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Wm. Beadle

CURRENTS in the INDIAN OCEAN

LONDON. James Imray & Son.

Capt Wm Beadle

INDIAN OCEAN DIRECTORY.

THE

SEAMAN'S GUIDE

TO THE

NAVIGATION

OF THE

INDIAN OCEAN

AND

CHINA SEA;

INCLUDING

A DESCRIPTION OF THE WINDS, STORMS, TIDES, CURRENTS, &c.; SAILING DIRECTIONS; A FULL ACCOUNT OF ALL THE ISLANDS; WITH NOTES ON MAKING PASSAGES DURING THE DIFFERENT SEASONS.

WITH NUMEROUS ILLUSTRATIONS, CHARTS AND PLANS.

By W. H. ROSSER, and J F. IMRAY, F.R.G.S.

SALEM MARINE MUSEUM

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*** Unless otherwise expressed the Bearings are all Magnetic; and the Distances are in Nautical miles.

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R82
1874

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p. 447, line 25 from top, *for* 12° 20′ *read* 10° 20′.
p. 456, line 2 from top, *for* 80° 20′ *read* 82° 20′.

LIGHTS.

—o—

The following is a complete list of the Lights shown at this date (October 1st, 1873), within the limits of the Navigation described in this work (Indian Ocean Directory). As a full description of them is given in the pages mentioned, or in the Addenda, it is unnecessary to add more detailed particulars:—

SOUTH AND EAST COAST OF AFRICA.

		PAGE.
Table Bay	Robben island.* *Fixed;* visible 20 miles	274
„ „	Green point. *Flashing* every 10 seconds; visible 13 miles	277
„ „	Mouillé point.* *Fixed red;* visible 10 miles	„
„ „	Breakwater. Small *green* light . . .	„
„ „	South wharf.† Small *green* light occasionally	„
Cape of Good Hope	*Revolving*; bright 12 seconds every minute; visible 36 miles	286
Simons Bay	South Roman rock.‡ *Revolving*; bright 12 seconds every half-minute; visible 12 miles	286
Cape Agulhas	*Fixed;* visible 18 miles	296
Mossel Bay	Cape St. Blaize. *Fixed red*; visible 15 miles	302

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* The lighthouse on Robben island has been coloured red and white in bands, and that on Mouillé point has been painted black and white in bands.

† The red light formerly shown at North wharf is discontinued.

‡ Roman Rock lighthouse has been painted in broad horizontal bands of red and white, in order that it may readily be distinguished when seen against the background of sand.

RED SEA AND GULF OF ADEN.

WEST COAST OF INDIA AND CEYLON.

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WEST AND SOUTH COAST OF AUSTRALIA.

TASMANIA AND ISLANDS ADJACENT,

INDIAN OCEAN DIRECTORY.

[ADDENDA to OCTOBER 1st, 1873.]

—o—

ALFRED DOCKS (Table Bay).—It appears by recent (1870) intelligence from Cape Town that the charge on ships in the New Alfred docks is 6d. per ton register for the first month, and 1d. per ton, against 5s. in the roadstead. There is also the saving of time to be noticed. One ship discharged 2000 bags of coffee and ballasted in 24 hours, and another delivered 6000 bags of rice and ballasted in 48 hours. Water 3s. per ton. There is a good patent slip and a steamer already on it. Arrangements are also in progress for a graving dock. The dock is still incomplete, the entrance from sea, roads, and approaches not yet finished; but there is 17 feet water at lowest spring tides in the entrance. The rise of tide is 5 to 6 feet. In the dock the water is 24 feet at low tides, with the facility of discharging alongside a quay in perfect safety. There are no light or other dues on shipping visiting here, except the 6d. per ton if they use the dock. Pages 273—282.

DASSEN ISLAND.—The following information is furnished by Navigating Lieutenant W. E. Archdeacon, Admiralty Surveyor;—

Two sunken rocks with respectively $5\frac{1}{2}$ and $6\frac{1}{2}$ fathoms at low water, and on which the sea breaks heavily during and after bad weather, lie $3\frac{1}{4}$ miles from the south-western shore of Dassen island.

The rocks are N.W. $\frac{1}{2}$ W. and S.E. $\frac{1}{2}$ E. from each other, distant $1\frac{1}{4}$ miles, with deep water between. The western rock, with $5\frac{1}{2}$ fathoms on it, is steep-to on the western side, 20 fathoms having been found at a distance of one cable. On its eastern side the bottom is very irregular for nearly a mile, the depths varying from 10 to 20 fathoms, causing a confused and dangerous sea in bad weather. From this rock the southern point of Dassen island (which is the highest) bears N.E. by E. $\frac{1}{4}$ E. $3\frac{1}{4}$ miles, and the conspicuous high sandhill at Bock Riviere S.E. $\frac{1}{2}$ S. The eastern rock with $6\frac{1}{2}$ fathoms on the shoalest part has depths exceeding 20 fathoms at a cable distance all round: from it the southern point of Dassen island bears N.E. $\frac{1}{2}$ N. $3\frac{1}{3}$ miles, and the sandhill at Bock Riviere S.E. $\frac{1}{4}$ S. *Variation* 29° 45′ *W.* (1869.) Page 273.

CAPE OF GOOD HOPE.—Heavy breakers, during bad weather, having been reported by the keepers of the Cape of Good Hope lighthouse in a north-westerly

direction, the following is the result of an examination made by the direction of the Commodore at Simons bay:—

The breakers are on a rocky ledge, about a mile in extent, and from 1½ to 2 miles from the shore, having 10½ fathoms on its shoalest part (near a depth of 11 fathoms already marked on the chart), with soundings gradually increasing to 20 fathoms on its outer edge, and with 18 fathoms between the ledge and the coast.

From it the following bearings were observed :—Cape of Good Hope lighthouse, S.E. ½ S., 6½ miles; Polesberg, E. by S.; and Slangkop point, N. by E. ¼ E., 10 miles.

This rocky bank lies somewhat in the fairway for vessels passing round the coast to and from Table bay, and as in heavy southerly gales a continuous line of breakers has been observed to extend between this ledge and the shore vessels are accordingly cautioned not to approach this part of the coast in bad weather. (1868). Page 285.

In reference to the following reported bank of soundings, it should be stated that the neighbourhood of the bank was closely examined by H.M.S. *Petrel* in 1868, and bottom touched at 200 fathoms on the assigned spot, and soundings of not less than 130 fathoms obtained within a radius of 5 miles of it; hence the bank, if it exists, must be in a different position than that assigned to it.

"The Spanish merchant vessel *Justa*, on her voyage from Macao to Havana, is said to have discovered a patch of shoal ground at about 5 leagues south-westward from the Cape of Good Hope.

The shoal bank, on which several casts of the lead were taken during a calm, had from 15½ to 13 fathoms, rocky bottom; from the latter depth the water suddenly deepened and no bottom could be found.

At the time of the first sounding in 15½ fathoms the Cape of Good Hope lighthouse bore E. by N. (N. 49° E. *true*), and the assumed distance from the cape was 16 miles. This bearing and distance would place the bank in lat. 34° 31½′ S., long. 18° 15½′ E." (1867). Page 286.

The following information respecting shoal ground between the Cape of Good Hope and the Bellows and Anvil rocks is by Lieut. W. E. Archdeacon:—

Three pinnacle rocks with 4½ and 5 fathoms on them have been found to lie between the Cape point and the Anvil rock, rendering that passage, which has hitherto been considered free from danger, unavailable for ships of large draught, or even for small vessels in bad weather.

The inner danger, with 4½ fathoms over it, and 10 fathoms all round, lies S.S.E. ½ E., 3 cables from the Dias rock off Cape point.

The two outer rocks, having 5 fathoms over them, are about a ¼ of a mile apart, with 10 fathoms between, and all round. The western one lies S. by E., 8 cables, and the eastern S.S.E. ¼ E., 9 cables, from the Dias rock; the latter danger bearing from the Anvil rock N.N.W., distant about 4 cables. *Variation* 29° 40′ *W.* (1869). Page 287.

COAST OF CAPE COLONY.—In consequence of the disastrous wrecks that have recently taken place in the neighbourhood of Struys point near cape Agulhas, and of the reported inaccuracies of the existing charts and sailing directions, a close examination of the coast and outlying dangers from Struys point to Hoop point, including the Atlas reef, has been made by Navigating Lieutenant, W. E.

Archdeacon, of the Admiralty Survey, in H.M.S. *Dido*, Captain William C. Chapman, R.N. The Hydrographic Office publishes the following as the result of the survey :—

Struys Point.—On the 8th of March, 1872, the *Dido* arrived off Struys point and was anchored in 23 fathoms, with the beacon which is built on that point close to the high water mark of spring tides, bearing N.N.W. distant 2·9 miles.*

From Struys point a chain of reefs extends a distance of 1¾ miles to the S.S.E. On the outer detached rock which is locally named the Blinder, 18 feet at low water was found, with 4 to 6 fathoms close to the rock, and 7 to 9 fathoms extending a distance of 4 cables to seaward. This Blinder rock (in close proximity to which Lieutenant Archdeacon was placed by the fishermen of the district) lies S.S.E., distant 1·8 miles from the beacon on Struys point. Northward, in the direction of Struys point, 3 cables from the Blinder rock is the Bulldog or Saxon reef, with 12 feet on it at low water, and 8 fathoms close to, but with shoal ground (about 4 fathoms) between it and the Blinder rock. Between the Bulldog reef and Struys point, the chain of reefs is shoal and extensive, with boat passages between in fine weather. In standing towards these dangers from the south-east, the Agulhas light will become invisible on a bearing of W. ¼ N., that line of direction passing more than 3 cables to the southward of the Blinder reef.

The experienced fishermen of the locality who assisted Navigating Lieutenant Archdeacon in his examination, all agreed as to the Blinder rock being the outer danger from Struys point ; from this fact and the close examination made at the time, as also from observations made during a south-west gale ;—which afforded a good opportunity for deciding the extent of the breakers,—it is certain that the limits of the dangers extending from Struys point as above described are accurately defined, and that there is no foundation for the report that these reefs are found at a distance of 6 miles from the shore.†

The fishermen also state that the whole of this line of coast, from Struys point towards Martha point and to the eastward, is fringed with a series of reefs, with depths varying from 4 to 6 fathoms which break in heavy weather ; there are passages between the reefs and deeper water inside of them.

The wind freshening from the south-west after the above examination, the *Dido* weighed and found good shelter to the eastward of Struys point where she anchored in 11 fathoms : the beacon on the point bearing West distant 1¾ miles.

The Atlas Reef was next examined, and found to lie 1·4 miles from the coast with Struys point beacon bearing W. ¼ S. distant nearly 7 miles. Although

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* A stone beacon 34 feet high, 10 feet square at base, and 6 feet at top, surmounted by a copper ball 4 feet in diameter, has been erected on Struys point. The beacon is coloured red to seaward, with red and white bands on the east and west sides, and is built about 2 feet above high water spring tides.

† Navigating Lieutenant Archdeacon remarks, that it is certain that the vessels which have been recently wrecked in this locality struck on, or in the vicinity of the Bulldog or Saxon reef. In the case of the *Benefactress* it was stated that the lighthouse was invisible, and in that of the *Saxon* that they opened the light a few minutes after hauling to the southward to get clear of the reef on which the vessel had struck ; which would agree with the inshore limit of the light on cape Agulhas, as given in the charts.

assisted by fishermen of the locality, the reported shoalest part of 3 fathoms was not found, nothing less than 5 fathoms being obtained; the extent of the Atlas reef was however determined, and another rock with 4 fathoms named the Miles Barton discovered at a distance of about 6 cables from the Atlas reef in the direction of Struys point.

The bearing of the conical peak (N.W. ¼ W.) and distance of Struys point (7 miles) as given in the African Pilot, page 43, nearly agrees with the position of the Atlas reef as now determined.

In the third paragraph of page 43 of the African Pilot, vessels are cautioned not to approach this part of the coast nearer than 7 miles, at which distance they will find 20 fathoms: Lieutenant Archdeacon recommends, particularly when westward of the Atlas reef, that vessels should not under any circumstances, at night, approach within a depth of 40 fathoms.

St. Francis Bay.—The Cockscomb mountain given as a distinguishing mark for St. Francis bay, bears N.N.E., distant 38 miles from cape St. Francis, instead of N.E. ¼ N., distant 30 miles as stated in the African Pilot, page 55.

St. John River.—Bismarck rock on which the steam-vessel *Bismarck* struck on 29th December, 1871, and described in Notice to Mariners, No. 24, of 1872, has been examined by Navigating Lieutenant Archdeacon, and found to lie one-sixth instead of three-quarters of a mile from the shore. This rock has not more than 6 feet on it at low water springs, with deep water between it and the shore. From the Bismarck rock cape Hermes bears W. ¾ S. distant 2·6 miles.

Caution.—The coast between the Bashee and Umcomass rivers is fringed with outlying rocks for a distance varying from one to 5 cables from the shore. *Variation* 30° 10′ *W.* (1872.) Page 297—332.

CAPE RECIFE.—The lighthouse on the cape now shows a ray of *red* light over Roman or Dispatch rock, in the arc from it of N. 39° E. to N. 12° E. (27°). Vessels bound to Port Elizabeth, after passing cape Recife, should not enter this red ray until the Harbour light on the hill (which when first seen is red) is seen bearing N.W., but as the southern limit of the Harbour light passes only 2 cables northward of Roman rock, it is recommended that a course for the anchorage should not be shaped until the red ray from the Harbour light is passed and the white light seen bearing N.W. by W. Pages 309-310.

ALGOA BAY.—The Harbour Master at Algoa bay has given notice of the existence of a rocky shoal lying to the southward of the anchorage in Algoa bay, 3 cables from the shore.

The shoal, named *Strutts reef*, is about 50 square yards in extent, and has 15 feet water on it at low water springs. The shoal lies with the water pipe and reservoir house in a line with the two southernmost houses of the town bearing W. ½ N.; Scotch church spire in a line with the square tower of St. Mary's church N.W.; Bird rock S.S.E.; Harbour lighthouse N.W. ¼ W.

Clearing Marks.—The tower of the Mosque (which is red) open of the north end of the breakwater, and the tower of the Gray institute open to the northward of the harbour lighthouse, clears the shoal in 25 feet water. Page 310.

BIRD ISLAND—A new lighthouse has been erected on Bird island, from which a *fixed red* light is exhibited, to supersede the two white lights hitherto shown.

The new *red* light is 80 feet above the sea, and visible all round the horizon at the distance of 14 miles.

The new tower is stone coloured, showing a large ornamental cross on its north and south faces; but only a circular aperture, in the centre of the tower, is shown on its east and west sides; its site is so near the old building (100 feet due North) as to produce no appreciable differences in the bearings and distances already given. The new building, 72 feet from base to vane being longer and higher than the old one, will be more conspicuous in daylight than heretofore. The old building will be removed.

Caution.—Ships passing inside the island during night, particularly steam-vessels, are recommended to keep nearer to the mainland than the group, as the land is higher and more readily discerned, and the roar of the surf (which is constant) is more distinctly heard than the breakers on the rocky reefs of the group. The lead will always indicate a too near approach to the main shore, and 11 to 12 fathoms is a safe depth in passing the group; but a wider berth must be given in passing point Padrone, off which shallow ground extends for a mile. In passing outside the group no vessel should approach within 3 miles of the light, as no advantage is gained by it, and the currents, though not generally strong, are uncertain and irregular, both in force and direction, in the vicinity of the group. Page 322.

NATAL.—A white conical tower 81 feet high has been erected on the bluff at the east side of the entrance to the harbour. It shows a light *revolving* every minute at 292 feet above the sea, visible 24 miles. The arc illuminated is 239° (from North eastward and southward to S. 59° W.).

As this light is not visible from Aliwal shoal, which is 25 miles S. 53° W. from the lighthouse, vessels approaching the harbour from southward and westward should not approach the shore nearer than 4 miles, nor get into a less depth than 40 fathoms. The lead should be hove freely until the light is well made out from the deck, when they may stand in until it bears N. 59° E.; this bearing will keep them outside all known dangers until abreast Umlazi river which is about 9½ miles southward from the lighthouse. As the land then trends more to eastward, the light must be kept more to northward, and the shore must have a berth of at least a mile; when the light bears about W.N.W., they can haul in northward for the anchorage. The anchorage is in from 8½ to 10 fathoms at about a mile N.E. to N.E. ½ N. from the lighthouse. Pages 335-337.

INHAMBANE RIVER.—A lighthouse painted white has been erected on Barrow hill, south side of entrance to Inhambane river. It bears a *fixed* light at an elevation of 80 feet above the sea level and visible 14 miles. The light is shown seaward from S.E. ½ S. to W. by N. ¼ N. Position, lat. 23° 45′ 30″ S., long. 35° 33′ 10″ E. Page 338.

DARRA SALAAM.—The following description of the harbour of Darra Salaam, on the East Coast of Africa, is by Commander Richard Bradshaw, commanding H.M.S. *Star*, 1867:—

The harbour of Darra Salaam is situated on the main land 41 miles South from Zanzibar, and is approximately in lat. 6° 49′ S., long. 39° 22′ E.; it lies in the bight of a bay formed by Motumoko point, 12 miles N.W. by W. ½ W. from the latter.

On approaching the harbour from Zanzibar, and after passing Choomby

island, the course is S. by E. ¼ E. to avoid the Tom shoal, which latter will be seen breaking about 2 miles distant. The same course should be preserved until Sindo island is clearly made out, bearing about S. by W. ½ W., then steer to keep Sindo island on the port side, passing it about three-quarters of a mile distant, the Goonja islands being kept on the starboard side. By this time the coast, which is low, will be clearly seen, and between two red cliffs, each about 80 feet high, is the harbour of Darra Salaam, the entrance being nearly opposite the East cliff.

Outside the entrance there is good anchorage under Sindo island. If proceeding into the harbour, two buoys will be seen nearly half a mile distant from the East cliff; they are placed on the edge of the reefs extending from the West and East cliffs, in 3½ fathoms at low water, 1¾ cables apart, and bearing W. by S. ¾ S. and E. by N. ¾ N. from each other. In approaching the buoys, a vessel should not get into less than 5 fathoms; it deepens between them to 9 and 10 fathoms; immediately after passing the buoys, alter course quickly to S.W. by W. ¼ W., keeping the inner point (a point forming the left extreme of a long sandy beach) a little on the starboard bow; not less than 5 fathoms should be struck in this channel. On rounding the inner point a large sheet of water opens to the view, in any part of which a vessel may anchor in 5 or 6 fathoms.

The entrance channel is about a mile long; it is narrow but strait, with coral reefs on either side; all dangers may be seen from half-way up the lower rigging. The harbour is capable of holding a great number of ships of moderate tonnage; the Sultan of Zanzibar with his fleet was at anchor during the visit of H.M.S. *Star*.

It was observed that a new palace was nearly completed, and a town laid out, the allotments of which were nearly all taken. The jungle was being rapidly cleared, and the soil is said to be excellent. It is thought that this port will supersede Quiloa as the domestic slave depôt of the Sultan, the caravans from the interior altering their route for it on account of its proximity to Zanzibar. Quiloa being 160 miles distant, the difference is a great consideration to the dhows conveying slaves.

Tides.—It is high water, full and change, at 4h. 0m.; springs rise 12 feet.

Caution.—A dangerous bank of coral lies 5 miles N.N.E. from the buoys; it was passed over in 3 fathoms, about an hour after low water.

The following description of a shoal patch to the northward of the harbour of Darra Salaam, south of Zanzibar, is from Commander George L. Sullivan of H.M.S. *Daphne*:—

This shoal, on which there is 18 feet water, and 5 fathoms on either side, was discovered in H.M.S. *Daphne* while on her passage from Zanzibar to Darra Salaam. From the shoal Pinda island bears S.E., the inner Sindo island S. ½ E., and the centre of the red or East cliff of the entrance to the harbour of Darra Salaam, S. by W. distant 4¼ miles.

Commander Sullivan gives the following directions for approaching Darra Salaam from the northward:—Keep Sindo island well on the starboard bow until the centre of the East cliff (red) bears S. by W. ¾ W., then steer for it on this bearing, which will lead to the buoys at the entrance; there should be nothing less than 5 fathoms on this line of bearing.

Note.—The island marked on the chart of this part of the coast as the South Goonja does not exist; what has been hitherto taken for this island is a part of

the main land. There are thus only two Goonja islands. *Variation* 10° 10′ *W.* (1869). Page 340.

LATHAM BANK.—The ship *Hydrabad* has lately (1869) been lost on this bank; she had been chartered at Jedda for Zanzibar. Mr. Kirk H.M. consul and political agent, says,—Finding themselves close to the Latham shoal at night they let go the anchor. On getting under way at daybreak the ship drifted on the reef, which lay to leeward, and broke to pieces in the surf. Sheik Suliman Bin Ali, the Sultan's Vizier, left in charge of the government during His Highness's absence, at once ordered His Highness's steam yacht *Star* to be got ready, and he and I started during the night to rescue those that remained. Having safely passed by moonlight through the reefs and sand banks near Zanzibar, we reached Latham shoal at 1 P.M. of the following day. A more dangerous or desolate spot I have never seen. It is a solitary coral knoll, about 300 yards in length, rising about 10 feet above the sea level at high water, and out of sight of land. No tree or blade of grass is to be seen on it. This barren islet is covered with sand and coarse guano from the sea fowl that are to be seen rising in dark clouds from time to time. Fortunately for the mariner the lead gives warning of this danger at a distance of several miles, and on the surrounding bank fair anchorage may be found. But the currents here are very strong, running always northwards, though with variable force and direction. Having anchored on the lee side of the reef, in 6 fathoms, at a distance of ¾ mile from the breakers, we at once commenced to take off the survivors. This was a slow process, which was not ended before 8 P.M., as the boat could not reach the shore, and the shipwrecked people had to be carried off one by one through the surf. Page 341.

ZANZIBAR.—The following information from the remark book of Lieut. H. C. Taylor, R.N., of H.M.S. *Cossack* November 1869, has been published by the Hydrographic office :—

The *Northerly Current* in the vicinity of Latham island was experienced by the *Cossack*, setting her, in November 1869, to the northward, against a north-east breeze, about 32 miles in 7½ hours.

Zanzibar Harbour.—Lieutenant Taylor recommends lying at single anchor at a short distance off shore in preference to mooring close in, and thus avoid the fetid and pestilential odours from the town, which at this season of the year (November) are not only disagreeable but unhealthy.

To the west and north-west of Bawy island the sea appeared to be very foul, numerous patches of coral showing in all directions.

Tumbat Island.—The *South* extreme of Tumbat is in Lat. 5° 52′ 30″ S., long. 39° 14′ 48″ E.

There is a passage between Benoth, the small island lying off the eastern side of Tumbat, and Zanzibar, but none exists between Tumbat and Benoth. The reef from Benoth island extends to the north-west and surrounds Moina island, connecting it with Tumbat. The shoal shown on the chart as lying to the north-east of Tumbat could not be found.

