}$ miles, this being the measure of the two sides of the triangle forming the pocket where the material had collected.

On the south side of the harbour the seaward measurement of the accumulation was at the same period 360 feet, and along the beach about $1\frac{1}{4}$ miles.

The material thus accumulated appears to be due to a transposition of material, as previous to the piers the beach was increasing at this part of the coast, and has since considerably diminished.

The accumulation at the piers, forming the entrance to the Maas, which extend seaward about a mile, has not been so great. On the north side the sand has extended seaward, since the construction of the piers in 1863-72, 820 feet, the width of the extension along the beach being 2 miles. On the south side the accumulation extends outwards 700 feet. Here also there is a corresponding diminution of the beach for some distance to the north of the piers.

In December 1894 there occurred a very heavy gale, accompanied by the highest tide on the Dutch coast recorded during the present century, and an immense amount of damage was done to the fishing fleet. Out of 200 boats moored at the foot of the sand hills near Scheveningen, not one escaped without injury, and many were entirely destroyed. The damage done to the sand dunes, on which this part of the country depends for its protection from the sea, was very extensive, and throughout nearly the whole length the foot was washed away, leaving the mounds with steep sides. The stone pitching on the Helder Sea Dyke was damaged over a surface of about 5000 square yards. In North Holland, the tide broke through the sand hills in several places, and near Callangstoog the hills were breached for a distance of 2 miles, the tide inundating the low land behind.

W. H. WHEELER.

RESULTS OF THE SCIENTIFIC EXPEDITION TO SOKOTRA.

DURING the past winter a biological and geographical investigation of the Island of Sokotra (lying in about 12° north latitude and 54° east longitude), some 600 miles south-east of Aden, was undertaken, on behalf of the British Museum, by Mr. W. R. Ogilvie-Grant, and, on behalf of the Liverpool Cor-

poration, by the Director of Museums (Dr. H. O. Forbes). Mr. W. Cutmore, of the Liverpool Museum, accompanied the party as taxidermist. From the *Bulletin* of the Liverpool Museums we learn that the expedition landed at Aden on November 18, 1898. Political difficulties between the Government of India and the Sultan of Sokotra unfortunately caused some delay in starting, but through the kindness of the Political Resident, Brigadier-General Creagh, V.C., these days were employed in visiting Sheik Othman and Lahej in South Arabia, where collections of considerable interest were made. On December 1, the difficulties referred to having been surmounted, the party was enabled to leave for Sokotra on board the Royal Indian Marine steamer *Elphinstone*, which had most generously been placed at its disposal by the Indian Government. Permission was also kindly given to detain the vessel for some days at Abd-el-Kuri, a previously unexplored island lying between Sokotra and Cape Guardafui, the eastern horn of Africa. There four days were spent in making as complete a collection of the fauna, flora and geology of the island as the time permitted. On December 7, the expedition was landed on Sokotra, near Hadibu, the capital, and it remained on the island till February 22, 1899. On the return voyage, a second visit was paid to Abd-el-Kuri for a couple of days, to enable more complete collections from that out-of-the-way spot to be made.

A complete account of Sokotra, with a map, a list of the collections, and full descriptions of the new species obtained by the expedition, illustrated by plates and blocks, will be published as a special volume, which is now in active preparation. Meanwhile, short diagnoses of some of the more conspicuous zoological novelties are given in the May number of the *Bulletin* of the Liverpool Museums.

Dr. Forbes reports to the Museums Sub-Committee that the share which Liverpool receives of the collections is as follows:—Of mammals, there are examples of one or two species of rat, of one species of civet cat, of one species of bat, and of the wild ass. Of birds, there are some 300 specimens, 250 in skin and 50 in spirit, out of which seven species have been diagnosed as new to science; a large series of reptiles has been acquired, which contains one genus and eight species new to herpetology. Numerous scorpions, millipedes and spiders, their exact number not yet ascertained, have been obtained, among which there turn out to be at least one new genus and seven new species; the land-shells number several thousands, of which Mr. Edgar Smith, of the British Museum, has already described eight species as new to his department of zoology. No doubt others will prove to be previously unknown. Of insects—almost the whole of which were collected by Mr. Ogilvie-Grant—there are several thousands, the majority of which have not yet been examined.

The plants, of which living specimens or ripe seeds—over 200 in number—have been brought home, are not only of the highest scientific interest, but, being at this moment unique out of Sokotra, are of great commercial value. Their cultivation is being undertaken by Prof. Bayley Balfour in the Royal Botanical Gardens, in Edinburgh. The plants, when in a condition to exhibit, will attract the keenest interest of all horticulturists by the beauty of many of them and by the bizarre form of others.

The report states that the true Sokoterians are only poorly civilised Mohamedans, living in caves or rude cyclopean huts, and possess but few utensils, implements, or ornaments, and no weapons. The ethnographical collection is consequently very small. Specimens of their pottery, of their primitive quern-like mills, of their basket work, and of their weaving apparatus were, however, obtained, and also two large blocks of stone, inscribed with an ancient script, which may perhaps throw some light on the indigenes of the island in a past age, and of whose cyclopean remains photographs were obtained.

Dr. Forbes concludes his report by pointing out that among scientific circles, especially among geographers and biologists, there has everywhere been expressed the warmest appreciation of the liberality and public-spirited action of the Liverpool Museums Committee and the City Council in taking part in the exploration of Sokotra; and also a hearty recognition of the great credit which unquestionably belongs to them of having been the first non-metropolitan Committee to recognise that it was the part of a great Corporation possessing an important scientific institution like the Liverpool Museums, not only to furnish their galleries with examples of what is already known, but also to further the advancement and increase of knowledge by actively sharing in the investigation of unknown regions.