Vessels anchoring off Tumbat island should not close the two southern points, which lie nearly east and west of each other. *Variation* 10° *W.* (1870). Page 341.

EAST COAST of AFRICA.—The following remarks on the East Coast of Africa, which is at present but imperfectly surveyed, are from recent observations of Sir H. Bartle Frere, K.C.B., who has drawn attention to the importance of an early survey; it is not improbable that a considerable trade may soon spring up with the whole of the East Coast of Africa:—

I will briefly describe the coast as it appeared to us between Ras Hafûn, the most easterly promontory ofAfrica, and Mozambique.

Ras Hafûn itself may be described as the crater of an extinct volcanic explosion, which has raised the limestone beds to a height of about 400 feet above the sea-level, not in detached peaks, but with a nearly uniform surface towards the east, the broken strata dipping inwards towards the centre of the crater. open on the western side towards the mainland, to which it is joined by a spit of sand. The bays north and south afford good anchorage and shelter, according to the monsoon, at all times of the year. From this headland the coast, for a distance of many miles, is a uniform rocky wall, with apparently few indentations, and no mountains in the interior visible from the sea. About Magadoxa the coast becomes very sandy, with occasionally rocky bluffs as far south as the Juba river; a fringe of coral reef and islets here begins to mask the coast; south of Melinda the sand-hills cease, and the coast assumes that aspect which it bears with little variation as far south as Mozambique.

The appearance of this Somali and Galla coast is singularly uninviting, seen as it usually is during the dry season (for during the rains vessels keep far off the shore); there are no traces of cultivation or pasturage, and at first sight all appears utterly barren and almost uninhabited. A nearer approach to the shore shows, however, numerous paths, parallel to the coast line, indicative of considerable transit along the shore. Smoke-signals by day and fire-beacons by night are seen giving notice along the coast that a vessel is in sight; and if the vessel approaches near the land, as if about to send boats ashore, groups of natives, generally armed, are seen collecting from all quarters and coming down over the sand-hills. The fact is that, as described by Dr. Kirk, the barren hills of the coast generally mask a country of great natural fertility, supporting a considerable population of pastoral tribes, with much cultivation in parts.

The few towns, such as Magadoxa, Merka, and Brava, through which the Somalis of the East Coast communicate with the outer world, are evidently centres of considerable commercial activity. The more opulent of the permanent inhabitants live in substantial masonry houses, which give to the towns, when seen from the sea, a very imposing appearance. The town is always capable of defence against the surrounding tribes, and strangers, who are not inhabitants, are usually turned out of the town at sunset.

Cattle-hides, orchilla-weed, small timber, and oil-seeds, and a few small horses, donkeys, and camels, are at present the principal exports, with a few articles, such as ivory and ostrich-feathers, from the far interior.

Between Melinda and Mombas the coast changes from the uniform barren sands and rocky ridges of the Somali coast, and assumes the typical features of the coral-fringed coast of East Africa. From Melinda to Mozambique the general features of the immediate vicinity of the seashore are those of raised coral-reefs, or sand and gravel beaches. Seaward the coast is fringed with a perfect labyrinth of coral reefs and islets, which, according to circumstances of

weather and current, prove the greatest dangers or afford the greatest facilities to the mariner. Woe to the large sailing vessel which finds herself set by the current or driven by the wind into the labyrinth, the intricacies and dangers of which are very imperfectly shown on his chart. The water between the reefs is often too deep to allow of anchoring, even close to the shore, and unless the wind be fair and daylight favourable, no prudent mariner will take a sailing ship near dangers which are more frequently just under than above the surface of the water.

But to the Arab mariner who knows the coast and its dangers by long practice, and who never willingly sails except at the season of regular steady winds, and always, if possible, anchors at night, the coral-reef fringed coast affords peculiar facilities. There is always smooth water inside the reefs, however hard it may blow outside. In fine weather, with the sun at the navigator's back, the reefs are easily seen by the colour of the water; when it blows they are marked by the break of the sea on their edges, and there are generally frequent openings, with deep-water channels, in the line of the reefs, giving easy access from one set of channels to another. The Arab dhows usually, if they can, navigate these seas in company, two or more together, and as they rarely attempt to beat against a wind, or to sail on after dark, and as time is to them of little consequence, they meet with disaster more rarely than might be expected of such frail barks, in seas so thickly studded with reefs and sand-banks. The beauty of the low coral islands has been often described.

The orchilla-weed has long been an article of export in large quantities, and though now somewhat superseded by the weed procured in South America, there are probably other dye-weeds and vegetable products useful in dyeing. Palm-nut oil has been already added to the commercial exports of East Africa. We were informed that it was formerly common in Zanzibar, but had been cut down in clearing the jungle. Madagascar appears to abound in valuable cabinet woods, ebony, &c. Cotton appears to grow wild on many parts of the coast. Many parts of the coast are obviously well adapted for the growth of coffee, and a list of oil-seeds which are now exported may be considerably augmented by fresh discoveries.

It is a curious fact that the mortality among European crews on this coast has greatly decreased since the ships have been restricted, as far as possible, to the use of distilled water. Pages 341—348.

MINOW ISLANDS.—A sunken danger has been discovered by the grounding of H.M.S. *Daphne*, while cruizing in September 1868, among the Minow islands, in the northern part of the Mozambique channel. This danger lies in the southern part of the group, directly between Mount and Coral islands; the peak of the former island bearing from the rock S. ½ E. and distant about 8 cables. On examination it was found to be a small detached coral patch, with 2 fathoms on the shoalest part, and 7 fathoms close to. Page 348.

COMORO ISLANDS.—The following information relative to the Comoro islands, is from the remark book of Lieut. H. C. Taylor, R.N., of H.M.S. *Cossack*, November 1869, and has been published by the Hydrographic Office:—

Johanna Road.—The beacon erected to mark the anchorage ground in Johanna road is difficult to see until quite close in, as it is partly overgrown with

bushes, and one of the numerous huts near the town is also built close alongside it. A better mark is a bluff point of rock, lying about 400 yards westward of the beacon, which has a large whitewashed target on its face used by men-of-war.

Pomony Harbour.—At present there are no beacons at Pomony, and the buoy on the Middle ground is also gone. A beacon is much wanted to mark the centre line of the harbour. The anchorage is limited, and vessels likely to remain at Pomony should keep the factory chimney on a N.E. by E. bearing, and not anchor in less than 12 fathoms.

Current.—The *Cossack* during her passage from Zanzibar to Johanna in December 1869, experienced the full force of the westerly current which flows past Comoro island. The day before making that island a course was shaped to pass 30 miles to windward of it; the *Cossack* experienced 40 miles current then, and 70 miles on the following day, setting in a direction nearly west, and forcing the ship to leeward of the islands.

The French ship *Persévérance* is reported to have touched the bottom on a bank westward of the island of Comoro. The bearings taken were, the north-west point of the island N. 40° E. and the south point of the island S. 58° E.;—the depth was about 17 feet. The bank was apparently of considerable extent. (1867). Pages 353—355.

RED SEA—Suez Bay.—A sunken rock has been discovered in the fairway of the entrance to Suez bay.

The rock is a pinnacle rock with only 13 feet water on it at low water springs, and lies S. $\frac{2}{3}$ W. $1\frac{7}{10}$ miles from the lightvessel, and S.S.E. $\frac{2}{3}$ E. $1\frac{9}{10}$ miles from Kal' ah Kebireh beacon.

To avoid the danger by day, vessels should keep the lightvessel on with the westernmost minaret of the town of Suez. By night, a N. by E. bearing of the light will lead to the westward of the danger.

A small *red* buoy has been temporarily placed on the danger. *Variation* 5° *W.* (1870).

Gulf of Suez.—The following description of the extension of the reef to seaward from Ras Sherateeb, on the eastern coast of the Gulf of Suez (northward of Tur harbour) as resulting from the survey now in progress, has been received by the Hydrographic Office from Captain G S. Nares, R.N., H.M. Surveying vessel *Shearwater*, 1872:—

A narrow ridge of rocks with from 5 to $3\frac{1}{2}$ fathoms on it, has been found to extend $6\frac{1}{4}$ miles from the land of Ras Sherateeb, or about 4 miles seaward from the encircling reef as shown in the present charts in that neighbourhood, and known as the Shab Khoswan. This shoal ground narrows the channel at this part of the Gulf of Suez to 8 miles.

From the western extreme of the shoal water on this rocky ridge, the Ras Gharib lighthouse bears S. $\frac{1}{2}$ W., distant 14 miles.

The Asses ears, a remarkable double boulder rock on the Jehan hills, (which are 10 miles to the southward of Ras Sherateeb,) when in one with Jebel Hooswah, the highest hill on the coast range $3\frac{1}{4}$ miles to the south-east of the Asses ears, and bearing S.E. by E. $\frac{1}{2}$ E., will lead clear of the west end of the shoal ground.

The approximate geographical position of the western extremity of this narrow ridge of rocks is lat. 28° 35′ N., long. 33° 5′ E, *Variation* 5° 20′ *W.* (1872.)

Strait of Jubal.—A small sunken rock, lies nearly in the middle of the bay, recommended as an excellent anchorage during north-west winds, on the south-west side of Shadwan island. It lies about 5½ cables from the shore, with the extreme of the low sandy point forming the western side of bay bearing N.W. by W. ¾ W., distant 8½ cables, and is thus nearly in the middle of the anchorage bay.

This rock can be seen with a proper look-out, having only 2 or 3 feet on it, or nearly awash. The depth is 5 fathoms inshore of the rock, and 6 and 7 fathoms on its southern side. *Variation* 5° 40′ *W.* (1871).

Jubal Strait Bank.—H.M.S. *Newport*, engaged in the survey of the northern part of the Red Sea, has found shoal ground of 18 and 24 feet on the bank in Jubal strait *(Jubal strait bank)*, lying midway between Tur and Shukhair, hitherto considered to have not less than a general depth of 5 or 6 fathoms water on it, with an assumed shoal of 21 feet.

The shoal coral patch of 18 feet sounded on by H.M.S. *Newport*, is in lat. 28° 10′ 15″ N., long. 33° 28′ 40″ E.; and 2 miles to the N.W. of this, is another shoal of 24 feet: in the neighbourhood of these shoals, several patches with from 7 to 10 fathoms were found.

There are no outlying dangers off the neighbouring coast of Ras Shukhair, which may be approached to a distance of one mile.

Mocha.—A shoal patch, hitherto unknown, lying a league to the westward of the shoal ground off the town of Mocha, and near the fairway track of shipping bound up or down the Red Sea, has been found by the Master of the S.S. *Priam* on her voyage down the Red Sea.

The shoal, is a bank of white sand, about half a cable long and 30 feet broad; it has 18½ feet on its central part with 11 fathoms at either end.

From the shoal, the north end of Mocha bore E.N.E., and Zee hill S.E. ½ S.

These bearings place it about 7 miles from the land. *Variation* 3½° *W.* (1870).

Brothers Islands.—Reliable information has been received, that the position in latitude hitherto assigned to the islands known as "The Brothers" in the chart of the Red Sea is about 4 miles in error.

The latitude of the northern island is approximately in 26° 17′ 30″ N. instead of 26° 22′ N.

Also, the sailing directions, following Moresby, make them 60 feet high: Captain Lapierre of the F.I.N. gives the height from 10 to 13 feet. (1870).

Perim Island.—The Commander of the steam vessel *Evora*, states in passing the north-west side of Perim island, the ship grounded in 18 feet water, three-quarters of a mile from the shore, and remained there upwards of 48 hours.

From the position in which the ship struck, the lighthouse bore S.E. ½ E., and the west point of the island S. by W. ½ W. nearly a mile. The water gradually shoaled towards the shore, but increased to 5 and 7 fathoms 1 cable to seaward.

Note.—Mariners are cautioned in approaching this locality, as the extent of the shoal ground is yet unknown. *Variation* 4° *W.* (1871).

Azalea Reef.—Information has been received from the Political Resident at Aden of the existence of a sunken rock on which the steamship *Azalea* was wrecked, off the east side of Perim island, and stated to be at a distance of 387 yards from the shore. This danger has 11 feet water on its shoalest part and

from it Perim Island lighthouse bears N.W. ¾ N., the north-east point of the island S.W. by W. ¼ W., and Bab-el-mandeb peak N.E.

It is reported that the tides are not to be relied on in this neighbourhood, and that the currents are variable and strong.

Ras-Gharib.—On the 1st of December, 1871, a *fixed white* light, visible 20 miles, was established on the point at Ras-Gharib, in lat. 28° 21′ N., long. 33° 6′ E.

It is shown from an iron lighthouse, consisting of a centre column supported by three stays, painted red—the centre of the lamp being 165 feet above the sea. Pages 384—387.

ADEN.—A lighthouse of dark blue stone and 69 feet high, has been erected on Ras Marshigh the eastern extremity of the peninsula known as cape Aden. It shows a *fixed* light at 244 feet above the sea, visible 20 miles. Its geographical position is lat. 12° 45′ 23″ N., long. 45° 4′ E. It is of service chiefly to vessels approaching Aden from eastward; those westward of the port, can see it only when it is open southward of Ras Tye. Page 388.

KARACHI.—The coast of Sindh southward of lat. 24° N., should be very cautiously approached, there being in places a depth of 20 fathoms within 2 miles of, and 10 fathoms close-to, the outer edge of the banks which extend to the south-westward from the Kukiwari mouth of the Indus.

It is equally necessary to be careful not to get too close in with the land when northward of lat. 24° N., as it should not be approached into a less depth than 14 fathoms, when the vessel will be only 7 to 9 miles from the Hajamri and Kediwari banks of the Indus. These banks are very dangerous, there being in some places a depth of 10 fathoms close to their extreme edge.

Vessels approaching Karachi from southward should make a frequent use of the lead especially when in the vicinity of the banks just mentioned. It should also be remembered that the land behind them is low, and scarcely visible in clear weather from their outer edge,—in addition, the set of the tides and currents is very uncertain.

Ras Muari (cape Monze), distant 18 miles W. ½ N. from the western entrance to Karachi, is high and bold of approach. Ships, during the south-west monsoon season, should make this headland, running to the eastward for Manora point, and keeping the latter on any bearing to the northward of East.

Light.—Manora point, on the west side of Karachi harbour, is 100 feet high, and has upon it a lighthouse and signal station. The light, *fixed*, is 119 feet above the sea, and visible 17 miles; but in the hazy weather prevalent during the south-west monsoon, is frequently not seen at a greater distance than 7 miles, —its geographical position is lat 24° 47′ 21″ N., long. 66° 58′ 15″ E.

Manora point can be approached to within half a mile on any bearing from North to East, in about 5 fathoms water; but the port should, if possible, be made during day. From June to September vessels can approach within 1 or 2 miles of the lighthouse, keeping it from N.E. to North, and should then heave-to until boarded by a pilot or directed by signal. Entrance to the harbour should not be attempted without such assistance. From September 15th until the end of March ships may anchor with the lighthouse bearing N. by E. to N.N.E. distant one mile, in 7 fathoms water. During the months of April and May

they should anchor in 8 fathoms, with the lighthouse bearing N.N.E. to N.E., distant 1½ miles.

The following instructions for vessels bound to the port were issued by Lieut. Geo. C. Parker, I.N., Acting Master Attendant, August 23rd, 1873;—

Tides.—High water full and change 10h. 30m. Average rise and fall—spring tides 9ft. 6in.;—neap tides 3 to 4 feet. The average depth of water on the bar at high water springs is 28 feet; at neap tides 25 to 26 feet.

Draught of Vessels Entering or Leaving Port.—Vessels with a draught not exceeding 21 feet can now enter and leave port without any difficulty or delay during all seasons of the year. During the fair season, from October to 15th May, vessels of the largest class with a draught not exceeding 24 feet, can now enter and leave the harbour. Fixed moorings will be placed for such vessels.

Time of Tide for entering Port.—Sailing vessels should enter port on the ebb tide. Steamers can enter either on flood or ebb, and stand at once into port. Masters of ships should not, under any circumstances, attempt to enter the harbour without a pilot.

Harbour Improvements.—The harbour works are nearly completed, and have proved most successful, both as regards deepening the entrance channel and enlarging interior accommodation for shipping. Among the extensive works executed, a breakwater has been built, running out from Manora point in a S. by E. direction to a distance of 1500 feet into 6 fathoms of water; this affords complete shelter to the channel over the bar during the S.W. monsoon.

Also, a channel has been opened through the bar with a depth of 19 feet at low water spring tides, 300 feet in breadth (to be widened to 500 feet); the channel is marked with buoys, and these, on entering, should be kept on the port side, about 100 feet.

Note.—Every facility will be afforded (during the fair season only), for mail steamers to enter port during the night. A 'red light' will be placed at the end of the breakwater, and a light will be shown on the west side of the channel.

A mail steamer arriving off the port at night, and requiring a pilot, should fire 'two guns.'

GULF OF CAMBAY.—Eight rivers discharge into the gulf of Cambay or Khambat; the Nerbudda or Narmada, Sabarmati, Mahi, Dhadar, Kim, Taptee or Tapti or Tapi, Bhaunagar or Ghadechi, and the Shetrunji.

The fall of rain in this part of the East Indies being very considerable (36 inches in the year), a great quantity of mud is carried by these rivers into the gulf of Cambay, discolouring the water, especially during the monsoon. After the latter, the water beyond the influence of the tide clears in some measure; but on the "Bombay Bank of Soundings," 100 miles below the head of the gulf of Cambay, it is always, more or less, muddy and discoloured. In the rivers, however, it cannot, on account of the immense amount of water flowing rapidly down, deposit; they nearly all deepen, but some of them change only their channels. The Nerbudda, for instance, the mouth of which lies against the flood stream, increases in depth, while the Tapi, on the other side of the gulf, frequently changes its channels. The mouth of the latter lies directly beyond a low promontory, called Vaux's Tomb, and situated in lat. 21° 5′ 35″ N., long. 72° 37′ 30″ E.

The Nerbudda is very easy to navigate; the flood tide setting directly into it, and the rise of the spring tide at the mouth being from 25 to 30 feet; at the mouth of the Tapi the latter is only 19 feet.

The width of the Nerbudda is, at the mouth, about 13½ miles, and about 16 miles up the stream, above Mehegam (Mehegaum), it is 1½ miles. Within this distance many places are dry, except in uncommonly high tides, occurring once or twice in the year, and others are just covered by the water. Between them are two channels, the southern of which, leading to Hansut, becomes dry at low water; the northern channel, which flows past Ambheta (Umbheta), is always navigable.

There is no bar off the northern channel, although older charts show two banks with a channel 1½ miles in width between them; the tongue of sand, extending from the northern coast southward to a distance of from 4 to 4½ miles, may be the cause of the many reports of the existence of a bar.

The part of the channel between the mouth and Ambheta has recently changed 1½ miles to the westward; it does not any longer trend from Ambheta downward in a south-western direction, but goes in a western direction to nearly opposite the village Lohara, and thence directly south.

The above-mentioned tongue of sand has been carried away outside to a considerable extent, so much so that, half a mile above its point, it is now only 1¾ miles wide, instead of 4½ miles, as shown on the charts. But it has grown in length, the point being at present half a mile farther south than shown on the charts. It is probable that in the course of time the river will break through the tongue directly west into the gulf, where there is very deep water, the depths being between 7¾ to 15½ fathoms at a short distance from the land.

Between the outer mouth and Ambheta is a narrow and ve y shoal channel, about a mile above the point of the sand.

The width of the main channel is, at the mouth, more than a mile, and the depth outside, near the buoy (lat. 21° 34′ 30″ N., long. 72° 30′ 20″ E.), is now 6¾ fathoms; formerly, it was only 3 fathoms.

N. 56° E., distant about 1½ miles from the outer buoy, lies the inner buoy, the water near it being from $3\frac{9}{10}$ to $5\frac{8}{10}$ fathoms; formerly, it was only $1\frac{9}{10}$ fathoms. The depth remains about the same up to Ambheta. This shows that the channel of the Nerbudda improves steadily by its own action.

Directions.—Besides the main channel passing Bharukh, there is also a channel along the southern shore of the river, opposite Bharukh, but only for small craft at high tide; large vessels cannot cross the bar there.

Beyond Bharukh (Baroche) the railroad crosses the river, whence the deepest channel remains near the northern shore. Below Bharukh the channel crosses over to the southern shore, running then some distance up, to a creek or cut open to the southward, opposite which the water shallows, forming a bar, over which at present large ships cannot pass. The channel recrosses to the northern shore, remaining there up to about 4½ miles below Bharukh, in the vicinity of Dasar village, where it divides into two branches, the northern of which is much narrowed by an island, while the southern is comparatively dry. The northern branch runs along the high northern shore for about 5 miles, making a curve toward the south, with a depth of 18 to 25 feet at spring low tide close to the shore (50 feet distant) and across the greater width of the river. Many ships may be moored here or may lie at anchor, those of 15 to 16 feet draught remaining afloat at all stages of the tide. The depth remains the same to a point

opposite the village Samni, on the northern shore of the river, whence the channel again crosses over to the southern shore toward a cut or creek, running past Hansut Bandar, which is the southern channel at the mouth, mentioned previously as becoming dry at low water.

From opposite Samni, where a narrow shoal extends along the northern shore, the channel leads to Mehegam, where, beside it, another creek or cut exists, called Bhuki or Badri. The water in the channel proper is here comparatively shallow, but never less than 6 feet at low tide; a buoy is moored here. The rise of neap flood is 6¼ feet and of spring flood 17¾ feet; the average water is about 18 feet in neap tide and 24 feet in spring tide, sufficient for all vessels of 15 feet draught, except in the lowest neap tides. From Mehegam the channel runs along the northern shore, past Kaladra, to near Vingni, where a high and sharply defined bank exists with 8¼ feet over it at lowest high water neaps, and 19¼ feet in spring flood tides; the lowest neap tides, however, occur but rarely and last only for three days.

From Vingni the channel crosses again to the southern shore, and widens to 1½ miles; it passes Karsalia (Bet) island, along the high shores of which the water is deep close to; there is, however, some shallow water near the first point of the island, where a buoy is moored in 8 feet at low tide, but the high rise of tide prevents any disturbance of navigation.

The channel runs along the southern shore to opposite Suva on the northern shore, whence it again bends north, touching the shore about 2 miles from Ambheta. There also exists a small shoal, which, however, does not impede navigation. The flood rises here extraordinarily high, and there is in this part of the river everywhere from 24 to 27 feet of water at spring low tide, so that the largest vessels remain afloat at any stage of the tide.

The prevailing belief is that the river changes every year considerably; but on comparison of its present state with the Admiralty chart published in 1845 (showing the river as far as Mehegam), it will be found that these changes are for the better. The only part which has changed greatly is that near the mouth.

Smaller changes occur, doubtless, every year during the monsoon, especially near and at Bharukh; everywhere else the powerful flood soon removes any obstacle.

The tidal observations show the flood to last on the average 3 hours, and the ebb 9 hours, varying probably in some parts, but only a little. The quantity of water in the upper part of the river at low water is greater in spring tides than in neap tides, as then each succeeding flood ascends before the preceding has descended. Very close observations confirm that in spring tides the rise is greater than the fall, and in neap tides the reverse; for instance—

Spring tide.—Rise 9¼ feet, fall 8¼ feet; rise 5¾ feet, fall 4½ feet; rise 9¾ feet, fall 8¾ feet.

Neap tide.—Rise 2¼ feet, fall 2¾ feet; rise 3¾ feet, fall 5 feet; rise 2¼ feet, fall 3¼ feet.

The flood differs also in day and night time; the higher flood is during the night. The rise of tide in the mouth of the Nerbudda is 25 to 29¾ feet.

The latter height was observed November 20th 1870, at the new moon. The water then rose in the three hours of the flood tide 9¾ feet per hour, or 0·16 feet

per minute. When such a flood enters the gulf the stream must naturally be very strong, and ships may readily drift; the roaring of the water can then be heard in the dead of night at a great distance. There is never a flood-wave in the Nerbudda as in other rivers, owing to its width at the mouth, which is a flat basin, over which a great quantity of water distributes before entering the narrower part of the river above Mehegam.

During the monsoon the motion of the water in the mouth of the Nerbudda is very considerable, especially at the beginning and when the flood meets the water coming down. The sea then rises very high, similar to the sea off cape Guardafui, and at the Agulhas bank south of the Cape of Good Hope, during the monsoon. Only good stout vessels can then enter the Nerbudda, and even such had better remain outside. But as soon as they have entered and reached the inner buoy, 1½ to 2 miles up the river, they are well enough protected except in severe gales, and even in such they are secure at Ambheta.

The navigation of the Nerbudda is, for ordinary ships, easy at all times; steamers commanded by experienced masters can reach the deep water beyond Samni, and 4 or 5 miles from Bharukh, in one flood tide, and under all circumstances in two. For sailing vessels two or three flood tides are required for reaching that place.

In navigating the river the tides must always be taken into account more or less, especially for long vessels with little beam. If not obeying the helm quickly below Bharukh or near Mehegam, they will ground or run on the banks, not for the want of water, but on account of the relative position of the banks. Sailing vessels are apt to ground in beating, from the same cause.

Well-built vessels, however, will not be damaged essentially by grounding, the bed of the river being very smooth, and the bottom principally fine sand, or here and there soft mud.

The directions for entering the river are: from the outer buoy the light tower of Perim bears N. 85° W., distant 10 miles; the channel trends N. 56° E. for 1½ miles to the inner buoy in $3\frac{3}{10}$ fathoms spring low water; from the inner buoy the channel trends north 3½ miles to the beacon, beyond which it is well defined by the banks. An experienced navigator will know where he may lay secure, waiting for the tide, in case he cannot sail up with one flood.

The first of such places is Ambheta, the second near Vingni, and the last beyond Samni. Each of them has good anchorages in deep water, at all stages of the tide, for vessels up to 14¾ and 16 feet draught.

The navigable part of the river could be improved greatly by closing the creeks or cuts on the southern shore, especially that below Bharukh and that leading past Hansut.

The navigation of the upper part of the gulf of Cambay to Gogha, Bhaunagar, and Dholera, has no difficulties, as the water is deep, with good anchorages; the farther up the gulf the greater is the influence of the tide. Ships at anchor off Mahi are exposed to drifting, and may readily get high and dry, especially when the prevailing S.W. wind exercises its full influence on the tide and increases the currents. At Gogha this danger is lessened through the protection of Perim island; but even here the sea rises, during the height of the monsoon, to a formidable height; the storm-waves are dangerous at all times. Notwithstanding these drawbacks, a mole might readily be built opposite Gogha if the commerce

was great enough to justify the expense; the construction would be less hazardous than at Madras, on the Coromandel coast.

Directions in Brief.—*A large red buoy*, surmounted by a basket, lies at the entrance in lat. 21° 34′ 30″ N., long. 72° 30′ 20″ E., in 6¾ fathoms water at spring low tide, the light tower of Peram bearing N. 85° W., distant 10 miles. The buoy is ¾ mile distant from the banks, and is the leading mark for the channel.

A second large red buoy, marking the bend of the channel, lies in the middle of it, in $3\frac{9}{10}$ fathoms water, spring low tide, the outer buoy bearing from it S. 56° W. distant 1½ miles.

A beacon stands on the northern shore at the high-water line, bearing North (*true*) from the inner buoy, distant 3½ miles. From the outer buoy, steer E. until the inner buoy bears N.E. by N., then steer for the inner buoy and pass it to the N.E. From the inner buoy steer N. for the beacon, and then along the northern shore toward a group of trees surrounding a temple close to Ambheta, where deep water will be found close to the north shore.

The least water in the entrance at spring low tide (15 feet) is between the two buoys. Between the inner buoy and the southern shore the depth $5\frac{8}{10}$ fathoms, with room enough for a large vessel to swing.

Perim Light.—The *fixed* light on Perim island is from a white stone building 78 feet high; it is 128 feet above the sea, and visible 17 miles. Its geographical position is lat. 21° 35′ 54″ N., long. 72° 23′ 38″ E.

Tapti Light.—The *fixed* light at Tapti is on a column 91 feet high, and painted in red and white bands, erected on the north side of the river, in lat. 21° 5′ N., long. 72° 38′ E. It is at 100 feet above the sea, and visible from an offing of about 15 miles. Page 407.

BOMBAY.—A lighthouse consisting of an octagonal tower on the centre of a flat roof house has been erected on Kennery (Kundari) island, south of Bombay harbour. It shows a *fixed* light at 161 feet above the sea, visible from all parts of the sea horizon at the distance of 20 miles. Its geographical position is lat. 18° 42′ 20″ N., long. 72° 48′ 50″ E.

The Outer lightvessel now shows a *red* light, *revolving* in 20 seconds. The fairway buoy has been removed. Page 410.

Signal Station.—The following is a revised code of urgent signals for use at Kennery (Kundari) island, to be repeated by the Pilot schooners, the Outer lightvessel, and at the Kolaba Signal Station:—

No. of Signal.	Gun Signals.	Signification.
1.	Two guns in quick succession.	A vessel is running into danger.
2.	One gun, followed after an interval of a minute by two guns in quick succession; thus O—OO	A vessel is ashore.
3.	Two guns in quick succession, followed by an interval of a minute by one gun; thus OO—O	Vessel for which No. 1 signal was made is now out of danger.
4.	Two guns, at an interval of one minute.	Kennery Lifeboat is disabled.

5.	Three guns, at an interval of one minute.	Medical aid is urgently required at Kennery.
6.	Four guns, at an interval of one minute.	Communication with Bombay is urgently required.

The above signals are to be repeated every five minutes until replied to by the Outer lightship and at the Kolaba signal station. The pilot schooners are to repeat the signals (made at Kennery either by guns, flags, or distant signals) by showing the corresponding signal in the *Commercial Code* under the red ensign, Union down, at the mast-head, and they are to close with and communicate the same to the Outer lightvessel and to the Kolaba signal station. For instance—If No. 1 or No. 4 signal is made at Kennery, the pilot schooners will hoist V.W.G. or V.W.K. under the red ensign, Union down. The Outer lightship will repeat all signals until replied to at the Kolaba signal station. Pages 408—410.

Trade between Bombay and Europe, via the Suez Canal.—*During the South-west Monsoon.*—The Salvage Association has issued the following mem. on this subject, furnished by Commander J. A. Heathcote, late I.N.:—

The South-west monsoon sets in at Bombay early in June; to the southward of Bombay it begins earlier, the average date of its commencement at Mangalore being the 20th May. Ships leaving Bombay in May for the Suez canal will certainly fall in with the monsoon in crossing the Arabian sea.

In June, July, and August steamers leaving Bombay harbour, after making an offing, generally govern their course by the winds which may blow from W.N.W. or from W.S.W., and from that to S.W. They run to the southward, steering as near to the wind as possible, to allow their trysails to draw, until they find that, as they get to the latitude of about 6° N., or to the southward of that, the monsoon is there sufficiently moderate to allow them to make their westing under steam alone.

About the meridian of 54° or 55° E. they will begin to haul up to the N.W., and when reaching about the lat. of 9° to 10° N., it is well to keep not too far from the African shore; for, by keeping well in with it, a strong favourable current running to the northward is experienced, whereas, about 100 miles further out, to the southward of Socotra, a very strong current to the E. and E.S.E. is found, and this current is of such force that if a vessel once gets into it she may lose her passage altogether, and be obliged to bear up before the wind for the port of Bombay again.

The passage against the South-west monsoon is, no doubt, one which is likely to strain any but a very well-conditioned ship. Steamers with only very small steam power in proportion to their size may find difficulty, or at least be detained, in making this passage. Sailing ships making this passage have to go very much further south than steamers, sometimes even into the South-east trades, in order to make their westing; they frequently pass to the southward of the Chagos archipelago, and then cross the Line again to the northward, about the longitude of Ras Hafûn.

The passage from the Red sea to Bombay, in the South-west monsoon, is one which any well-conditioned ship can make without difficulty; the only anxious part of the voyage is when approaching Bombay harbour. In doing this, the great point is not to get to the northward of the harbour, and to pay particular attention to the lead. A powerful light now established on Kennery island causes the

making of Bombay harbour by ships approaching it in the South-west monsoon to be much less hazardous than before. Pages 407—412.

RATNA GHIRI, at about 115 miles southward from Bombay. A *fixed red* light is shown here from the south-west bastion of an old fort; it is 300 feet above the sea and *said* to be visible from the distance of 18 miles. Its geographical position is lat. 16° 59′ 30″ N., long. 73° 15′ 47″ E.

Anchorages.—At Ratna Ghiri there are three anchoring grounds:—The outer anchorage for sailing vessels; the outer anchorage for steamers; and the inner anchorage for steamers during the fair season only.

Vessels anchoring at the outer roadstead should do so in 8 fathoms, at a little more than a mile from the lighthouse, with the lighthouse bearing N. 59° 4′ E. or N.E. by E. ¼ E.; Adawlut building, (a very large house on the hill bordering the creek to the North) N. 81° 33′ E. or E. ¼ N.; and the white tomb, (near the beach southward of the creek), S. 75° 56′ E. or E. by S. ¼ S.

Steamers making the port at the beginning or close of the South-west monsoon should anchor in 6½ fathoms with the lighthouse bearing North and the Adawlut building E.N.E.

The inner anchorage is only available for steamers during the fair season. Vessels should anchor in not less than 4 fathoms with the lighthouse bearing N.W. ¾ N. and the Adawlut building E. by N. ½ N.;—that position will place them at about 1200 yards from the landing place and 700 yards from the edge of a ridge of rocks running out from the beach in front of the custom-house.

The port of Ratna Ghiri does not afford the least shelter to vessels during the South-west monsoon, but a vessel in distress would, in a measure, be sheltered by anchoring in 5 fathoms after rounding the north point of Meria Donghur, a hill 3 miles northward from the lighthouse.

The bay between Meria Donghur and the lighthouse hill does not afford any shelter, but on the contrary, is open to the full force of the monsoon. Page 413.

VINGORLA.—Two *fixed white* lights are exhibited from the headland overlooking the Vingorla roadstead, visible seaward a distance of 9 miles. The lights are placed 20 feet apart and at an elevation of 250 feet above the sea. These lights will not be shown during the S.W. monsoon, that is, from 15th June to 31st August, inclusive. Page 413.

VINGORLA ROCKS.—A *fixed* light is shown from a lighthouse erected on the outermost of the Vingorla rocks or Burnt islands; it is elevated 110 feet above the sea, visible 15 miles.

From the lighthouse, Vingorla point bears E. by S. 9½ miles, and Malwan, North 9¼ miles. Position, lat. 15° 53′ 20″ N., long. 73° 26′ 40″ E. Page 413.

CALICUT.—A *black* buoy has been moored off this port in 4 fathoms, to mark the inner edge of the best anchorage; it lies with the lighthouse bearing E. ¾ S., and Conolly hill N.E. by N. To avoid dangers when passing to or from southward and in the vicinity of Cooty reef, great care should be taken not to bring the buoy westward of North, as there are several shoal patches of rocky ground close inside of that bearing (1869). Page 416.

COCHIN.—The new lighthouse is of white stone and 89 feet high; it shows a

fixed light at 95 feet above the sea, visible 14 miles. Its geographical position is lat. 9° 57′ 50″ N., long. 76° 14′ 40″ E. *The light referred to in the text has been discontinued.* The best anchorage in the roadstead is in 5½ to 6½ fathoms, soft ground, at from 2 to 2½ miles from the shore, in the direction of W. ¾ S. to W. by N from the lighthouse. (1868).

Limits of the Port.—The limits of the Port are as follows: *To the North*—The boundary pillar, 1 mile north of the Northern point of the entrance to the harbour or back water.

To the South.—The boundary pillar, 3 miles south of the Southern point of the entrance to the back water.

The sea shores between them to within 50 yards of high water mark, spring tides.

To the East.—The harbour and back water with all creeks and channels leading thereto, that may be within the Indian Government territories, and so much of the shores thereof, whether of the main land, or the islands, as are within 50 yards of high water mark, spring tides.

To the West.—The space enclosed by two lines, running due West from the boundary pillars, to 9 fathoms water.

Anchorage.—The best anchorage in the roads is with the following bearings: flag-staff E. ½ N. to E.N.E. in 5½ to 6½ fathoms, soft ground, about 2 to 2½ miles off shore. Page 416.

NARRAKEL.—A first class buoy, painted *red*, is moored in 18 feet water, soft bottom, with the Narrakel flagstaff bearing E. by S. ½ S.

The best anchorage in the South-west monsoon is with the buoy bearing East to E.S.E., in from 3½ to 4½ fathoms. Vessels of small draft, from 12 to 15 feet, can anchor close to the buoy.

The buoy will remain in position throughout the South-west monsoon, and is seen from a distance of about 3 miles.

The Master Attendant's office, which has been recently erected a little to the northward of the flagstaff, will be clearly seen from the offing as a white object, and form a good guide to ships running in for the roads. (May 7th, 1867). Pages 417—419.

GREAT BASSAS ROCKS.—See List of Lights page ix.

MOELETIVOE (N.E. coast of Ceylon):—There is reason to believe that the shoals off Moeletivoe, have extended further seaward. Mariners are accordingly cautioned not to approach that portion of the coast into less than 20 fathoms water until they are certain the shoal ground is cleared, as on some of the ridges there is not more than 12 feet water. Page 440.

POINT CALIMERE.—The land at this point has suffered so much from the sea, that the beacon upon it is now surrounded by water. At about a mile inshore is a flagstaff. The two pagodas in lat. 10° 22½′ N. bear West, when in line. Page 448.

NEGAPATAM SHOAL is a small patch of about a mile in extent, and with only 3 fathoms upon it; it is in lat. 10° 36′ N., long. 79° 55′ E., and consequently 3¾ miles from the beach. From it a narrow 4-fathom tongue extends 4½ miles

due North, in a direction parallel to the coast; and also extends southward from it until at last it joins the flats off point Calimere. At a mile eastward from it the depth is 7 fathoms, and immediately westward of it 5 fathoms. As the channel between this shoal and the shore is shallow for a distance of 2 miles from the land, vessels approaching Negapatam from southward should keep eastward of it, in a depth of not less than 8 fathoms. Page 448.

JEYTAPUR (West coast of India):—A *fixed white* light has recently been established on Keeva hill at Jeytapur; it is elevated 75 feet above the sea, visible about 9 miles. Position, lat. 16° 36′ 10″ N., long. 73° 18′ 30″ E. From June 11th to September 9th, inclusive, during the South-west monsoon, the light is extinguished. Page 413.

COLEROON SHOAL, in lat. 11° 27′ N., consists of a sandy flat at the mouth of the Coleroon river. It projects from the shore about 1¼ miles, and at a mile eastward from it is a depth of 7 to 9 fathoms. Page 448.

TRIPALOOR REEF, in lat. 12° 37′ N., extends one mile from the land, and is immediately succeeded by a depth of 5 and 6 fathoms, deepening to 11 and 12 fathoms at 2½ miles from the beach. This reef runs off the coast at the seven Moolivaram pagodas. Page 449.

The bank in lat. 12° 26′ N., 10 miles from the shore, reported to have been sounded upon by Captain Barclay, does not exist. The depth in that latitude and at that distance from the shore is 23 to 25 fathoms. Page 449.

CORINGA.—Lloyd's agent, dated Cocanada, Feb. 3rd, says:—"The port of Coringa has for a long time been abandoned as an entering and clearing port for ships under command of Europeans, and it is entirely confined to native vessels of small draught of water. All ships come to Cocanada and must clear from Cocanada; vessels do not communicate with Coringa officially." Page 456.

GOPAULPORE.—A light is now exhibited at Gopaulpore, Bay of Bengal. It is a *fixed white* light, exhibited from a flagstaff, and elevated 89 feet above the sea; visible 8 miles.

The position of the flagstaff is lat. 19° 13′ N., long. 84° 52′ E.

Directions.—Vessels making the roadstead should bring the light to bear N.W. ½ W., and anchor in from 8 to 9 fathoms water. Page 463.

MORELLGUNGE (Huringotta River).—This port has been declared by the government surveyor to be safe of access and egress during the North-east monsoon, for vessels drawing 17 feet water. The entrance has been buoyed, and the port is very favourably situated for exports of rice from Bengal.

With reference to the South-west monsoon, though the port may be considered safe for vessels entering during that season, because as the wind would be fair for entering, the time for running in may be chosen so as to carry high water over the shoal part of the entrance, yet the coming out during the South-west monsoon is reported (also by the surveyors of the government of India) to be not safe for vessels under sail, drawing above 12 or 13 feet, because the ebb tide has to be taken advantage of to enable the vessel to beat out, the wind being contrary, and the extent of shoal water is so great, that a portion of it must be crossed at low water. At low water spring tides, on the lower part of the shoals there is only 16 feet of water, therefore, with the swell and sea of the South-west monsoon, it is plain that vessels under sail cannot come out from the Huringotta

river drawing above 13 feet at the most. Therefore, for vessels drawing above 13 feet of water, steam is absolutely necessary in coming out during the South-west monsoon, and even then it would not be safe that a vessel, either a steamer, or in tow, should draw more than 16 feet during the height of the season.

About the entrance of the Huringotta river the South-west monsoon may be taken to last from April to September.

Directions.—The following directions for entering the Huringotta river from sea were published by the Government of Bengal in 1869:—

The channel leading from sea into the Huringotta has been buoyed as follows;—

The outermost or fairway buoy is a first class spire buoy painted *white*, and laid in lat. 21° 26′ N., long. 90° E., in 6 fathoms low water spring tides. The lower Landfall flat buoy is a second class spire buoy painted *black;* it lies in 3¼ fathoms low water spring tides, 7 miles N.N.W. from the fairway buoy. The Argo flat buoy is of the same description, but painted *red;* it lies in 2¾ fathoms, about 6½ miles N.N.W. ⅝ W. from the eastern buoy. The upper flat buoy is of the same description, painted *black*, and lies in 2¾ fathoms, about 6½ miles N.E. ½ N. from the Argo flat buoy. The lower spit buoy is a second class spire buoy painted *black;* it lies in 2½ fathoms, about 6 miles N.W. by N. from the upper Landfall flat buoy. The upper spit buoy is a third class buoy painted *red*, laid on the south end of the spit above Tiger point; it bears from Tiger point N. ¼ W., distant about 7 miles.

A beacon with a basket on it is placed on Tiger point to mark the point, and a similar one on Deer Point bush.

Vessel bound for the Huringotta river in the North-east monsoon should first make the fairway buoy, and then stand over on the starboard tack till the lower Landfall flat buoy is sighted. Should, however, the wind be well to the northward, and the buoy is not sighted, they should take care to tack to the eastward in time, as there is usually a westerly set of from 1½ to 2½ knots per hour during this period of the year. After sighting the lower Landfall buoy vessels should tack as soon as they can fetch it, and when close to it they will be fairly in the channel; they should then work to windward during the flood tide and anchor at high water.

Vessels drawing less than 14 feet can anchor in any part of the channel during the North-east monsoon, but if drawing more than that they must anchor below the Argo flat buoy, unless they can make certain of passing the spit buoy before the tide is done.

In working up, the lead will be found a safe guide, as the soundings in the channel are all soft mud, but the following bearings of the buoys should be attended to;—

In standing to the westward—The Argo flat buoy must not be brought to bear to the eastward of N. by E. ½ E., or to the southward of S. ½ W., when to the northward of it. And the spit buoy must not be brought to bear to the eastward of North.

In standing to the eastward—The lower Landfall flat buoy must not be brought to bear to the westward of S. by W. ¼ W., and the upper Landfall flat buoy must not be brought to bear to the westward of N. by W., or to the westward of S. ½ W. when above it.

Vessels should pass close to the spit buoy, when they will be in the channel.

and must not stand over to the westward further than to bring Tiger Point beacon to bear N. by W.; when this bearing is on, they should tack, making short tacks to the eastward all the way up the channel. Having passed Tiger point, a vessel may stand close in shore on the starboard tack, making short boards over to the eastward till abreast the upper spit buoy. After passing it, the tacking mark to the westward will be the buoy bearing South, when short boards must be made to the eastward, till Deer Point bush is reached. Being to the northward of that, the water is deep close to on the eastern shore, and short boards must be made to the westward till clear of the upper spit shoal. The vessel will then be fairly in the river and clear of all dangers, and careful attention to the chart by Lieut. Sweeney will enable her to proceed in safety to Morrellgunge.

It is to be understood that these directions have been framed from the latest survey in 1861 by Lieut. Sweeney, but as he found very little alteration since 1840, the date of Captain Lloyd's survey, it may fairly be assumed there has been no material alteration in the channels up to date.

It is high water at the fairway buoy, full and change, at 10h.

The port will be opened during the North-east monsoon only, and by attending to the above directions, and by a careful observation of the chart and attention to the sounding, no difficulty can be experienced by a commander of a vessel in making or leaving the port.

Beyond the above aids, commanders visiting the port must rely upon their own skill. *Variation* 2° E. Page 465.

PORT CANNING.—It has been decided to close Port Canning, and to withdraw all harbour establishments from the Mutlah except the outer lightship. (1871). Page 469.

CHITTAGONG RIVER.—Two *fixed* lights are now shown on Norman point, a short distance southward of the entrance to this river, at the respective heights of 38 and 30 feet above the sea, visible about 8 miles. During day, the point may be recognised by a barrel-shaped beacon on a tripod 65 feet high.

Vessels making the port should sight the lights on the bearing of about N.E. They should approach them on the bearing of N.E. to E.N.E. and when distant about 3 miles from them, should anchor or wait for a pilot. Page 472.

AKYAB.—The lighthouse on Savage island has been altered from a *fixed* to a *fixed* and *flashing* light, showing a flash every minute. The light is elevated 99 feet above high water; visible 13 miles. (1871).

The light which was *temporarily* exhibited from the table-land of Borongo island is extinguished and the structure is destroyed.

A flagstaff carrying a ball at the mast-head stands on Oyster island. It is 82 feet above the sea-level and bears from the lighthouse on Savage island N. 69° W., distant 21 miles. Page 473.

RANGOON RIVER.—The following lights are now (1873) exhibited at the entrance to Rangoon river:—

The lightship which formerly marked the entrance to the Rangoon river has been removed.

A coast light due of one anna a ton is levied on all vessels of 5 tons burden and upwards, if the voyage be from Rangoon or Maulmain to Bassein, or from Bassein to Rangoon or Maulmain.

Krishna Shoal Lighthouse.—A lighthouse on screw-piles in 3 fathoms at low water, near the south-western end of Krishna shoal, shows a *fixed* light at an elevation of 60 feet above high water, visible 14 miles. Rise and fall of tide 12 feet. H.W. at F. and C. XII hours. The light is cut off at W.S.W. to the westward, and at N.N.E. to the eastward, the centre of the light being South-east. Position, lat. 15° 36′ 30″ N., long. 95° 35′ E.

It is provided with a fog-bell which, in foggy weather, is sounded at intervals of 30 seconds.

Directions.—In making the light (the object of which is to enable vessels to round Baragou point so as to avoid the dangers of the Baragou flat and Krishna shoal) from westward, a vessel should keep in not less than 7 fathoms water to the southward, steering eastward until the light bears N.W. and distant 5 to 10 miles, then steering according to the strength and set of the tide, between N.E. by N., and N.E. 40 miles, to make China Buckeer lighthouse off the mouth of Rangoon river.

Vessels from northward going south must not get into less than 6 fathoms water when standing to the westward, or bring the light to bear to the southward of S.W. by W. ¼ W.

No vessel should approach within 5 miles of the lighthouse.

A vessel bound westward may steer in that direction after she has brought the light to bear North, distant 5 to 10 miles. taking care to keep in not less than 7 fathoms water.

China Buckeer Lighthouse.—This lighthouse is situated on the high land of China Buckeer, which is generally first made by ships bound to Rangoon, and is about 3 miles north-east of the mouth of China Buckeer river. It is built on screw-piles, and the lower part being against a back ground of dark trees is painted white. It is close to high water mark, but the sands at low water stretch 6 miles eastward from it; ships must therefore keep well to seaward. It shows a *revolving* light attaining its greatest brilliancy once a minute. The light is elevated 74 feet above the sea, and visible about 15 miles. Position, lat. 16° 19′ 30″ N., long. 96° 12′ E.

Eastern Grove Lighthouse.—This lighthouse is also on screw-piles, in lat. 16° 29′ N., long. 96° 26′ 30″ E. It shows a *fixed* light over an arc of 60° (South to S. 60° W.). An arc (10°) of greater brilliancy is shown from S. 25° W. to S. 35° W. (over the position formerly occupied by the lightvessel). The light is elevated 93 feet above the sea, visible 12 to 16 miles. It is not intended to be a leading light into the river, but to prevent vessels, making the land or China Buckeer light, from running too far to the westward.

Directions.—To make the mouth of Rangoon river steer so as to make China Buckeer light bearing between N. by E. and W. by N. To avoid the Eastern sands, a vessel should not go so far north as to bring the light to bear to the southward of W. ¼ N.; and to avoid the Western sands, the Eastern Grove light-house must not be brought to bear to the eastward of N.N.E. ¼ E. With China Buckeer light bearing W. ¼ N. and the Eastern Grove light bearing between N.N.E. ¼ E. and North, vessels will be on the Rangoon pilot station, in the neighbourhood in which pilot vessels are constantly cruising, and should anchor until daylight, or until a pilot is obtained. Pages 481—483.

MAULMAIN.—The light on Amherst point is discontinued. Page 485.

DOUBLE ISLAND.—The lighthouse on this island shows a *fixed* light, visible at the distance of 19 miles. Its approximate geographical position is lat. 15° 52′ 30″ N., long. 97° 36′ 30″ E., and from it Amherst point bears N. ¾ W.; the Patch buoy N. by W. ½ W.; and the west point of Kalegouk island S. by E. The arc illuminated is 164½° (from N.N.W. westward to S. ¾ E.); the bearing of N.N.W. passes 1½ miles westward of the Patch buoy, off Amherst; that of S. ¾ E. 1¼ miles westward of Kalegouk island.

A strip of light is shown from the Patch buoy eastward as far as Amherst point.

Vessels making the light should endeavour to keep it between the bearings of S.E. and N.E., paying particular attention to the tides, as at springs they run about 5 knots an hour, parallel with the coast. If the land be too closely approached the light will be lost to view, but so long as the light is in sight, they will be in no danger until they are 10 miles northward of it, when they will be in the neighbourhood of the Goodwin sands, where the tides are very strong. The anchoring ground in the vicinity of Double island is good, but, on account of the strength of the tides, vessels should avoid as much as possible the risk of anchoring in such deep water. Page 486.

PAK-CHAN RIVER (Bay of Bengal).—The following directions for the Pak-Chan river have been furnished by Navigating Lieutenant James Harry of H.M.S. *Spiteful*, Commander Mostyn, R.N. This officer also reports that in several places in the channel where 7 fathoms are shown in the survey of 1847, rocks are visible at low water 3 and 4 feet high.

To enter the Pak-Chan river vessels should coast along Saddle island, which will be easily recognized by two saddles, one on the north part of the island the other on the south, the latter being the higher, taking care to avoid the shoal water which extends north-westward from the north end of Delisle island. When abreast Tree island, which is small, nearly awash, with one or two trees in the centre, steer to pass between Harry head (the northern point of Saddle island) and the Spiteful rock, rounding the head about 1½ cables distant, hauling to the eastward for Stainer rock, which like Tree island is low, with trees about its centre; this course will lead clear of the reef in mid-channel, S.S.W. of Mostyn island, over which the tide sets strong; when abeam of Stainer rock, bearing about S. by W. to S.S.W. haul to the north-east, passing Dyke island about a cable distant, and when to the northward of the north-east point of Victoria island, the vessel will be clear of the dangers in the river between that and Malewan creek. (1869). Page 489.

MERGUI ARCHIPELAGO.—The following information relating to the Mergui archipelago has been furnished by Navigating Lieutenant John Phillips and W.H. Hayward, of H.M.S. *Forte* and *Dryad*. 1871:—

Cabosa is the northernmost island of the outer group, and has a small islet on its north side. It is of moderate height and thickly covered with jungle.

About midway between it and Tanasserim island (the next large island to the southward) and nearly 5 miles east of the western Canister, a small steep high island densely covered with jungle, is a group of pinnacle rocks above water.

Freak Island is low with only a few scraggy trees on it, and surrounded by rocks. A line, joining this island with the western Canister, passes to the southward of the above-mentioned group of pinnacle rocks.

Brown Rock, lying about 18 miles E. by S. from Cabosa and from 8 to 9

miles S.S.W. of the small Canister, shows well above high water. No dangers are visible between it and Freak island.

Iron Island lies to the south-east of the small Canister; the depth of water along its eastern side, at a distance of about 2 miles off the shore, is from 14 to 18 fathoms.

Lord Loughborough Island, in lat. 10° 25′ N., long. 97° 57′ E., is about 7 miles long and 3 miles broad, high and steep-to. Three-quarters of a mile from the shore, on the north-east side, the soundings are from 17 to 19 fathoms. Nearly abreast the eastern point and half a mile from the shore, is Hayward island, with rocks showing a short distance off; these rocks are steep-to, and there is good anchorage off this island in 17 fathoms, clay.

Between Loughborough and Richard islands there is good anchorage in from 8 to 15 fathoms, mud. Through the channel separating these islands, 3 fathoms will be found close to the shore, on either side.

To the eastward of Richard island are three other islands, O'Connor, Saul, and Skinner; the northern of which, O'Connor island, alone appears in the charts. They are of irregular form, about the same size, and are said to be dangerous to approach from sunken rocks between and about them. Vessels passing between these islands and Richard island, should keep the latter on board.

Bird's Nest Island is said to be much narrower than shown on the chart.

St. Andrew Group—Cockburn Islands.—The three islands to the northward of C. island are in one upon a S. ¾ W. bearing; they are a mile to the southward of the position assigned them in the chart. The island as shown between them and F., on the chart, does not exist: but there is a dangerous rock, not marked, named Parson rock, dry at low water, from which North Cockburn island bears W. ½ S., and the north point of C. island, S.W. by S. The east point of Bird's Nest island, bearing North, or a conspicuous round island covered with jungle, off the east side of C. island bearing South, clears Parson rock to the westward.

The *Tides* in the different channels of the Mergui archipelago run east and west, the flood setting to the eastward.

The Hydrographic Office publishes the following account of outlying dangers in the Mergui archipelago, not marked in the charts, on one of which H.M.S. *Daphne* grounded on the 5th July 1872:—

The **Oubliee Rocks,** in the north-west part of the archipelago, one about 12 feet high, and the other awash, are nearly one mile apart, north-west and south-east. They lie nearly 2½ miles to the northward of the north-west point of Elphinstone island, and 3 to 4 miles N.E. by E. of Saddle island, with 15 fathoms between them and Elphinstone island. The position given to these rocks is lat. 12° 36′ N., long. 97° 59′ E.

The reef shown on Admiralty chart No. 216 *a*, Mergui archipelago, as lying off mount Elphinstone, was not seen, and probably does not exist.

Warning Rock, awash at low water, lies between Court and Lord William Bentinck islands, about 4½ miles E. by S. ½ S. from the south-east point of the former island. There is 10 fathoms a mile to the northward, and no bottom at 13 fathoms half a mile to the eastward of the rock. The channel between Warning rock and the reef "above water," 1½ miles S. by E. of the rock, appeared to be clear.

The position given to the Warning rock is lat. 11° 54′ N., long. 98° 6′ E.; but as the rock was only observed in passing, this position must be considered as approximate.

Daphne Rocks, on which H.M.S. *Daphne* grounded, are just covered at low water ordinary tides, and lie north and south, about 100 yards long by 50 broad, consisting of several large boulders with 12 feet on a bottom of sand and mud, between them at low water. They are nearly one mile distant from the mouth of a small creek on the eastern side of Lord William Bentinck island, with 9 and 10 fathoms between them and the land.

From the rocks the east point of West Passage island (off the north-east point of Lord William Bentinck island), was open about one-fifth its apparent length of the western point of South Passage island. The south-east extreme of Lord William Bentinck island bore S. ¾ E., and the centre of the small creek W. ¾ N.

The position given to the Daphne rock is lat. 11° 42′ N., long. 98° 7′ E. *Variation* 2° *E.* (1872). Page 489.

PORT OF PENANG.—The following Port Rules have been made by the Governor in Council for the Port of Penang:—

1. The Port of Penang is declared to be a Port subject to the provisions of this Ordinance. (Ordinance for the regulation of Ports and Harbours).

2. The limits of the Port of Penang are as follows:—From an obelisk built at Klarwey in a straight line to Bagan Jermal, along the western shores of Province Wellesley, to an obelisk at Bagan Luar, and in a straight line to Penang bridge, thence along the eastern shores of Prince of Wales' island, to the obelisk at Klarwey, including the mouth of Prangin river, as far as the second Teetee Papan bridge, including the public streets, roads, or high ways, made or to be made, along the banks of these rivers, to the limit specified and including all public landing-places, stairs, piers, or jetties, made or to be made, along the shores of the Prince of Wales' island, or that part of Province Wellesley included in the limit of the Port. The limits of the South channel are as follows:—From the north bank of the Penang river to Nos. 3 and 5 red buoys, from thence along the eastern bank of Pulo Jerajah to the south-easternmost point of Pulo Rimo, thence in a straight line to No. 9 white buoy, then passing close to Nos. 8, 7, 6, 4, and 2 white buoys, and in a straight line ending at the obelisk built at Bagan Luar.

3. On being boarded by an officer of the Marine Department, every master of a vessel is to fill up the book handed to him, and is at the same time to give a correct list of all the passengers on board.

4. Masters of vessels lying at anchor in the harbour of Penang, on board of which a fire breaks out, are directed to make the following signals without any delay.—In the daytime, the *Commercial Code* signal of distress indicated by "NO;" at the same time, when possible, two guns should be fired, at an interval of one minute; at night time, two rockets fired, and two blue lights burned alternately at an interval of one minute, and two guns fired as in the daytime. Masters of all vessels are also cautioned, when signallising for assistance, not to forget to take every precautionary measure to put the fire out, and to prevent it spreading.

5. Masters of vessels requiring the assistance of the Police while in the harbour are to make the following signals:—In the daytime, the national ensign to be hoisted at the main-masthead; at night, one gun to be fired, and one blue light burnt.

6. Masters of vessels are prohibited from anchoring abreast the jetty or in any place within 250 yards on either side thereof.

7. To prevent accident. all vessels anchoring among the shipping in the harbour intending to take in or discharge cargo, or remain upwards of 24 hours, are to moor and keep a clear hawse. No sailing veesel is to be unmoored or shifted about without permission from the Harbour Master, and on no account after dark, except in case of emergency. Singapore, June 21st 1873. Page 489

PORT LOUIS (Mauritius).—*The red light at Great River bay, and the green light at fort George, Tonnelier island, have both been discontinued.*

A lightvessel bearing a *flashing white* light, visible 9 miles, is moored at the Bell-buoy anchorage. It is in 15 fathoms at a little to the north-westward of the present well-known bell buoy, and from it the extreme of the land to the northward bears N.E. by N.; the extreme of the land to the westward W.S.W.; and the flagstaff on fort George S.E. ½ S. As the mooring chain of the vessel runs about 150 fathoms in a N.N.W. direction, care must be taken when anchoring to avoid hooking it.

In the event of its being necessary to take the lightship into port for repairs, or should she be absent from her station for any other cause, a vessel will be anchored on the spot, and will be distinguished as follows :—

During the day—Two flags, white, with blue cross and a ball below each, on two separate masts. During the night—Two signal lamps, one on each mast at the same horizontal height, and a blue light or a flare up light every half hour.

Directions.—Vessels from northward, after rounding Canonnier point, must be careful not to bring the lighthouse on that point westward of Flat island lighthouse till this lightvessel is seen. They may then steer for the latter on a S.S.W. ¼ W. bearing, and anchor on that bearing at from half a mile to a mile from the light.

Vessels from westward may steer for the lightvessel on an E. by N. ½ N. bearing, and anchor either at half a mile from it on that bearing or further to the northward as may be convenient. The depth at the anchorage is from 12 to 20 fathoms. Pages 528—530.

EAST COAST OF MADAGASCAR.—The following remarks are abridged from a paper by the Rev. J. Holding descriptive of the province of Tanibé, on the east side of Madagascar. As the various towns and villages mentioned lie on the sea-coast, these notes will be acceptable to mariners :—

Tamatave, the chief port of Madagascar, stands on a point of land at the west end of Tamatave bay. The town is much better built than most of the Malagash towns, and is at present divided into streets. There is no pretension to architecture except amongst the foreigners. The Malagash have no public buildings except the battery, which is a rude, square, heavy building, at the north end of Tamatave, and at a short distance from the town itself. It is built of stone unhewn, and plastered over with mortar made from coral, which is abundant along this coast. The sides are perforated for about eight guns, three only of which are really serviceable, and now only used in firing salutes.

The chief exports are bullocks ($0,000 per annum), rice, fowls, and hides. For the Mauritius and Bourbon markets there is an occasional cargo of gum and

india-rubber, also tobacco. The imports are manufactured goods—such as cottons, iron-pots, clothing, and house-furniture; also rum and other spirituous liquors; beer, porter, liqueurs, wines, &c. It is not unusual for traders to barter their rum for cattle. A fat bullock costs on board between 14 and 15 dollars, and is sold in Mauritius for £7 or 35 dollars. Wood is not permitted to be exported.

The chief employment at Tamatave is mat-making, rice-bag making, fancy boxes, cigar-cases, which employment is altogether confined to the women, who earn about sixpence a day each, which is quite adequate for their maintenance. Two-pennyworth of rice will support one person, and the rest goes for *bouillon* and betsa-betsa, a drink made from the sugar-cane, and *toaka* (rum).

The men are usually engaged in fetching rice, wood for building, and cattle and poultry from the country, to supply the market and shipping; others in pounding rice (cleaning it of the husk), fishing, labouring for the Europeans, or engaged in what is called the "Fandroana," or queen's service,—making improvements about the battery or the Hovah town. They are liable to be called upon at any time to perform this service, for which they receive no pay, and not even rations frequently. Even the servants of the white traders may be caught by the Hovah "police" if seen in the streets, and forced to labour. It is of no use resisting: the answer is, "It is the queen's service," and all are considered slaves to the queen. If you ask a Malagash who is his master, if he is free, he will say, the queen; if a slave, he will give you the name of his immediate owner.

The country to the west of Tamatave is a dead, unbroken level, a vast plain about five miles inland, southward to Hivondro, and north to Ampangalana. The streets are even and regular, but most disagreeable to traverse, on account of the great quantity of sand. Each foreigner who intends to make Tamatave his home for any lengthened period, sets about building a comfortable house, with verandahs to screen him from the scorching rays of the sun; fruit trees are planted all around in his compound, and in time his home becomes really luxurious.

Hivondro lies about 8 miles south of Tamatave, and was the dwelling-place of the old princes of the Betsimisaraka.

Hivondro is important, not only on account of its historical connections, but on account of its position on the river Hivondro. This river is navigable for many miles inland. It is also connected with the southern lakes, and is on the road to the capital, Antananarivo. Hivondro presents a curious spectacle in the rice season. Along the banks, or mooring-places for the canoes, we see representatives from various provinces—the Betsimisaraka, Betanimena, and Antimoras and Antisakas. The Antimoras and Antisakas, with their round skull-cups made of rice-straw or grass, such as we see the lower class of Mahomedans wearing, and the Antisakas from the district south of Manangary are there, looking more savage and wild than any. I have seen some two hundred canoes lying moored here at a time, each canoe containing upwards of thirty-five bags of rice, and each bag weighing 100 lbs. This rice is landed at Hivondro, and conveyed thence to Tamatave, to supply the rice-vessels trading between this island and Mauritius and Bourbon.

The town consists of one long narrow street, running parallel with the arm of the river which comes from the north. The houses on the whole are well built

—much more so, I think, than most Malagash houses. There is here a chapel belonging to the Church of England, at the north end of the village, directly facing the road leading into the town from Tamatave. The district round Hivondro is very bleak and uninteresting; sand-hills rise from the shore, and, to a certain degree, screen the town from the strong breezes which blow from the S.E. in the hurricane months; but their position is manifestly unfortunate in another sense, for the very breezes which might be destructive in one way, would in another be most beneficial in blowing back the dreadful effluvia which the land-breezes bring from the jungles, swamps, and marshlands on every side the broad river. The country inland is very flat for some miles along the valley of the river until we reach Mahasoa.

Ampalamasina is a village in the interior west from Tamatave. It stands upon a high mountain and is reached by passing through a most interesting country, quite refreshing to a foreigner who has been living along the coast some time. The air is bracing, and there is no fever. The village is named from there being in it a huge boulder, which is reverenced by the people in the neighbourhood. The hill sides are covered with various kinds of trees and shrubs, and there are a great number of ferns. In one of the valleys I saw a group of splendid fern-trees. The scenery about Ampalamasina is magnificent; splendid valleys; stupendous mountain cliffs, rugged and precipitous; beautiful cascades; varied tints of foliage—gorgeous brilliancy of flowers. The village consists of one main street and of about thirty-two houses. The prospect from the summit is grand—huge black mountains stretching away inland, and running in one unbroken line to the district opposite Hivondro. The highest peak is about 2800 feet high, and from it may be seen Tamatave, Foulepoint, Vohidoity, and Ifontsy, and the country south of Hivondro. The sea is distant in a direct line about 32 miles. This seems to me a delightful sanatorium for fever-stricken white men.

Vohidoity, a village about 9 miles north of Tamatave, is a miserably unhealthy place on the bend of the river Vohidoity, just where it commences to wind along the coast for about half-a-mile, when it enters the sea. The village itself is a little elevated, some 30 feet above the river, while below and on the whole western sides are stagnant lagoons and fever-breeding jungle, the usual haunts of crocodiles; in fact, these amphibious animals are so numerous here, that after sundown no one dares to go near the stream, and any unlucky traveller who arrives here after sunset must perforce content himself with staying in this wretched village, sleeping in a miserable hut, and inhaling the noisome pestilential vapours.

The river is broad and deep, and well stocked with a variety of capital fish, which the natives catch in baskets and with nets. There is a bridge of rough shapeless wood across one branch of the river which leads into the road conducting to the north side of the village; and a few yards outside the town, on the road to Foulepoint, is a tomb of some former chief. Near this place the *indigo* plant grows very luxuriantly in a wild state.

Ifontsy.—The next village of any importance is Ifontsy, which is about 14 miles north of Vohidoity. It stands on the east side of the island which bears the same name, and which is formed by the confluence of two unimportant streams, one coming from the south-west and the other from the south. This district derives its name from the trees, called Ravenfotsy, which grow in great

numbers in the vicinity. There are no large houses, unless we except the one belonging to the Custom-house official at Tamatave, who has much land and many slaves in the neighbourhood. Ifontsy is the stopping place between Tamatave and Foulepoint. There is here a Queen's house for the use of travellers, and a flag-staff at the end of the village. The white flag is hoisted when any officer of distinction passes through. The village is very neat and dry, but far from being free from fever, which is generated in the neighbouring swamps and jungles. A sail round the island in a canoe is quite a treat; and the variation of the foliage from the overhanging woods is quite delightful. I found some very magnificent ferns in this neighbourhood. The country between Ifontsy and Foulepoint is very beautiful until the stagnant lagoons in the immediate neighbourhood of the latter place are reached.

Foulepoint is a town lying about 37 miles north of Tamatave. It is irregularly built, with narrow streets, and the native name is Mahavelona. It is a tolerably safe port, and during the fine season, when hurricanes are rare, vessels can be moored opposite the custom-house. The anchorage is good and firm, and vessels of any tonnage can be admitted into the roadstead. There is a huge reef, extending a mile seaward, parallel to the coast, which is dry at low water. Many fine cocoa-nut trees extending along the coast, and mangroves here and there.

Foulepoint is almost surrounded with stagnant lagoons, stretching from the river Hiarana to the outskirts of Mahambo, a distance of 19 miles. These lagoons are well stocked with crocodiles, some 16 feet long, which are so audacious as to approach even the town itself, carrying off pigs and young calves. In fact, after a certain hour at night, the passage between the Betsimisaraka town and the Hovah village near the battery is not safe for any one to travel. It is not unusual, when passing up the river Hiarana, to see at least a score of these horrid brutes basking on the banks, in the short distance of 100 yards. Their eggs are seen lying on the sand on either hand. The natives have the greatest horror of them, yet withal reverence them. The *odys*, or charms, are composed of crocodile's teeth, intermixed with small portions of their ancestor's bones. These charms are always carried about with them; the *ampi sikidy* having sold or prepared them, they are considered as talismans against any danger. They are generally worn about the neck, ancles, or wrists.

The town of Foulepoint may be said to be divided into two parts; the portion occupied by the Betsimisaraka and Hovah traders is called *Mahavelona*, and the town surrounding the battery which commands the roadstead and Betsimisaraka town is called *Antanara* or *Hovah Town*. In the first, the poor Betsimisaraka dwell and carry on their various avocations; here also the Hovah and foreign traders reside, and several Hovah officials are in command of the "police." The chief of the custom-house also resides here. The foreign traders live as near the sea-side as possible; in fact, the whole extent of land bordering on the coast is occupied by them, except a small portion surrounding the custom-house.

The Hovah traders do the retail trade. About 2000 bullocks are exported every year, and about 180 tons of rice, while in return they receive about 560 barrels of rum, or 27,000 gallons. The rum is carried into the villages in the interior, and sold retail by the Hovahs; for one barrel the trader will receive two bullocks. Rice-bags and mats are also exported. The means of subsistence

are similar to those of the people of Tamatave, and the occupation the same. The trade of Foulepoint is evidently declining, and that of Mohambo is increasing; the cause of this is the fever, which prevails here during the greater part of the year, and is most destructive to the life of the Europeans.

Mahambo is the port of the Antsianaka nation, and there is no doubt that in time it will become an important rendezvous. There is good anchorage and deep water, and the place is much healthier than Foulepoint. At present rice is much cheaper here than at any other port, but this may be owing to the fact that there is no competition. The town or village consists of one long narrow street, beginning at the beach and leading to the battery, which is built of red sandstone and mounted by two small guns. It is a rude structure, uncemented by mortar, and of a circular form, with loop-holes for the centries. The governor's house is outside the battery, and the soldiers reside in the immediate neighbourhood, in wretched leaf-huts. Three traders live here; one exports rice and bullocks, another rice and tobacco, and the third (French) salt pork and beef, and hides. Rum and cottons are the principal imports. There is a rivalry springing up between this place and Foulepoint, and, as before observed, the latter must give way—not only on account of health, but because there is every facility for reaching the interior; in fact this port commands the province of Antsianaka which is rich in cattle and rice, while the province of Betanimena is becoming impoverished. As far as the anchorage goes, Mahambo is by far the best; for, if a heavy storm comes on, the land jutting into the sea at Foulepoint is frequently washed away, and renewed in another position. I have seen the point washed away twice in three years! The road from Foulepoint to Mahambo is much pleasanter than from Tamatave to Foulepoint; we have to pass through a splendid wood about half-way. It is very refreshing to leave the sea-side, with its heavy sand, its rolling surf, and glittering spray, to range through green meadows, and experience the cool temperature of the woods, after the burning heat we have had along the sands. The landscape around Mahambo, too, is much prettier. The hills advance nearer to the shore, and are covered with wood; rivulets flow across the plain, first rippling down the hill-side, and at length emerging from the shadows of the woods, glide in smooth and shining streams across the fields and plain into the sea. There is a coral barrier-reef extending along the coast; this is the only place where one can safely have a sea-bathe. The sea at Tamatave and Foulepoint swarms with sharks; but here on the soft sands, when the tide is up, one can shelter behind the inner barriers, and enjoy it to one's heart's content.

Fenoarivo.—This town is about 12 to 14 miles north of Mahambo. The road to Fenoarivo is partly along the coast, and partly through meadows and woods. The sea-coast here is much more elevated than the rest of the coast from Hivondro to Mahambo, which is really one dead uniform level. When Fenoarivo bursts into view, a long large bay is observed, running to a sharp point of rock, on which the Hovah flagstaff stands, with its white ensign fluttering in the breeze; then widening gradually as it extends along the coast, until the beach is lost sight of in the rugged mountainous region of point Zarre. An island stands at the south end of the bay.

The town of Fenoarivo is irregular, as are most Malagash towns. There is only one main street; it leads to the battery and along the banks of the river Fenoarivo. There is a small custom-house near the river. The whole, or nearly

the whole trade of Fenoarivo is in the hands of Mr. De Castelle, who has large plantations of rice and coffee on the opposite bank of the river, stretching as far as the village of Soavola, where most of the labourers reside. I visited these plantations, and found them in excellent order, exhibiting taste and thorough practical knowledge. The coffee-trees seemed very vigorous, and the soil well adapted for their culture. On the way back I visited the European cemetery; it is a wild, neglected place on the borders of the sea; the beach here is composed of black sand.

The road to the "battery" leads through the town, and through pleasant meadows, beyond which a swamp extends to the north, and ends near the hills about 5 or 6 miles distant in the interior. The road to the Hovah town leads across this swamp by means of a narrow wooden bridge. It is not by any means a safe mode of travelling. At every step there is danger of falling headlong into the dismal miry swamp below. As soon as the swamp is crossed, there is a circuitous pathway among several small steep hills leading to the Hovah town. From the Governor's house, the whole of Fenoarivo is seen, with the bay. The mountains running parallel with and near the coast, and stretching northward to the river Manaugoro, are also seen to great advantage.

In passing through Fenoarivo I saw the butchers' stalls, or rather the place where butcher's meat is sold. The carcase lies on clean mats, spread out on the ground. There is only one killing day in the week here, the demand for flesh being almost entirely confined to the white traders, who are frequently the only people able to purchase it. The natives are satisfied with rice and occasionally a fowl, or such fish as are caught in the river without much exertion. At Foulepoint they kill twice a week, at Tamatave every day. The owner of the bullock must first send the choicest piece to the Governor of the place before he can sell any to others. This is called the queen's beef, and is really a government levy.

The English Church is the only religious body having any place of worship here. It has a temporary chapel in the main street, which cost 14 dollars—a portion of which was contributed by the native Christians.

Fenoarivo is much healthier than any of the other ports in this province. Indeed, the European trader may remain here during the entire fever season without suffering much from the effects of this dreadful scourge. The ground is not so damp, and the elevated position of Fenoarivo lifts it out from the surrounding lowlands of pestilential swamps, and, to a certain extent, from the influence of their deadly miasmas. The anchorage of Fenoarivo is good, but the bay is much exposed to east winds, and occasional hurricanes, which visit the coast of Madagascar during the months of January, February, and March.

Tamatave contains 8000 inhabitants; Foulepoint, 1500; Hivondro, 900; Fenoarivo, 800; Mahambo, 400; Mahasoa, 280; Vohidoity, 360; Ifontsy, 180.

Rivers.—The rivers in the province of Tanibè are the Hivondro, Vohidoity, Rangazavaka, Ifontsy, Hiarana, Paombé, Mahambo, and Fenoarivo; of these the Hivondro and Paombé are the largest; none of them are navigable; in the dry season their embouchures are stopped up, and the surrounding country is one mass of mud and alluvial deposit, left during the inundations in the rainy season. Frequently, when the rainy season commences, they change the place of embouchure. When the rainy season commences a fearful scene is presented, even after two days' heavy incessant rain—the banks carried away, trees come rushing down with the torrent, navigation by canoes rendered impossible; the

surrounding country is inundated, the people only saved from being washed away by building their houses on the highest points near the river. The rise is sometimes 20 to 30 feet, and the water may then fall in a few hours to the level of the natural bed. Another obstacle to navigation, besides the bars at the mouth, is the frequency of cataracts—some very beautiful and lofty in their falls, others broad and shallow. The volume brought down by these cataracts after a storm is sometimes tremendous. None of the streams are fordable; but they are much shallower beyond the cataracts, as a matter of course.

Lakes.—The lakes are merely lagoons of stagnant water, filled during the rainy season by the surplus waters from the rivers. These abound in the neighbourhood of Foulepoint and Mahambo; hence this is the district which is most addicted to fever and malaria. The rivers and lakes abound with fish of various kinds, all agreeable to the palate, and proving a luxury not only to the natives but to the white man who may sojourn there. The finest is similar in character to the salmon, but called *zampuna* by the natives.

Mountains.—The mountains of this province (Tanibé), which borders on the sea, are insignificant. From Hivondro to Fenoarivo the land does not begin to rise until 2½ miles from the coast. In the neighbourhood of Tamatave the hills are more distant still—about 6 miles. Near Fenoarivo the coast land is bolder and more defined—huge rocks jutting into the sea. Approaching inland the hills rise gradually until they attain the height of nearly 3000 feet above the level of the sea. Each range runs parallel to the other and longitudinally with the coast, and each is separated by a narrow and beautiful valley, through which a stream meanders to its confluence with some larger stream, and flows onward to the sea, or forms stagnant lagoons in its course, encircling the rice fields. The coast land from Mananzari, in the province of Antimora, in the south, to Marancetra, in the province of Antavaratra, north, at the extremity of the bay of Antongil, is one huge belt of morass, and lagoon, well stocked with many varieties of fish, harbouring many beautiful and rare water-fowl, and abounding with crocodiles. To gain a distinct idea of the disposition of the mountain-ranges in Madagascar, we must set out from the dead and uniform level of the sea-coast, and lands stretching several miles inland, till we come to the foot of the first range of small hillocks of red sand, surmounted with bananas and other endogens; when we arrive at the summit of these, we generally find a village of some eight or ten houses We see behind us the surf dashing on the shore, deafening with its roar; around us on every side rice fields and herds of cattle feeding; before us inland, at no great distance, a fresh and higher range of hills, approached by a circuitous path, rising gradually, making terraces as it were, almost imperceptibly. When we reach the summit of this range we see behind us the stream we have crossed in a canoe, winding about lazily in the valley below—now swollen and wide by the heavy fall of rain, or nearly dry in the hot season. The small hills we have crossed are meagre, and do not show much above the dead level. We see before as a fresh range to climb, which is easily done, and then commences a range of mountains much drier and harder under foot, more solid in their formation; we still see the ocean. Twenty-five miles inland we cross another range, formed of harder substance still, of quartz rock, with crystal shining here and there. As we ascend we are almost blinded with the dazzling rays of the sun shining on its surface; still the Indian Ocean is seen, and still we hear its roar, though faintly

now. We have no deep valley to cross before we reach the base of the next range; only a slight fall on the inland side, and we commence to climb another and loftier hill, and we are now upwards of 1800 feet above the sea-level, but apparently not more than 400 feet from the base of the mountain on which we stand; and so on until we reach the highest range in the centre of the island, where the various ranges are seen lying below on both sides and descending in terraces to the sea. The highest peak is near Ampalamasina, about 2870 feet above the level of the sea. Page 544—560.

MARIE EUGENIE BANK (Madagascar).—This bank situated 6 miles off the east coast of Madagascar, N. 38° E. from Nossy Alana or Plum island, and S. 28° E. from the Mamelles de Natte, has recently been examined by the French steamer *Prégent*: the reported soundings of 3¾ fathoms has not been found, but there are several coral patches with not more than 5 fathoms water,—thus verifying the existence of the bank. (1866). Page 550.

FARQUHAR ISLANDS.—These islands were visited in 1867 by M. Lieutard of the French marine. The hill at the north-west end of the largest and northernmost island, according to his observations is in lat. 10° 7′ S., long. 51° 13′ 14″ E.; the latter is dependent upon the position assigned to St. Paul, Réunion.*

The north point of the island (near which is the only anchorage possible during south-easterly winds, the prevalent winds in these parts) is terminated by a reef. Upon this point there is a hill, which is conspicuous from a moderate distance by a white spot in its centre; this hill resembles an islet when first seen, at the distance of about 8 miles, but a nearer approach shows it to be attached to the north point of the island, and at the same time land more extensive than it will be seen behind the southern reefs.

The anchorage is in 1½ fathoms at about a mile from the land, in the direction of N.N.W. from the hill. In this position the south part of the hill will appear in one with the north part of the most northern hill of the south island.

When seeking the anchorage either from northward or southward it is for the hill at the north end of the island that a shipmaster should steer. When it bears S. by E., a course may be shaped for it, until distant about a mile from the land, when the best anchorage in the vicinity of the islands will have been attained.

Approaching the anchorage from westward, the hill will be seen in the form of an islet, with a white spot on its north face. Great care is required to give a good berth to the southern reefs and also to keep a good look-out for other dangers, because according to Captain Berloim, who has a thorough knowledge of the islands, a bank of 16 to 18 feet exists at about 4½ miles W.S.W. from the south-west point of the south reef.

The bottom near the Farquhar islands consists generally of sand. A prudent shipmaster would not run for the anchorage at night.

The channel into the lagoon formed by the islands and reefs is fronted by a bar upon which at low tide the depth is only 7 to 10 feet. When running in, it is necessary to get as close to the land as possible to avoid the heads of rocks about

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* Unfortunately M. Lieutard does not state the longitude of St. Paul, nor his meridian distance. He had two chronometers, which were timed four days previously at St. Paul.

the edge of the reef. At high water, the ebb tide in this channel has a strength of about 5 knots.

Tides, &c.,—The tides in front of the bar have been observed to rise from 3 to 7 feet. The flood flows to the N.E., the ebb to the W.N.W. with a maximum strength of one mile an hour, the wind being south-easterly.

The current, which, after passing cape Amber (Madagascar) bifurcates to the West and S.W., attains in the vicinity of these islands a strength of 2 to 4 miles an hour, flowing in a westerly direction. Page 565.

SEYCHELLES.—The following observations are furnished by the Civil Commissioner of the Seychelles islands, Mr. Swinburne Ward :—

The harbour of Victoria is filling up in many places, and the coral all round the Seychelles group is growing with an extraordinary rapidity. Taking the original survey of Captain Owen, executed in 1825, the difference between some of his soundings and the existing ones is very large ; more than might have been expected even after so many years. In one spot on the anchorage near St. Ann's island, on the opposite side of the harbour, only 7 fathoms are now found where 14 are marked on the chart. In the inner basin, the triangulation of which was made three years ago by the master of the *Orestes*, almost on the spot marked as the best and most secure anchorage for vessels of war, and soundings given as 7 fathoms, the coral is now within 2 and 2½ fathoms of the surface, not water enough for the larger vessels of the East African squadron, such as the *Highflyer*.

Another instance, or rather a series of instances, will be found on the whole bank extending from Frigate island to Eagle island, the whole of which has much increased, but most markedly when passing half way between Mahé and Silhouette, the ordinary course for ships. In many places, 6, 7, 8, 9, and 13 fathoms only are now found where 39 and 40 are marked on the chart. According to the men who now constantly resort to this shallow portion of the bank to fish, this difference has taken place within the past 4 years, but it probably has only been noticed by them since that date. It is at a distance of 6 miles from Mahé, in the middle of the usual passage for vessels of all classes. Of its actual depth at present I have made certain by personal observation and soundings, but for want of proper instruments I was unable to fix their exact positions on the chart.

It is stated by the captains of the different trading vessels and of the whalers cruising in these waters that the same increased growth of coral is found on all the banks between this and Mauritius. "Coetivy" is in reality very much larger than what it is marked on the chart, and the soundings very much less, 7 fathoms only having been obtained for a distance of 20 miles. At this depth in anything like heavy weather, the sea would necessarily break. The "Fortune bank" has greatly expanded. "Saya de Malha" is becoming dangerous, and is likely to appear above the surface before many years elapse.

It is very important in the interests of navigation that these waters, especially such portions as are frequently crossed, should be re-surveyed. Of the growth of coral nothing absolutely positive is known beyond the fact that it requires a substantial basis. The bank between Frigate and Eagle islands is part of the Seychelles geological range, and probably, therefore, composed of granite, upon which the coralline insect has commenced its work. This work can be advanced to within 6 feet of the surface, but the progress of its advance is very

uncertain. Still, the well ascertained growth of more than 20 fathoms, as is the case in the channel between Mahé and Silhouette, supposing the coral to have been growing since the date of Captain Owen's survey, sufficiently denotes the great necessity that exists for fresh soundings being taken.

The following sailing directions for the roads and harbour of Victoria, Mahe island, Seychelles, are furnished by W. H. Franklyn, Esq., H.M. Civil Commissioner, May 1870:—

Buoys and beacons have been placed both in the outer roads and inner harbours of port Victoria, in order to render the approach to the anchorage for the larger vessels safe and easy by daylight without a pilot. There are no port charges.

Vessels coming in from seaward should pass all chequered buoys and beacons with balls at the top on the starboard hand, and all black buoys and beacons with half balls at top on the port hand. On rounding the northern end of St. Anne's island a red and white chequered buoy with staff and ball will be observed bearing W. by S. distant 1¼ miles from the north point of the island. Steer so as to pass this buoy on the starboard hand at a distance of about 100 yards; a black buoy with pole and half a ball will then be seen, which pass, keeping it on the port side of the vessel. Two other buoys of the same description and in similar positions will next be passed, and when Beacon island is in line with the southern end of St. Anne's island steer for the entrance of the harbour, which is marked by a large red and white chequered beacon surmounted with a ball on the starboard hand, and a black beacon surmounted with a half ball on the port hand; pass between them and steer for the anchorage, keeping the red and white beacons on the starboard hand. The best anchorage for large vessels is after passing the third red and white beacon and the second black beacon.

With reference to the entrance of port Victoria, Lieutenant C. H. Taylor, R.N, of H. M.S. *Cossack*, remarks, that in October 1869, the Fairway house of the charts could not be distinguished, as it was entirely hidden by palm trees, and that no means then existed of finding the fairway line of approach and entering given on the chart.

This officer reports a shoal patch with 17 feet as lying W. by S. ½ S., about 8 cables distant from the south-west point of St. Anne's island.

Lieutenant Taylor further remarks that vessels bound to the southward from the Seychelles should not attempt to pass to windward of the islands and reefs lying between them and the north end of Madagascar, the winds being variable, the weather frequently thick and hazy, the currents strong and uncertain, apparently for a great part of the year. The *Cossack* experienced the strong westerly current very unequally, and twice had to use steam to ensure the safety of the vessel.

Alphonse, the southern island of the Amirante group, he describes as particularly dangerous, being low and difficult to distinguish even at a distance of 3 miles. There is deep water close to the reef, over which the sea breaks heavily, the surf being seen before the island can be made out. *Variation* 4° *W.*

M. Decugis, Master of the Schooner *Gilberte*, while in sight of Mahé Island passed over a bank which he places in lat. 5° 8′ S. long. 55° 43′ 9″ E. The soundings varied from 6 to 10 fathoms in the space of 1¼ miles. From the mast

it appeared to be round, extending about 2 miles from N. to S. Pages 576—582.

MINICOY ISLAND.—The following account of Minicoy, by Captain J. P. Basevi, R.E., F.R.G.S., is extracted from the Journal of the Royal Geographical Society, vol. XLII, (1872), page 368:—

Minicoy (strictly Minakai) is a small coral island, dividing the 8th and 9th degree channels in 73° E. longitude. In shape it somewhat resembles a crescent, the concave part facing the north-west; its total length is about 6½ miles. The northern half of the island is very narrow indeed, being in no place more than 200 yards broad, but the southern portion is wider and averages 600 yards; the greatest breadth is not more than 1000 yards. The lagoon is on the west side and has a maximum breadth of 3½ miles; the reef which encloses it on the west is always bare at low water. The depth of water inside is very variable, but probably does not exceed 8 or 9 fathoms; towards the southern end the lagoon is very shallow.

The principal entrance is at the north-east extremity, where there is a depth of 12 feet at high water. There is no surf on the bar at any season, but the channel is narrow, and there is a disagreeable cross surf on the eastern (island) side, which has to be avoided. There are three anchorage grounds, where vessels drawing too much water to enter the lagoon can lie; none, however, are good. The *Sir John Lawrence* anchored in about 15 fathoms off the north-east end of the island, but there is merely a narrow rocky bank here, and it would be unsafe in bad weather. The best anchorage during the North-east monsoon is westward of the reef a little below the middle of the island, where for a considerable space the soundings do not exceed 10 fathoms; it is about a quarter of a mile from the reef. There is a narrow passage through the reef near, which is used by fishing-boats; it is not more than 12 or 15 feet broad, and about 6 feet deep. The third anchorage is eastward of the island, nearly opposite the village (which is, however, not visible from it), where the depth of water is said to be 20 fathoms. There is a good landing place *in fine weather* close by, the only possible one on the east side of the island, where the surf is always very high. There is a very small detached island at the south-west end of the main island, half a mile north of which is a third passage into the lagoon; it is of the same description as the second one just described, but still narrower. The rise of tide, at springs, is rather under 3 feet.

The island is elevated only by a few feet above the main level of the sea, and the central parts are, if anything, below that level. Along the east coast, opposite the village, a high bank has been raised for protection against any encroachment of the sea, which the present inhabitants say was built several centuries ago; the bank is over 20 feet high in parts, and extends for quite 2 miles, if not more. There is a natural bank thrown up by the action of the sea, which is difficult to be distinguished from what may have been artificially constructed. The whole of the island is covered with coco-palms, which are the chief source of wealth to the inhabitants, all of whom have their own trees, the rich as many as 2,000. Away from the village, the undergrowth consists chiefly of a prickly bush which has a large white flower of a strong but agreeable scent.

The village of Minicoy is situated nearly in the middle of the island, on the west side; it is half a mile long, and contains at least 300 houses, arranged in

lanes parallel to the water. The houses are invariably built of coral rock, cemented with lime, and are thatched with palm-leaves; every house stands in a separate compound, the divisions of which are of coco-leaf matting, and the entrances into the enclosures are shut by a hanging mat of the same material. There is abundance of fresh-water on the island, almost every house has a separate well; it is slightly brackish, but not at all unpalatable. The people asserted that good water could be found close even to the edge of the lagoon. Besides the wells, there are a number of good-sized tanks, revetted with masonry, in different parts of the village. In the northern and southern portions of the island water is only found in a few places. There never has been, in the recollection of the present inhabitants, any scarcity of water.

The people are Mahometans, and are of the same race as the Maldives; they speak the same language called Malikh or Malkee, and occasionally intermarry with them. They are now, and have been for the last 200 years, under the Rajah of Cannananore, having voluntarily placed themselves under his rule to obtain protection against the Malabar pirates, who used to molest them. The dress of the men is the same as on the Malabar coast; the women wear a long jacket of a silk material, reaching nearly to the feet. Some of the men do no work, others work as sailors, and fish, but on land do no labour. Every description of land work is done by the women, who clear paths through jungle, collect firewood, &c, &c. The population exceeds 2,000.

Behind the village the people have their gardens in which they cultivate plantains, limes, betel. palms, pan, the bread-fruit and papaya, and a few vegetables. No kind of corn or rice is grown. All their food (rice, dal, ghi, &c.) is imported. The chief products of the island are coco-nuts, coir, cowries, sugar made from coco-palm toddy, and salt fish. The coco-nuts, coir, and cowries, are generally taken to Calcutta, the salt fish they take to Ceylon. There are but few animals on the island. The people do not keep cows, sheep, or goats, and no dogs; but they keep cats and have plenty of fowls and ducks. The island is overrun with rats which live up in the coco-trees and destroy, it is said, three-fourths of the produce. There are also legions of mosquitoes which are small but very pertinacious; they bite through anything. Turtle abound but are not eaten by the people.

The climate of the island is said to be very equable. (Page 589.)

ANDAMAN ISLANDS.—The lighthouse on Table island (one of two islands, Table and Skipper) at the north end of Great Coco island, consists of an iron building 72 feet high; the light *(fixed)* is 200 feet above the sea and visible in clear weather from the distance of about 20 miles. Its approximate geographical position is lat. 14° 10′ 52″ N., long. 93° 20′ 45″ E.

This light, at the southern limit of the Preparis south channel, forms for vessels passing between the gulf of Martaban and the Madras coast, and between Calcutta and the Malacca straits or China, a good point of fresh departure in the South-west monsoon, while the Alguada reef *revolving* light, placed at the northern limit of the Preparis north channel, is a good point of fresh departure in the North-east monsoon. By shaping a course to make either of these lights, the dangers about Preparis island are avoided.

Vessels using Preparis channels in the South-west monsoon, should endeavour to make Coco light, and in the North-east monsoon, Alguada light; powerful

steamers between Calcutta and the ports of Pegu, use the latter in both monsoons.

Table and Skipper islands are steep-to, with no dangers to seaward; there is a passage between them and Great Coco island, but its navigation is not safe without a pilot. Page 625.

The following Notice relative to the geographical position of the Andaman islands, was issued in March 1866, by Lieut. Col. J. T. Walker, R.E., Superintendent of the Great Trigonometrical Survey of India;—

Doubts having been expressed as to the accuracy of the longitudes assigned to the Andaman islands on existing charts, notice is hereby given that the longitude of Chatham island, port Blair, has been recently determined to be 92° 43′ E. of Greenwich; whereas in the chart of the Andaman islands, which is compiled from the surveys of Lieut. Blair, and Captain Morrsom, in 1789—90, revised by Lieut. Heathcote in 1853, it is assumed to be 92° 56′. The whole group of islands is probably 13 miles west of the position that has hitherto been accepted.

The recent determination of the position of Chatham island is deduced from 202 observations of lunar zenith distances, and 29 culminations observed by Mr. Nicholson, of the Survey Department, with an alt-azimuth instrument, having a vertical circle 36 inches in diameter. They were reduced in the office of the Great Trigonometrical Survey of India. Page 634.

NICOBAR ISLANDS.—The following information relating to the Nicobar islands has been furnished by Navigating Lieutenants John Phillips and W. H. Hayward, of H.M.S. *Forte* and *Dryad*, 1871:—

Car Nicobar, the northernmost island of the Nicobar group is about 7 miles north-east and south-west, and 6 miles broad. The south and south-east ends are moderately high, the north end being low, but in no place less than 60 feet above the sea. The island is thickly covered with jungle.

Anchorage.—There is anchorage all round the island, but in rather deep water, except in the bay on the north-west side, known as Saoui bay, where vessels may anchor in from 12 to 14 fathoms, rock and coral with a light surface of sand.

The principal village named Moose is situated on the east side of Saoui bay, near the north end of the island; there is good landing in a cove immediately under the flagstaff recently erected on De Roepstorff bluff; at high water the landing is indifferent.

Tides.—There are regular tides in Saoui bay, the flood running eastward.

Nancowry Harbour.—This harbour, formed between the islands of Nancowry and Camorta, is commodious and sheltered from all winds. It has two narrow entrances, one from the east and the other from the west, and can therefore be entered or left without difficulty in either monsoon.

Buoys.—The eastern entrance is marked by two buoys: a white buoy marks the north-east extreme of the reef off the village of Alla Coango, and a black buoy, with staff and two balls, is placed outside the southern edge of the reef, extending off Naval point. The western entrance is narrower than the eastern, but has the advantage of all dangers being visible.

Directions.—In coming from the southward and westward, and with the south-east point of Katschal island bearing N. by E., mount Edgecumbe the highest and southern part of Camorta island forming the north side of the entrance to the harbour will be seen. Upon opening mount Edgecumbe, the south side of

the entrance is marked by a detached rock, resembling a dog's head, having steep sides and a bushy top, with rocks apparently extending off it.

A vessel should pass midway between Indian and Man points, then steer N.E. by N. up the harbour, edging to the northward as point Leda is approached until Naval point beart E.N.E. when the latter may be steered for. This will lead midway between the reefs off Alfred and Leda points, and on to the anchorage off the settlement, which latter is on the Camorta side, between Naval and Battery points.

A wooden pier about 700 feet long is being built at the settlement and is already about two-thirds finished.

Great Nicobar is the southernmost island of the Nicobar group; at its south end is Galathea bay, a deep indentation of two or three miles in extent, where there is fair anchorage during the North-east monsoon in from 9 to 16 fathoms.

Upon passing the south or Parson point, off which the surf breaks heavily, a remarkably flat island named Walker will be seen on the west side of the bay, resembling a fort with sentries posted round. The only landing place bears from Walker island, N.E. by E. ½ E. and is on coral slightly fringed with sand, between two reefs.

Tides and Currents.—When in the immediate vicinity of the Nicobar islands, a ship will be influenced by the tides, the flood setting to the eastward. In the offing the currents as affected by the prevailing monsoon will be experienced, but they are uncertain in strength and irregular in direction. Page 641—652.

CAPE LEEUWIN.—The following information on the current in the neighbourhood of cape Leeuwin and Swan river, on the west coast of Australia, during the summer months of January and February, is extracted from the remark book of Capt. Charles W. Hope, of H.M.S. *Brisk*, 1868:—

After rounding cape Leeuwin a strong set to the E.N.E. was experienced. At 8h. p.m., abreast cape Naturaliste, 15 miles distant, a course was steered to pass 8 miles to the westward of Rottnest island; but at daylight Garden island was observed on the starboard bow and Rottnest island on the port bow, the ship having been set 20 miles to the E.N.E. during the night. Had the weather been thick, so that the land or Rottnest light could not be distinguished, the ship would have been in a very dangerous position, as the course steered would have led directly on to the reefs north of Garden island, Pages 232, 652.

GEOGRAPHE BAY. (Western Australia.)—The following information relative to the capabilities of Geographe bay as a secure and convenient anchorage has been received from His Excellency the Governor of the Colony, 1871:—

Residents of long standing and captains of merchant vessels who have of late years visited Geographe bay agree in considering that it has good and safe anchorages, with smooth water and well sheltered from all winds, westward of N.N.W.: that as an anchorage it is one of the best in Western Australia or Victoria, being preferred by them to Freemantle, Macdonnell day, Portland, port Fairy, or Warrnambool, and that if a vessel be provided with a good ground tackle it may be used with safety both in winter and summer. The depth of water is sufficient for vessels of moderate tonnage, there being 4 fathoms within a mile of the shore, and vessels are easily loaded with timber by the Australian Timber Company established on its shores.

Should masters of ships not like to remain at the anchorage off the timber station, the signs of approaching bad weather give ample time for them to run under cape Naturaliste, and find protection in all weathers.

It is farther stated that a reef of rocks crosses Geographe bay from cape Naturaliste to Koombanahpoint, and although the bay appears to lie open to the full force of the northerly and north-westerly gales, yet through the even nature of the bottom, which is covered with seaweed and deepens very gradually from the beach to a depth of 20 fathoms in a distance of about 20 miles, these winds only create a broken swell not sufficient to wet the flooring of Busselton jetty.

The south-west swell divides between cape Leeuwin and cape Naturaliste, the northern current rushing past the latter cape and crossing Geographe bay intercepts the swell caused by northerly gales. The bay is protected from Castle rock to Minninup by cape Naturaliste, and vessels finding it advisable to seek more shelter during a gale should make for Dimsbro bay, which is also protected by the reefs extending from the cape. The northerly gales seldom last more than 6 or 8 hours, and then veer to north-west.

Busselton jetty runs in a north and south direction, and is fully exposed to the force of the northerly winds, its platform being only 8 feet above the sea. Coasting vessels have remained at anchor off this jetty in perfect safety during the most severe gales.

The brigantine *Odalisk* lay in Geographe bay through the winter of 1869, and only on one occasion had to let go a second anchor. Several stiff gales were experienced, but the sea never came in heavily.

In June, 1867, the *Odalisk* ran inside cape Naturaliste in a strong gale from West and W.N.W., and anchored about 6 miles south-east of the cape in smooth water.

The *Eliza Blanche* put into Geographe bay for shelter three times in 1870, when on her passage from Adelaide to Freemantle.

Geographe Bay is wide and deep, the soundings decreasing from about 18 fathoms near the centre of the bay, to 3 fathoms, at one mile from the southern shore.

This southern shore is low and sandy, and off it vessels employed in bay whaling and in embarking timber, find good anchorage during the greater part of the year, notwithstanding their exposure to the north-west winds of the winter months.

Busselton.—The anchorage chiefly resorted to by shipping in Geographe bay is in 3 to 5 fathoms water off the mouth of Vasse inlet and the small town of Busselton.

At half a mile northward of the town there is a narrow strip of weeds, with only 9 feet water over them; but the water deepens to 3 fathoms close to the northward of this strip, and to 2¼ fathoms towards another weedy bank which extends from the shore.

Approaches to Geographe Bay.—Cape Naturaliste, the western headland of Geographe bay, is low at its extremity, but soon rises to an elevation of 500 or 600 feet, its rounded summits appearing smooth and much wooded. The extremity of the cape is closely fronted by rocks.

Pioneer Reef is said to lie 4 miles to the northward of cape Naturaliste, heavy breakers having been seen in that position by the *Pioneer*, American whaler, in a light breeze after a heavy gale in 1838. H.M.S. *Beagle*, in 1842, passed close

to the spot, and saw no appearance of the reef, although aware of its reported existence. From the soundings being very regular in 25 or 27 fathoms, it is supposed that the broken water seen by the *Pioneer* was caused by the meeting of the swell from the S.W. with a strong southerly current sweeping out of Geographe bay.

Wright Bank, said to be a patch of rocks with 5 or 6 fathoms over them, is reported to have been sailed over at about 1½ miles to the northward of cape Naturaliste, by the *Samuel Wright*, American whaler. The *Beagle*, on the foregoing occasion, passed at about a mile to the north-westward of its supposed position, with regular soundings in 27 fathoms, without any appearance of shoal water.

Naturaliste Reef lies N. by E. 16 or 17 miles from the extremity of cape Naturaliste, and consists of three patches of covered rocks extending about 1¼ miles, N.E. by E. and S.W. by W., with passages between them. The sea does not always break on this danger, nor do the soundings afford any certain warning in approaching it, the average depth of water being 25 to 30 fathoms at 5 or 6 miles to the westward of the reef; and there are 13 fathoms at one mile to the northward of it.

Naturaliste reef, and the supposed Pioneer reef, and Wright bank are the only dangers reported to exist in the vicinity of cape Naturaliste. *Variation* 5° *W.* (1871). Page 653.

PORT GREGORY.—Lloyd's agents writing from Freemantle, Western Australia, 10th November, says—A report having reached us that the master of a ship has been instructed to proceed to Port Gregory to load ore, we deem it our duty to report, for the information of Underwriters, that Port Gregory is not a fitting place for any but very small vessels to enter, and it is a most dangerous place even for small vessels. Page 655.

ROTTNEST ISLAND.—The following information on the navigation of the approaches to the Swan river, Western Australia, is from the remark book of Staff-Commander William H. Bradley, of H.M.S. *Galatea*, 1869;—

The pilots report Roe reef, with a depth of 24 feet, to extend farther to the westward than shown on the charts.

A 15-foot patch is also reported to exist on the northern extreme of the bank outside the Transit rocks; Bare hill well open northward of Ropeyarn rock (the rock westward of Duck rock) W. by S. ¼ S. is the mark given to clear it.

A 19-foot rock is said to have been found on the tail of the bank that extends E.S.E. from Phillip point. A vessel coming in from the southward may pass between it and the Pilot reef by keeping the knob of Parker point touching the south end of Direction island until the pilot house on Bathurst point is open northward of Phillip beacon, when she may haul to the north-east until the Winding sheet (a bare sand-patch on the mainland) bears E. ½ S. and then steer in for it. These directions lead over the bank in not less than 5 fathoms, and clear some patches of 21 feet which lie to the eastward of the 19-foot rock.

Another bank, with 15 feet water extending north and south one-third of a mile long, is reported to lie W. by N., about 1¾ miles distant from the Winding sheet sand-patch.

The Challenger pass, between Garden and Carnac islands, is not recommended for any class of vessels.

The Success beacon has been removed from the southern edge of the Success bank. *Variation* 5° 30′ *W.* Page 656.

BEAVER REEF.—A bank with 20 fathoms water on it has been discovered some 50 miles to the west of Rottnest island, and breakers were said to have been seen in 1864 from the *Beaver*, merchant vessel, W. by S. 52 miles from cape Vlaming, the west extreme of Rottnest island.

The existence of this reef has been confirmed by Captain Laing of the schooner *Gift*, who passed it on the 15th of April, 1869, when the sea was breaking heavily and continuously on the danger.

The reef appeared to extend about half a mile North and South; soundings were obtained in 15 to 18 fathoms, a quarter of a mile from the southern end, and its position agreed with that assigned to it in 1864, viz., about 52 miles W. by S. *(true)* from the west end of Rottnest island, or in lat. 32° 8′ S., long. 114° 32′ E., approximately. Page 656.

POINT CLOATES.—Information has been received of the existence of a sunken rock on which the ketch *Strathmore* touched. This rock has about 8 feet water on it and is situated about 12 miles West from point Cloates, and therefore approximately in lat. 22° 37′ S., long. 113° 24′ E. (1873). Page 665.

PORT DARWIN.—The following remarks on Port Darwin, are from a report by Captain Van der Gevel of the Dutch ship, *Maria Elizabeth*:—

When once inside, Port Darwin is seen to be a most splendid harbour, sheltered from all winds and having no sea whatever; a dock can be made there, at very little cost, large enough for the Great Eastern, owing to the favourable nature of the tides. At present (1871) the delivery and landing of cargo is still very wearying and tedious for ships' crews; the cargo has to be landed in boats belonging to the ship, for there are no others, excepting a small cutter which may now and then be made use of by way of favour from the Resident. Labourers cannot be obtained, for the natives will not work, but earn their livelihood by the spear. As to the Europeans, all are in the employment of Government. Port Darwin is in great want of coolies.

The following information relating to Port Darwin, with instructions for anchoring clear of the ocean telegraphic cable laid between it and Java, are from Lieutenant B. Douglass, R.N.R., the Government Resident, March 1872:—

Port Darwin is a free port; neither customs duties nor harbour dues are imposed. A shipping-master is appointed for the shipping and discharge of seamen under the Marine Board Act of South Australia. The commanders of Australian ships are, however, required to report and clear their ships in the usual way before the custom house officer, and a correct account in the form of entry must be given of all goods landed, although no import duties exist. A magistrate's court exists, and a body of mounted police are stationed in the territory.

Position.—The flagstaff at Port Darwin stands on Fort hill on the northern shore, and is in Lat. 12° 28′ 28″ S., Long. 130° 52′ E. *The Commercial Code of Signals is in use at this station.*

Pilot.—When a vessel heaves in sight, the Harbour-Master and pilot will board, and bring her into the anchorage.

Anchorage.—The best anchorage is off the south side of the little valley

between the table land of point Emery and Fort hill, not coming under 7 fathoms at low water in a large vessel, nor under 6 fathoms in a small craft. Ships remaining more than two or three days should moor with open hawse to the north-west.

Great caution should be observed in taking up an anchorage near the line of the cable during the strength of the tides, as the soundings are deep, and ships sometimes drag before bringing up. This caution should be specially observed during the North-west monsoon.

The Tides in the vicinity and in the harbour of Port Darwin are rapid and somewhat irregular. It is high water at Port Darwin, full and change, at 5h. 25m. Springs range from 16 to 24 feet; neaps, 2 to 12 feet. The ebb stream makes 40 minutes before high water. Outside the harbour the flood runs from the north-westward and the ebb from the E.S.E.

Landing Place and Direction of Telegraph Cable.—The shore end is landed on the mud flat below the Residence, on the east extreme of the table-land on which the town stands.

At about a cable from the edge of the flat, the telegraph cable runs W. by N. ½ N. for about two miles, when the north extreme of point Emery bears N.E. ¼ N., and the base of Fort hill, on which the flagstaff stands, bears E. by S. ¼ S.

From that position the cable lies in a N. by W. direction, running parallel to the point Emery shoal for 3 miles, when the extreme of the cliff of point Emery bears S.S.E. and East point N.E. ½ E. It then takes a W.N.W. direction for 2½ miles, when the south extreme of East point bears E. by S. ¼ S., and Talc head S. by E. From the above position the cable is laid about N.W. ½ W. for 11 miles, when its course is changed to W. by N. ¼ N. into the offing, and in soundings beyond the depth of 14 fathoms.

Directions.—When off the coast line between Fort point and point Emery, and in the vicinity of the ordinary anchorage off the town, to keep outside and clear of the cable, keep the extreme of the land of the West point at high water mark N.W. by W. ½ W., and the summit of Talc head from W. ½ S. to S.W. by W. ¼ W.

Off the coast line between point Emery and East point, keeping to the westward of the cable, keep the summit of King's Table S. ¼ E. until East point bears N.E. ½ E.

In the offing clear of the harbour, to keep south-west of the line of cable in about 12 fathoms, keep the south extreme of point Emery S.E. ¼ E. until the West extreme of the land about point Charles bears S. by W. ¼ W.

It is not recommended to navigate inside the line of cable between Emery point and East point, as that portion of the coast is much encumbered with shoals. In the offing the navigation is safe on both sides of the cable.

The shore end of the cable, which is carried out to the north of point Charles, is very heavy, and could not be lifted by any small craft, though it might be injured, and commanders and owners of ships are subject to heavy damages if the cable is negligently fouled. Page 666.

KING GEORGE SOUND.—The *fixed* light on Breaksea island is visible by a vessel approaching from south-eastward between Bald head and cape Vancouver (S.W. ¼ S. southward and eastward to E. by N. from the light); approaching

from south-westward, it is first seen for a brief interval over the sinking of Bald Head ridge (S.W. ¼ W. from the light). Within the sound it is shown over the horizon (360°), but is masked by Michaelmas island to a small vessel passing through the north channel. This light must not be steered for till it bears N.N.E. ¾ E. from the vessel, to clear Maude and Vancouver reefs. Page 671.

SPENCER GULF—Tipara Lightvessel.—The lightvessel on Tipara reef, east side of Spencer gulf, now exhibits a *fixed white* light, 35 feet above the sea, visible about 10 miles.

Tipara Reef.—A rocky patch, having only 12 feet water at low spring tides, lies N.W. by W. 1½ miles from Tipara lightvessel. It is marked by a buoy placed outside (to the westward) of it. The buoy, chequered *red* and *black*, is moored in 4 fathoms, and its approximate position is with the Tipara lightvessel bearing S.E. by E. ¼ E., distant 1⅔ miles.

Mariners are cautioned not to approach the reef to a depth less than 7 fathoms, as the ground, to a considerable distance from the reef, is uneven.

Wallaroo Bay.—A shoal patch, with only 16 feet at low water spring tides, has been discovered in Wallaroo bay.

A *red* perch buoy has been placed on this patch with the following bearings:—Extreme of Riley point N.E. by N. (northerly), the Smelting chimney at Wallaroo S.E. by E. ¼ E.

Note.—Vessels beating up the anchorage with S.E. winds, are recommended not to bring the jetty to bear to the southward of E.S.E. until point Riley is brought to the northward of N.N.E.

A small rocky patch, on which the ketch *Dashing Wave* is reported to have struck, and having only 4 feet water on it at low water, is stated to exist about N.W. from the Walrus rock, distant a short mile. As this danger lies directly in the track of small vessels trading to and from Moonta and Wallaroo, mariners should be cautious to give the same a wide berth.

Beatrice Rock.—Information has been received from Staff-Commander F. Howard, R.N., of H.M. surveying schooner, *Beatrice*, that a rock having only 9 feet water on it at low water, with from 7 to 8 fathoms all round it at one cable's distance from its centre, has been discovered, with the following bearings from the rock:—Small islet off cape Donnington, N. 49° W. (*true*) distant 10·2 miles; highest part of Dangerous reef, N. 68° E. (*true*) distant 2.8 miles.

A rock, on which the cutter *Secret* was totally lost, is reported to exist about 3 miles north of Bolingbroke point and one mile off the headland; it lies in the track of vessels trading to and from port Lincoln, Tumbay bay and port Augusta. (1873).

Port Augusta.—Masters of vessels trading to and from Port Augusta are informed, that a cheese-shaped buoy, with beacon top, painted *red*, has been placed on the edge of the sandspit, to the southward of Yatala harbour, in 17 feet at low water spring tides, on the following bearings:—mount Grainger N.N.E. ¼ E., and mount Gullet E. by S.

A *red* buoy of the same description has been placed on the S.W. end of Ward's spit, in 18 feet at low water springs, on the following bearings:—Point Lowly N.W., distant 3¼ miles, and the beacon on the N.W. end of Ward's spit, N. 35° E., distant 1¼ miles.

The nun buoy, on the south end of the eastern shoal, has been shipped to the west side of the shoal, and painted *red;* it now lies in 21 feet at low water springs, on the following bearings :—mount Young, N. 85° W., and point Lowly, N. 10° E. *Variation* 4° 40′ E. Pages 672—682.

CAPE BORDA (Kangaroo Island).—The following instructions were issued by Capt. Douglas, President of the Marine Board, Adelaide, in 1866 :—

Captain LEGOE, of the ship, *The Murray*, reports that on his passage from London to Australia, at 4h. 30m. a.m., on the 21st of October 1864, running in for cape Borda on an E.N.E. course, with strong S.S.W. winds and thick rainy weather, he saw the land between capes Bedout and Borda, before sighting the light, although, from the course and position (subsequently verified by cross bearings) he should have seen the light at 2h. a.m., allowing for the state of the weather.

At 5h. a.m., after tacking off the land, cape Borda bore N.E. 10½ miles, cape Couëdic S.E. by E.; thus putting the ship quite within the range of the light (it being visible from N.E. by N. to S.W. by W. round by west); it was not seen until some clouds cleared off the summit of the care and adjoining land.

The light is placed 510 feet above the sea level, and in clear weather is visible at a distance of 30 miles.

By Captain LEGOE's report, it appears that, during thick or hazy weather, the light is occasionally partially obscured; in such weather, commanders of ships should exercise great caution in approaching the land, even when quite confident of their position. No safer guide exists in the vicinity of Kangaroo island than the lead, as by keeping in a depth of not less than 70 fathoms, a ship will be well outside all the dangers off this part of the coast, including the Neptune island group. In fact, in that depth, a ship will be clear of all danger on any part of the coast of South Australia, as included between the Great Australian bight, and cape Northumberland.

During strong S.E. winds, the prevailing easterly current on this part of the coast is checked and diverted to the northward into Spencer gulf, and north-westward along the coast-line; whilst after S.E. winds, and the wind changing to the northward and westward, the current exhibits an unusual force and sets strongly to the S.E., sometimes at the rate of 1½ knots per hour.

Commanders of ships, after a prevalence of S.E. winds, should, on the wind changing to the N.W., be on their guard, as they are liable to be set to the S.E. on approaching the western end of Kangaroo island. Pages 672—682.

BACKSTAIRS PASSAGE.—The following information has been received from Captain John Hutchinson, R.N., Admiralty Surveyor, on the Yatala and Scraper shoals.

Yatala Shoal is 3½ miles long, north-west and south-east, by about a cable broad, shoaling gradually from 9 fathoms at its edges to 3 fathoms on its centre. From the shoalest part cape Willoughby lighthouse bears S. by W. 6¾ miles, cape Jervis N.W. ¾ N. 7¼ miles, and the South Page E. by S. ½ S. 6¼ miles.

The Scrapers.—The least water on this shoal is 14 feet, distant 4 cables W.N.W. from cape St. Alban, with cape Willoughby lighthouse bearing S. ½ E. 2¼ miles. From the breakers on the south-eastern extreme of the shoal, cape St. Alban bears N.W. ¾ W. 1¼ miles, and cape Willoughby lighthouse S. by W. ½ W. 1¾ miles. *Variation* 5° 40′ *E.* (1869.) Page 683.

ADELAIDE.—*The lightvessel has been removed*, and instead of it an iron tower has been erected on piles near the end of South sand, in 7 feet water. It is 65 feet high, and shows a *fixed* light at 50 feet above the sea, visible 10 to 12 miles. The navigable channel for large vessels is 70 yards northward of the lighthouse; the depth in it at present (1868), is 13 feet at low tides, ordinary springs —the rise is 8 feet.*

Approaching Adelaide from south-westward in a heavy ship, endeavour to make the lighthouse on a bearing from N.N.E. to N.E., and carefully avoid bringing it northward of N. by E. to avoid the Wonga shoal, southward of the jetty. The most convenient anchorage (in 5 fathoms, sand) will be found with the lighthouse bearing N. by E. to N.N.E.; and the red light on the jetty from E. by S. to E.S.E. Page 685.

The Wonga, a sandy shoal, extends in a north-westerly direction from the sand-hills southward of the Semaphore. A bell buoy painted *red* (shaped like a boat, with a staff and ball) has been placed in 17 feet at low water, on its northern extremity, off the end of the jetty; it may be seen during day at a distance of 2¼ miles. From the buoy the water shoals gradually in a southeasterly direction to the shore.

The buoy should be left to the southward and eastward, but small vessels may cross the shoal southward of the buoy in 12 feet water, by bringing the Semaphore jetty light to bear E. by S. ¼ S., and anchor according to draft of water off the end of the jetty. Large vessels should avoid crossing the shoal southward of the buoy.

The best anchorage for large vessels is anywhere northward of the bell buoy, in 4 or 5 fathoms at low water. Vessels waiting for orders will find it convenient to anchor tolerably close to the buoy; whilst those only waiting for tide to pass the bar, should anchor with the jetty light bearing S.E. Small vessels may anchor inside the bell buoy with the jetty light from E. by S. to E.S.E.

It is high water at full and change, at the Outer bar of port Adelaide, at 4h. 30m.; and the rise is about 8 feet. Tidal signals are shown from the Semaphore flagstaff on the hill, but as strangers are required to take a pilot, it is unnecessary to describe them here. The signal for a steam-tug is the ensign at the fore. A signalman is stationed on the hill above the inner end of the jetty, to attend to vessels' signals. (1866). Page 685.

CAPE JERVIS.—A *fixed white* light is exhibited from a lighthouse, on cape Jervis, at the entrance of Backstairs passage from St. Vincent gulf.

The light tower is in lat. 35° 37′ 3″ S., long. 138° 7′ 30″ E., and the light is shown over an arc of 151° (from S. 25° W. westward to N. 4° W.); visible 12 to 14 miles.

The outer extremity of the reef projecting from cape Jervis, lies 1600 feet to the S.W. of the lighthouse. (1871). Page 685.

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* Early in 1874 a *revolving white* light will be exhibited from Port Adelaide pile lighthouse, in lieu of the present fixed light.

On January 1st 1874, a *fixed red* light will be shown from Glenelg jetty in lieu of the present green light.

And, a *fixed green* light will be exhibited from the semaphore jetty in place of the red light now shown.

PORT WAKEFIELD (Gulf of St. Vincent).—The following instructions for making this port were issued at Adelaide, in September 1866 :—

From port Adelaide outer bar, steer N.W. by W. ½ W., making allowance for tide and leeway. The tides N.W.-ward of the lighthouse are strong; the flood sets over the long spit N.W., and the ebb S.E., attaining at springs a velocity of 2 knots.

Keep the above course (N.W. by W. ½ W.) for 25 miles, to sight a large red buoy with a pyramidal top, surmounted by a triangular head; this buoy marks the western extremity of the long spit, extending 20 miles to the westward. from the low sandy shore to the northward, and in the vicinity of the Gawler river. The buoy is placed at the south-west and western extremity of the shoal in 19 feet at low water, ordinary springs, in lat. 34° 33′ 40″ S., long. 138° 7′ 40″ E., with the western summit of the Hummock range of hills at the head of the gulf, bearing N. 8° W., and mount Lofty, S. 56° 30′ E.

The coast line on the east side of the Gulf, in the vicinity of the long spit, is very low, and cannot be seen from the deck of a small vessel when outside the buoy, unless there be much refraction. The coast on the west side, to the westward of the long spit, is bold, and in places cliffy.

At about 1½ miles northward of the buoy there is a swatchway or channel, in which there are from 6 to 8 fathoms.

It is probable the patch on which the buoy is placed is detached from the main shoal; but until this portion of St. Vincent gulf has been accurately surveyed, this cannot be determined.

To the eastward and N.E. of the buoy the water appears to shoal gradually towards the land, the before-mentioned channel, or swatchway probably intervening.

Caution.—In thick weather, or in the middle of a summer's day, when the sun is ahead, and objects much affected by refraction, the lead should be carefully attended to; by maintaining a depth of 5 fathoms, reduced to low water, the edge of the long spit may be avoided, and the buoy sighted.

Sailing Directions.—Having brought the buoy to bear N.E., distant 2 miles, steer N.W. by N. ½ N. for 5 miles, until the western summit of the Hummocks is seen bearing North, when alter the course to North for 15 miles, until the land at the head of the gulf is distinguished, and a bold hill on the east side (inside Sandy point) observed; then alter the course to N.N.E., not going into less than 4½ fathoms, until a large nun buoy is seen; steer then to keep the buoy to the eastward, at a distance of 2 cables; then alter the course to North.

The buoy is placed in 17 feet on the outer extremity of the shoal spit, stretching out to the westward of Sandy point, on the Bald hill spit. Before nearing the buoy, sail should be reduced, and the ship got ready for anchoring.

The soundings southward of the buoy are shoal; this portion of the gulf being only navigable by barges and small craft of little draught of water.

Thistle Rock.—This rock has been removed by blasting, the *debris* of the rock being only 3 feet above the surface of the bottom. Its position was lat. 34° 19′ 2″ S., long. 138° 11′ 30″ E.: from it mount Lofty bore S. 40° E.; and the west summit of the Hummocks range N. 20° W.

It will be seen by the above that the rock was apparently close in shore. This is owing to the imperfect charts of this portion of the gulf, as the rock was fully 2 miles from the low coast line. It was, however, quite out of the track of

large vessels, and could be always avoided by not coming under 3 fathoms at low water.*

Anchorage.—Having brought the largest store in the township of port Wakefield to bear N.N.E. ½ E., or the buoy S. ¾ E., and the mangrove bushes on the Sandy point to between E.S.E. and S.E. by E. ½ E., anchor in 4 fathoms at low water.

There will be room to swing in this berth, but not space to beat out of it without going into 18 feet at low water.

Beating up the Gulf.—In making a passage from the lighthouse to port Wakefield against head winds, make the first board to the westward, and stand on that tack—say West,—for about 16 miles, taking care not to come under 8 fathoms, so as to avoid the shoal water on Orontes bank; then, going about, endeavour to work between the two shoals—viz., Orontes bank and the long spit,—but, in drawing to the northward, do not fail to sight the buoy on the latter danger, as it forms an excellent guide for enabling a commander of a ship to know when he is to the northward of Orontes bank.

Being off the buoy, and consequently northward of Orontes bank, the western coast may be safely approached, making long boards from 5 fathoms outside the long spit, on the east side, to within a mile of the western shore.

On nearing Sandy point, the red buoy on the Bald hill spit should be passed as previously directed, when short tacks must be made, taking care not to bring the buoy to bear to the southward of S. ½ E., and not standing to the westward into less than 3½ fathoms, anchoring in the space before indicated.

Anchorage for small vessels.—Small vessels may stand towards the creek, observing that the water shoals very rapidly, from 3 fathoms in some places; but even should a vessel touch the ground no injury will arise, as the bottom is generally composed of sand and mud, and there is no sea.

Care, however, must be taken to keep a ship in such a position as to be clear of her anchor.

Land Wind.—When leaving port Wakefield, it is advisable not to start until morning, when the wind generally being easterly, an offing may be easily obtained without beating out.

Winds.—The winds during fine weather, in the summer, are generally as follows:—From sunrise to about 8h. a.m. from E. to E.S.E.: in hot weather, the wind in the morning may be from N.E., gradually falling calm towards 8h. a.m.

The sea breeze generally sets in after an interval of a couple of hours light winds, or calm at about 11, and freshens towards 5 o'clock, gradually moderating till sunset, when it comes round to the S.E., and dies away towards night. The barometer falls rapidly with northerly winds both in the summer and winter seasons, and generally precedes a change of weather from the westward.

In summer the change often occurs suddenly from the southward, when it blows hard.

In the winter the strongest winds are from the westward.

Tides.—The tides at the head of the gulf are very irregular, and much affected by prevailing winds.

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* The coasters report other small rocks in the vicinity of the site of the Thistle rock; but until the gulf is re-surveyed, no further information can be given.

With strong westerly winds the rise of tide is much augmented, whilst the fall is much diminished. It often occurs during westerly winds, at neaps, that a higher tide will be experienced than at the springs, with fine weather, and south or south-east winds.

With the latter the tides are at the lowest, and the rise at springs is much reduced.

In fine weather, with the ordinary land and sea breezes, the time of high water at F. and C. is 5 hours, and the rise about 9 feet.

At neaps, in fine weather, the rise and fall is almost imperceptible, the time of apparent high water being very irregular.

Remarks.—Produce is now sent from port Wakefield to the shipping in the roadstead by barges. The river entrance is very shallow, and has a flat of upwards of a mile in extent, uncovered at low water springs. At a rise of 6 or 7 feet above the low water spring level, the loaded barges can cross the bar. The question of either deepening the entrance of the river, or building a jetty across the flat, is now under the consideration of the Government.

The supply of fresh water at port Wakefield is limited, and difficult to procure. It is, therefore, recommended that a sufficient stock should be procured at port Adelaide, if the ships call there on their way up the gulf; or water can be obtained by arranging for the barges used at port Wakefield, but which generally belong to persons at port Adelaide, bringing up a supply. Page 687.

Bald Hill Beacons.—Two triangular beacons have been placed on Bald hill, the termination of the low wooded range rising above the mangrove swamp southward of the town of port Wakefield, as anchoring marks for large vessels.

The upper triangular beacon, about 50 feet above high water mark is painted white, and distant 322 yards E. ¼ S. from the lower triangular beacon, which is painted red.

Channel Beacons.—The channel leading to the anchorage has been recently deepened, and beacons have been placed on its edges; the western side of the entrance is marked by a black beacon with a round top, and the eastern side by a red beacon having a lozenge-shaped head: a similar black beacon and a red beacon are placed inside.

Anchorage.—Large vessels approaching this anchorage should shorten sail off the Spit buoy, and anchor in 4 fathoms low water, with Bald hill beacons in line; Sandy point, the end of the low mangrove swamp under Bald hill, S.E. by E. ¾ E.; and the Spit buoy S. ¾ E.

A *fixed white* light has been established at the Railway shed of port Wakefield, visible 4 miles, to guide small vessels navigating the creek. With the light bearing N.E. by E. ¾ E., the entrance to the creek is between the beacons. Page 685.

PORT WILLUNGA (Gulf of St. Vincent).—A large *red* buoy has been placed outside the edge of the reef, extending to the westward of Snapper point, the southern horn of the bay in which lies port Willunga.

The buoy is of pyramidal shape, with a round top, and may be seen at a distance of 4 miles in clear weather. It is moored in 10½ fathoms at low water, immediately beyond the edge of the reef, and affords an excellent guide for clearing the rocky and uneven ground lying to the S.S.W. of the reef.

In the event of any accident happening to the buoy, the reef may be cleared by keeping the inn close to the beach (to the northward of the jetty) twice its own breadth open to the northward of the end of the jetty. The buoy is placed inside this mark.

The moorings which were laid down in 1855 have been removed; ships will, therefore, have to depend on their own anchors. The holding ground is good anywhere outside the 4-fathom line off the jetty.

Anchorage.—The anchorage is exposed to all winds from N.W. to S.W. round by west. At times a heavy sea rolls in, rendering ships at anchor very uneasy, and, unless well found in ground tackle, in an unsafe position; it is, therefore, recommended, on the approach of a S.W. gale—which is indicated by a falling barometer, and the wind freshening from northward, with a cloudy sky—that shelter should be sought in Eastern cove, Kangaroo island, where a ship may anchor in perfect safety, according to draft of water, and remain until the wind shifts to the southward, when she will have a fair wind to return to port Willunga to complete her loading. (1866). Page 689.

PORT VICTOR (Encounter Bay).—Commanders of vessels bound to port Victor, port Elliot, or the mouth of the river Murray, are hereby informed that a very heavy break has been seen about half a mile south-east of the Seal rock.

The break was observed from the Government schooner *Flinders*, when lying at port Victor during an unusually heavy swell after a hard south-west gale. The sea did not break oftener than every half hour; but with such violence and volume as would imperil any small or deeply-laden vessel.

Immediately on the south-west swell slightly subsiding, the break was no longer seen. Soundings were taken in the *Flinders* during a favourable opportunity, when from 15 to 17 fathoms were found on a sandy bottom in the vicinity where the breakers were seen; it is moreover probable that less water may exist on a small patch; but it is evident, from the sea being only seen to break on very rare occasions after violent south-west gales, no shoal water exists, as the ocean swell, if at all heavy, generally breaks on the uneven bottom to the southward of the passage between Granite island and Seal rock, on which there are 5 fathoms.

Commanders of vessels bound for port Victor, in rounding Seal rock during south-west gales, or during the heavy swell that often succeeds a gale in the offing, should either keep close to the rock (outside), or give it a berth of at least a mile, until it bears W.N.W., when a course may be shaped for the anchorage.

At night, when Seal rock can easily be distinguished, it is advisable to keep off the land until daybreak, with the remarkable conical peak of Rosetta head bearing North—thus avoiding the bight of the bay between that headland and the Murray mouth and the rocky patches between Rosetta harbour and Seal rock.

The soundings off Seal rock do not afford any guide within a reasonable distance of the land. (1867). Page 690.

CAPE JAFFA or BERNOUILLI.—A light is exhibited from a screw-pile lighthouse erected on the reef off cape Jaffa. It is a *revolving white* light, eclipsed *every half-minute*, elevated 100 feet above the sea, and visible 16 miles.

The lighthouse is built of iron. Position lat. 36° 55′ S., long. 139° 36′ E. Page 691.

GUICHEN BAY.—Captain Douglas (Adelaide) has published the following instructions for this bay;—

Guichen bay is formed by cape Lannes (or Dombey), in lat. 37° 9′ 45″ S., long. 139° 44′ 15″ E., on its southern extreme, and Baudin's rocks and reefs N. by W. 4½ miles from thence, at its northern extreme. From cape Lannes, a reef of rocks runs N.N.W. 1¼ miles: from Baudin's rocks, another reef stretches 1¼ miles in a S.E. direction. Cape Lannes may be known by an obelisk on its extremity, 40 feet in height, painted red and white in horizontal stripes, which being about 100 feet above the sea level, is visible 12 miles from the deck of a moderate-sized vessel in clear weather; the coast to the southward is composed of sandy hillocks lightly timbered. Breakers extend fully 2 miles off this part of the coast, and, from their treacherous nature, and the heavy ocean swell settling directly on them, should be most carefully avoided. Baudin's rocks form a group of islets, situated from cape Lannes, N. by W., 4½ miles; they are visible about 7 miles.

The bay inside the reefs, off cape Lannes and the Baudin's rocks, is 3 miles deep, and lined by a clean sandy beach, the bottom quite clear, and of excellent holding ground, with gradual soundings from 5 fathoms in the stream of the reefs to the shore, with the exception of a few rocky points, near the township, which terminates a few fathoms from the beach.

A convenient jetty, with a tramway from the road to the end, is now completed, having, at its extremity, 6 feet at low water; boats can load here in any weather, by having a line fast to a grapnell outside, to steady them and haul off by.

Vessels bound into this anchorage, from the southward, should bring the obelisk on cape Lannes, to bear S.E. 2¼ miles, when the point of the reef will bear E.S.E.; having a leading wind, run in East until the obelisk bears S.S.W., and from thence steer South for the anchorage. Small vessels will find excellent anchorage inside the buoys, with the pier-head S.W. by S. ½ S., and the obelisk W. ½ N., in 3 fathoms, veering away a good scope of chain at once; and, in the event of bad weather, having a second anchor ready to let go.

Vessels coming from the northward should carefully avoid the reef off cape Jaffa, in lat. 36° 55′ 30″ S., long. 139° 35′ 30″ E., by keeping at least 10 miles off the point; for, though the outer rock is not more than 5 miles from the beach, the bottom is so uneven that the sea often breaks in deep water, in bad weather, with such violence as would jeopardize a small deep-loaded vessel.

Having sighted the obelisk, and brought it to bear S.E. 6 miles, and the Baudin's rocks E. 2½ miles, steer in S.E. by E.. keeping the reef off Baudin's rocks on the port hand or to the eastward, until the obelisk bears S.W. by S. ¾ S. when shorten sail and stand in to the anchorage.

Small vessels in the winter season should carefully avoid anchoring too close to a rocky point at the eastern end of the town; as, in the event of their wanting to veer away cable, such a position might be inconvenient.

Vessels working into the bay with head winds will find the channel between Baudin's and cape Lannes reefs fully 2¼ miles broad; by not borrowing within the already prescribed distances, and keeping the lead going, they may work in safety, taking care not to approach the shelf, which lies inside cape Lannes, too closely.

The barometer in this bay, as is generally found on all parts of the coast, is an invaluable guide. The mercury falling with a N.E. wind and sultry close

weather in the winter season, is a sure precursor of bad weather, for which preparation should be made. Page 691.

MACDONNELL BAY.—Vessels bound into port MacDonnell by day should give cape Northumberland a good offing, taking care not to bring the cape to bear to the westward of N.W. by N., until mount Schanck bears N. by W., when a course may be shaped for the anchorage, which will then bear N.W.; stand boldly on, carefully observing the breakers on the reef. On this course, the water will shoal rapidly from 10 to 6 fathoms, and as the beach is approached to 3 fathoms on a rocky bottom, generally, in the latter depth, the soundings will be very regular, as, although the ground is rocky, the patches appear to be composed of limestone flats covered slightly with seaweed.

Before thus closely approaching the coast, strangers should hoist the signal for a pilot, who will, if the weather be not too bad, come off.

Should the pilot not be able to board, it is recommended to obtain an offing until the weather moderates.

At night, except under the charge of the pilot, it is not prudent to enter the bay; and masters of vessels should keep the light bearing from N.N.W. to N.N.E., taking care not to come under 25 fathoms water, which will place a ship about 5 or 6 miles from the cape. Masters of vessels acquainted with this port will find no difficulty in entering it by observing the following directions:—

On approaching from seaward keep point Douglas, a headland to the W.N.W. of cape Northumberland, well open of the latter, and mount Gambier more than the length of mount Schanck open to the eastward of the latter before standing in, after which steer for mount Schanck until the mooring-buoys are made out. By keeping the eastern set, bearing between N.W. ½ W. and W.N.W., they may be safely approached, when the Harbour-Master will, if possible, come off and moor the ship.

Masters of vessels are requested to carefully observe if any of the signals hereinafter mentioned are made from the flagstaff near the jetty.

In the event of the moorings being occupied, vessels entering the bay must anchor; and should be kept in such a condition, as to ballast and trim, as will enable them to seek an offing in the event of bad weather coming on.

Although the moorings now laid down at this port are of the heaviest description, and fully competent to hold any vessel that can enter port MacDonnell, it must be remembered that, during heavy south-west gales the sea rolls in over the outlying reefs, and breaks in the bay very heavily. On these occasions vessels will ride very uneasily, and be cut off from communication with the shore.

A life-boat and an efficient boat's crew, together with Dennett's rocket apparatus for saving life, has been established at this port.

The following signals are established at this port. The flagstaff at which the signals will be displayed is situated near the base of the jetty.

From Shipping to Signal Station on Shore.

Signals.	When shown.	By day.	By night.
Harbour Master	At Peak.	Union Jack.	One flash or blue light; red above green light.
Pilot	At Fore.	„	Two flash or blue lights.
Police	At Peak.	Wheft, or No. 1 Pennant.	*In harbour.*—Two lights horizontal at peak. *In the Roads.*—Two lights horizontal.—one flash light.
Shipping Master	At Fore.	No. 1 Pennant.	—
Water tank	At Main.	No. 6.	—
Custom House Officer	„	Ensign.	—
Health Officer	„	No. 9.	Two blue or flash lights; two vertical lights.
Medical assistance required	At Peak.	No. 1.	Two lights horizontal; two flash or blue lights.
Provisions	At Main.	No. 7.	—
Ship's agent	At Peak.	No. 3.	—
Distress	—	Ensign Union down.	Guns; blue or flash light, or rockets alternately, until reply is made.
Ship calling for orders	At Main.	Telegraph flag.	—

By day will be answered from shore by Numeral Pennant, by night by flash light.

From Signal Station on shore to Shipping.

Signals.	Where shown.	By day.	By night.
Gale approaching from north	Below Ensign or Jack.	No. 1.	Two horizontal lights.
Ditto, north-west	„	No. 8.	Two horizontal lights; one flash light.
Ditto, west	„	No. 5.	Two vertical lights.
Ditto, south-west	„	No. 6.	Two vertical lights; one flash or blue light.
Ditto, south	„	No. 7.	One rocket.
Ditto, south-east	„	1st. disting. Pennant.	Two horizontal lights; one rocket.
Send down top-gal. masts and yards and let go second anchor	Above Ensign.	No. 6.	One flash or blue light; one rocket.
Proceed to sea. Not safe to remain at anchorage	—	Blue and white flag.	Two rockets or two guns.
Anchorage unsafe	—	Blue flag.	One gun; one flash light (repeated if necessary).

VICTORIA.—*New Flag.*—A new Victorian flag, which, at the suggestion of the Admiralty, has been designed as the distinguishing mark of the Victorian Mercantile Navy, has been formally adopted by the Government. The ensign will have five white stars on the blue ground, and the "jack" five white stars in the cross of St. George, which forms the central line of the pattern. Pages 694—710.

PORT FAIRY.—A *green* light is established on the end of the jetty at port Fairy; the light is cut to clear the buoy off the foul ground to the northward of the lighthouse, and visible, between the bearings of W.S.W. and S., about 3 miles.

Vessels entering port Fairy should steer in until the *green* light on the jetty is

opened out, when steer for it and anchor. The best anchorage is in about 3 fathoms, at about a cable N.W. of the *black* buoy off the foul ground, with the light on Rabbit island bearing S.S.E. (1872). Page 695.

KING ISLAND (Bass Strait).—A rocky ledge, which appears to be several miles in length in a north and south direction, has lately been found to exist 6 miles seaward of Sea Elephant bay, King island; the general depths on this ledge are 4½ and 5 fathoms, but a patch with only 22 feet was found near the northern extreme, from which Sea Elephant rock bore E. ¾ S., distant 4½ miles.

As a dangerous sea will be found on this ledge during bad weather, ships should approach Sea Elephant bay with caution. Page 696.

WARRNAMBOOL HARBOUR.—The following alterations have been made in the lights in Warrnambool harbour, Lady bay:—

The light on Middle island is discontinued and the lighthouse removed.

Leading lights are now established on the sites of the obelisks, on the hill ridges immediately in the front of town of Warrnambool.

The upper light, *fixed white*, is shown over an arc of 135° (from West southward to S.E.); it is elevated 109 feet above the sea, and visible 14 miles.

The lower light, *fixed red*, is only shown over an arc of 12½° (from S. ⅛ W. to S. by E.); it is elevated 87 feet above the sea, and visible 5 miles.

A *fixed green* light is exhibited from the extremity of Warrnambool jetty, the latter extends 230 yards from the shore.

Directions.—Vessels entering Warrnambool harbour from westward or southward, should first sight the *red* light, (carefully avoiding the 17-foot patch which lies S.S.E. half a mile from Middle island), and then bringing it in line with the *white* light, bearing North, steer in between the 5-fathom bank and the foul ground south-east of the Breakwater rock until the *green* light on the jetty is opened, when steer in for it and anchor. From the eastward, either bring the marks above described on, or cross the bar to the south-eastward, taking care not to shut the *white* light in when standing towards the mouth of Hopkins river.

It is not safe to enter or leave the harbour in south-westerly or southerly gales. In bad weather, or with a heavy southerly swell, the sea breaks at the distance of a mile from the land. *Variation* 6½° *E.* (1871). Pages 695–696.

BASS STRAIT.—Navigating Lieut. H. J. Stanley, R.N., reports that a reef on which the sea breaks heavily has been discovered in Seal bay, at the southern end of King island, lying from a mile to 1½ miles east of Seal rocks. The reef is apparently several cables in extent, with 6 fathoms on its north-west edge. Page 697.

PORT WESTERN.—A light is exhibited from a lamp-post on the outer end of Flinders jetty (a small jetty north of West head); it is a *fixed* light, *white* and *red* on different bearings, elevated 24 feet above high water, and visible 4 miles.

Vessels anchoring off the jetty should, to avoid fouling the submarine cable, anchor within the red light. Page 699.

PORT PHILLIP.—The lighthouse on point Lonsdale is coloured in red and white bands; it exhibits a *fixed* light, visible about 10 miles. The light is *green*, from about S. by E. eastward to S.E. ½ E. (39½°); *red* from S.E. ½ E. eastward to

E. by N. (50½°); bearings from the lighthouse. Lonsdale point is a mortar and rocket station. Tidal signals, denoting the quarter of the tide with reference to the stream, are made at the flagstaff on the point.

The Lonsdale rock lies nearly ⅔ mile, and the Lightning rock $1\frac{1}{10}$ miles from the lighthouse, both on a S.E. ½ E. bearing. While the *green* light is in sight, vessels are outside these rocks; while the *red* light, inside:—the blending of the lights is on a line with the dangers, hence the greatest caution is required when the colours are about to blend. Pages 697 and 700.

Shortland Bluff.—The Low lighthouse shows a *fixed* light at 90 feet above the sea, visible 10 to 14 miles. The light is *white* from S.W. by W. southward to S.W. (11¼°); *red* from S.W. southward to S.S.W. (22½°); *white* from S.S.W. eastward to E. by S. (101¼°);—bearings from the lighthouse.

The High lighthouse, a stone tower on the bluff at 352 yards N.E. by N. from the Low light, shows a *fixed* light at 130 feet above the sea, visible 17 miles. Its geographical position is lat. 38° 16′ 27″ S., long. 144° 39′ 46″ E. The light is shown seaward from about W. by S. to South (78¾°). By an observer close in with the Lonsdale land it will be seen only between the bearings from it of S.W. by W. southward to South (56¼°). Within the harbour it is shown over an arc of 180° (from S.W. by W. southward and eastward to N.E. by E.) Shortland bluff is a Life-boat station.

The two lights in one, N.E. by N., lead in. The *red* light (in the Low lighthouse) must be kept in sight until within the Heads; the change of colour from red to white indicates the immediate vicinity of the reefs extending from points Lonsdale and Nepean, hence the line of the lights in one should be strictly followed. At the extremity of the reef extending from point Nepean (east side of the entrance) is the Corsair, a rock 8 feet under water, having a depth of the 8 to 5 fathoms close to it; Lonsdale reef is also very steep.* Pages 697 and 701.

Portarlington.—A *green* light, visible from W. by S. ½ S. southward to S.E. by E. ½ E., is exhibited on Portarlington jetty, elevated 22 feet above high water, and visible 5 miles.

The light in sight clears the north side of Prince George bank to the east, and the buoy of point Richards to the west.

Schnapper Point.—A *fixed white* light has been established on Schnapper point; it is elevated 50 feet above high water, and visible 10 miles.

The light at the end of the jetty has been replaced by a *red* light shown from an ordinary lantern, visible 3 miles. Page 700.

BANKS STRAIT.—Navigating Lieut. H. J. Stanley, R.N., states that heavy breakers have been reported on the following bearings:—Mount William S.W. ½ W.;—Swan island lighthouse, W.N.W.;—St. George's rock, S. ½ W.; and recently the ship, *Salamander*, struck and was severely damaged on a rock not far from the above neighbourhood. This rock was reported by the master of the *Salamander* to lie E. by S., distant 12 miles from Swan island lighthouse.

The Colonial governments of Victoria and Tasmania are about to have the dangers in this locality examined. *Variation* 10° *E.* (1869). Page 708.

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* It is intended to establish two leading lights for South channel. The inner or eastern one (*green*) is now lighted, and is shown from the end of the jetty at Dromana, visible 4 miles.

HALLY BAYLEY ROCK.—The master of the schooner, *Hally Bayley*, has reported the existence of a sunken rock having about 3 fathoms water on it, about 13 miles off the west coast of Tasmania, between cape Grim and West point, on the following bearings:—cape Grim N.E. ½ E. 15 miles, and West point S.E. by E. ½ E. 14 miles. These bearings place the rock in Lat. 40° 48′ 30″ S., Long. 144° 23′ E. In bad weather the sea breaks heavily over the rock. *Variation* 9° *E.* (1872.) Page 708.

PORT ALBERT.—The red fixed and flashing light at port Albert has been altered to a *white fixed* and *flashing* light, showing a flash every three minutes, visible 11 miles. The fixed light shows for one minute forty seconds, it is then eclipsed for twelve seconds, and after the flash again eclipsed for thirty-four seconds.

Within a distance of 3 miles the light appears as a continuous *fixed* light between the flashes. Page 709.

GABO ISLAND LIGHT (Cape Howe).—The western limit of Gabo Island light has been altered from S.S.W. to S.W. by S. (from seaward), so as to clear the cape (cape Howe) and dangers to the southward. *Variation* 10° *E. in* 1872. Page 710.

KALI MAAS SHOAL.—Captain Spring, of the *Kali Maas*, reports that in April 1869, being in Lat. 34° 9′ S., Long. 58° 21½′ E., he had a good observation of a bank of white coral, with here and there dark stripes, apparently 30 feet long and 12 feet below the water, but in the trough of the sea not more than 5 feet below it. Page 716.

CORAL REEF.—The *Marshal Pelissier* reports that when running before a strong S.W.-ly wind, she struck on a coral reef in lat. 6° 50½′ N., about 8 miles off shore, the easternmost point of Ceylon bearing N.W. ¾ N.

Routes for Steamers from Aden to Sunda Strait and Back.

The following remarks are a synopsis of a pamphlet issued by the Royal Meteorological Institute of the Netherlands; by pursuing the *routes* indicated it will be possible "to make every voyage from Aden to Sunda, and back, with wind and current, except during the months from November to March, when it will be necessary to steam up with a head wind under the coast of Sumatra (from the Strait of Sunda) till the equator be crossed."

1. **April, May, and June.**—*Aden to Sunda Strait.*—During the first half of April the winds are variable in the Arabian gulf: in the latter half of April vessels on leaving the gulf of Aden meet the S.W. monsoon, which blows with considerable force throughout May and June: this admits of a straight course for Sunda strait, between the Maldive and Laccadive islands,—going south of Minicoy: at the end of the run make Engano, and thence lay the course between Engano and the coast of Sumatra for the Flat Point of Sumatra.

Sunda Strait to Aden.—The S.E. trade wind being prevalent between Lat. 5° and 10° S., run on the parallel of 8° or 9° S., and thus south of the Chagos archipelago; then come up slowly towards the equator so as to cross it about the meridian of 60° E.; full advantage is thus taken of the southerly and S.W.-ly

winds, which will at first be light, but steadily increase in strength as the ship makes progress, so that she reaches the gulf of Aden between Socotra and cape Guardafui.

2. **July and August.**—*Aden to Sunda Strait.*—The S.W. monsoon is still prevalent and strong, therefore the route is on the whole the same as that for April to June.

Sunda Strait to Aden.—The S.E. trade wind now extends nearly to the equator, therefore take a course northward of the Chagos archipelago, till the S.W. monsoon is met with, then shape a course for the gulf of Aden between Socotra and cape Guardafui.

3. **September and October.**—*Aden to Sunda Strait.*—Take a more northern route, in order to make the most of the westerly winds which are increasing in force there: the track runs north of Minicoy, and it is best to cross the equator eastward of Long. 95° E.: according to the weather, run inside or outside the Mantawi islands, and then into Sunda strait along the coast of Sumatra.

Sunda Strait to Aden.—The S.E. trade wind being on its way back, the route southward of the Chagos archipelago should be chosen, as in April to June.

4. **November, December, January, and February.**—*Aden to Sunda Strait.*—The N.E. monsoon is now prevalent in the northern part of the Indian Ocean, and from the meridian of Mauritius to Sumatra the calm belt has moved southwards, towards the equator: shape a course between Socotra and cape Guardafui, to seek the calm belt, then steer between the Maldives and the Chagos archipelago, towards Engano.

Sunda Strait to Aden.—To reach the N.E. monsoon, lay along the coast of Sumatra, where, when steaming against wind and sea, the force will be the least possible: this may be westward or eastward of the Mantawi islands: when north of the equator and in the N.E. monsoon, shape a course for Aden to the south of Ceylon and north of Minicoy.

5. **March.**—*Aden to Sunda Strait.*—The force of the N.E. monsoon is failing, and N.N.W. winds appear: go southward between Socotra and cape Guardafui; cross the equator between 68° and 72° E.; lay the course for Sumatra in the calm belt of variable westerly winds, taking care to cross the meridian of 100° E. northward of the parallel of 5° S.

Sunda Strait to Aden.—As from November to February, steam N.W.-ward along the coast of Sumatra, westward of the Mantawi islands: when up to the parallel of 4° or 5° N., with the variable easterly winds a course can be set along Ceylon, thence through the Nine Degree channel, and to the north of Socotra for the gulf of Aden.

The *Currents* are entirely dependent on the winds even when these have only blown for a few days from the same point. Pages 731–748.

PART I.

NOTES

ON THE

PHYSICAL GEOGRAPHY

OF THE

INDIAN OCEAN

IN ITS APPLICATION TO NAVIGATION.

CHAPTER I.

INTRODUCTORY.

1. THE **INDIAN OCEAN**, like the Atlantic and Pacific, has its boundaries partly natural and partly artificial: it is limited westward by the African and Arabian coasts; and northward by Persia and India—the latter (by its peninsular-form) breaking it into two deep and nearly symmetrical indentations; its eastern boundaries are Birmah, the Malayan peninsula, the west coast of Sumatra, the southern coasts of Java, Baly, Lombok, Sumbawa, Floris and Timor, and the west coast of Australia from Melville Island on the north thence round to the southern point of Tasmania; these constitute its natural lines of demarcation: southward it communicates freely with the Great Southern Ocean, but its artificial boundaries in this direction are the meridian of Cape Agulhas on the west, and that of the south point of Tasmania on the east, each prolonged to the Antarctic Circle, which forms its southern limit,*—and hence the track of vessels bound for the colonies of Australia and New Zealand lies in the Southern Indian Ocean.

Within the boundaries just indicated the Indian Ocean cannot be said to be rich in islands: in mid-ocean, rocks, shoals, and vigias—some real and some imaginary, such as have been and still are so frequently reported as existing in the Atlantic and Pacific—are comparatively few, although such dangers are numerous enough in the

* These are the geographical boundaries of the Indian Ocean as settled by the Council of the Royal Geographical Society in 1847.

vicinity of some parts of the coast. The *continental* islands are represented by Madagascar and Ceylon; the *oceanic* islands—sometimes volcanic, sometimes of coral formation, sometimes partaking of both characters—dispersed singly or in groups, have representatives in Mauritius, Réunion, the Seychelles, Kerguelen, &c. &c., and in that long chain which, commencing with the northernmost of the Laccadives, is continued through the Maldeeves to the Chagos; but by far the most remarkable mass of islands—one which has nowhere else a parallel—is the Indian Archipelago, which, while sketching out the connexion between the Asiatic and Australian continents, forms, by the numerous channels and straits between the islands, the only equatorial communication of the Indian with the Pacific Ocean,—the channels, however, being everywhere encumbered with a wilderness of shoals and rocks, islets, and small islands, rendering the navigation of that region the most hazardous on the globe.

The chief branches of the Indian Ocean are the Bay of Bengal, the Arabian Sea, the Red Sea, the Persian Gulf, the Mozambique Channel, and the Straits of Malacca.

The fame of the isles which stud the Ocean as its waters roll by their shores from the Pacific to the Indian had, in early ages, filled the minds of western adventurers with luxurious dreams of gold, pearls, gums, spices, rubies, sapphires, emeralds, velvets, damasks, silks, and the "purple light of perfumed lamps." From such visions, created by the romancing of earlier voyagers, men awoke to soberer views of the barbaric grandeur of the people and of the neglected treasures of those distant groups—for there was wealth enough and to spare. Extending through thirty degrees of latitude and forty-five degrees of longitude, the Archipelago is the centre of those ocean highways which connect the Asiatic nations with the ports of Europe and Western America. It lies along both sides of the equator, and is approached from the west through the Straits of Sunda and Malacca,—with openings from the southward too numerous to indicate here. The islands are abundantly volcanic, and the islets, rocks, and shoals are of coral: their appearance to the navigator of the narrow seas that separate them is singularly pleasing—while the dangers for incautious mariners are strewed about by myriads; but it is in this very region that commercial enterprise has yet to show its power in the development of unbounded wealth at present neglected.

It is the whole of the oceanic area here briefly indicated—the coast-line surrounding it, and the groups of islands scattered over its surface—the bays, gulfs, and straits—the principal ports, harbours, and roadsteads—the character of the seasons, and of the prevalent winds—the tides and currents—together with other information useful to the Navigator, which will be found abundantly discussed and examined in the following pages, and in such a form that the work may be a complete

"SAILING DIRECTORY FOR THE INDIAN OCEAN."

CHAPTER II.

GENERAL REMARKS ON THE WINDS AND SEASONS.

2. The WINDS representative OF THE DIFFERENT REGIONS OF THE GLOBE.—In parts of the world widely separated there is a distribution of the winds peculiar to the region, and these differences serve to characterize the climate of each. In and near the tropics, in the Atlantic and Pacific Oceans, the winds blow, almost all the year, from the same points of the horizon—the *eastern*—the deviation being near the equatorial regions, where the "belt of calms" separates the "N.E.-ly perennial Trade-wind" of the Northern Hemisphere from the "S.E.-ly Trade-wind" of the Southern Hemisphere. In the Indian Ocean (and in the seas connected with it) the same persistency of the winds during the whole year is not observable between the tropics; here they are periodical, blowing for five months from one quarter of the horizon, and for another five months from an opposite quarter; these are the "Monsoons;" and the interval between the termination of one characteristic wind and the setting-in of another is known as the "change" of the Monsoon. In middle and higher latitudes all the winds are variable, but with a general prevalence from the *west*, being S.W.-ly in the Northern Hemisphere, and N.W.-ly in the Southern Hemisphere. On the sea-coast —more or less in all climates, but especially between the tropics—a regular period of change is observed every day; at nearly the same hour in the evening the wind blows from the land, in the morning it comes from the sea; these are the "land-and-sea breezes."

In this brief sketch is indicated the general distribution of the different currents of air over the surface of the globe, while the alternating land-and-sea breezes give us an insight into their origin.

3. THEORY OF THE WINDS.—The main cause of the disturbance of the equilibrium of the atmosphere and of the propagation of currents of air (*winds*) over the surface of the globe is the *unequal heating* of portions of that surface more or less widely separated; for, under the influence of heat, the air expands and becomes lighter, and even acquires an ascensional (or upward) tendency when pressed upon by the cooler (and heavier) particles surrounding it. We see the simplest instance of this in the land-and-sea breezes prevalent on nearly all seaboards at certain seasons, and especially characteristic of all large tropical islands. The respective surfaces of land and water absorb and radiate the sun's heat unequally, and the variation in the atmospheric temperature corresponds thereto: in proportion as the sun rises above the horizon, the land becomes warmer than the neighbouring ocean, hence the cooler *sea-breeze* sets in towards the land to restore the equilibrium. During the night, the process is reversed, the land loses heat by radiation and cools more quickly than the ocean, hence the stream of air flows from the land towards the sea as a *land-breeze*, which ceases as soon as the density of the two atmospheres has again become the same.

Similar causes on a large scale set the whole atmosphere in motion—producing winds characteristic of the tropical regions on the one hand, and of the temperate and polar regions on the other,—the direction and intensity of each system of air-currents being, however, greatly modified (1) by the earth's rotatory motion, and

(2) by the relative position of the continents and the oceans. Such was the theory first announced by Halley,* and afterwards enlarged and modified by Hadley,†—the latter insisting especially on the necessity for the S.W. and N.W. *compensating* currents beyond the tropics.

The effect of the diurnal motion of the earth in altering the direction of a current of air moving from North to South, or *vice versâ*, will be readily understood; for, since all circles parallel with the equator decrease in circumference as they approach the poles, it follows that, in one diurnal revolution, a spot on the equator must describe a greater circle than any spot in middle and polar latitudes, and must consequently move with greater velocity: the earth in turning on its axis from west to east carries the atmosphere with it and imparts its own motion to it; a *polar current* of air, therefore, on passing towards the equator takes with it only the velocity which it had acquired from that part of the earth whence it came, and must, in its progression, be moving more slowly than the region towards which it is travelling; in being thus left behind, the apparent motion will be in the contrary direction, and, accordingly, the North wind in the *Northern* Hemisphere and the South wind in the *Southern* Hemisphere—the tendency of both being ever towards the equator—will have a westerly direction impressed upon them by virtue of the movement of the earth on its axis, *i.e.* the North wind will become successively a N.E. and East wind,—and the South wind, a S.E. and East wind, for their respective hemispheres; and these are the TRADE-WINDS—*perennial* (or constant) breezes—the expression at once of the difference of temperature between the tropics and the polar regions, and of the *permanent inequality* of the distribution of the solar heat: but the MONSOONS—so characteristic of the tropical area of the Indian ocean—being *periodical* winds, are expressive of the difference of temperature between the extreme seasons of the countries where they are prevalent, as will be presently shown in detail.

Where the trade-winds approach towards each other, and from the excessive heat of the equatorial regions take the form of an ascending current, is the Region of Equatorial Calms, or Doldrums—an irregular belt varying in breadth and form, as well as oscillating with the sun's position in the ecliptic. Notwithstanding, however, that the predominating condition of the air within this belt is one of intense (oppressive) heat and general stillness, the equilibrium is but imperfect, and consequently easily disturbed;—storms occur occasionally, and are frequent in the vicinity of the land,—while deluges of rain at intervals of a few hours are accompanied by deafening thunder and the most vivid of forked and sheet lightning; here also originate the *hurricane* and *cyclone*.

The *upper* or *return Trade-winds* ("COUNTER-TRADE" of MAURY, and ANTI-TRADE" of HERSCHEL) are the natural consequences of the ascending current of air at the equator *overflowing* and passing off towards the temperate and polar regions; in the Northern Hemisphere the heated air is determined towards the north, —in the Southern Hemisphere, towards the south, and hence these *equatorial air-currents* must behave in a manner exactly the reverse of the polar: they come from regions moving with the greatest speed round the earth's axis—a speed which they share themselves—and as they advance into higher latitudes where the rate of

* An Historical Account of the Trade-Winds and Monsoons observable in the Seas between and near the Tropics, with an attempt to assign the Physical Cause of the said Winds. PHIL. TRANS. 1686.

† The Cause of the General Trade-Wind. PHIL. TRANS. 1735.

motion is slower, they must, the further they get from the place of their origin, appear to move to the east at a rate proportionate to the difference between their own velocity and that of the earth in the latitude at which they arrive;—thus the wind is from the westerly points of the horizon, which combined with the initial movement (from N. or S.) gives a S.W. wind for the temperate zone (or middle latitudes) of the Northern Hemisphere, and a N.W. wind for the middle latitudes of the Southern Hemisphere.

Where the equatorial upper currents first approach the earth's surface (in about lat. 30°) is another *Calm-belt*—in each hemisphere—chiefly remarkable however for light baffling airs, intermingled with frequent squalls; that of the Northern Hemisphere is known (after MAURY) as the *Calm-belt of Cancer* or the *Horse-latitudes*—that of the Southern, as the *Calm-belt of Capricorn*; here the winds from S.W., N.W., N.E., and S.E. blow (approximately) the same number of days in the year, for within these belts a constant conflict is sustained between the upper (descending) and the surface currents of air—a portion only of the former current pursuing its course polar-wise, since a large part necessarily returns to the equatorial regions to feed the Trade-winds.

4. MAURY'S Theory of the circulation of the wind, in which the air is supposed to travel *from pole to pole* and then return to the place whence it originally started—making the Trade-wind of one hemisphere pass into the other hemisphere as an upper current within the tropics, and so also placing the source of the rainfall of one hemisphere in its opposite—is known to all navigators who have read either his "SAILING DIRECTIONS," or his "PHYSICAL GEOGRAPHY OF THE SEA,"—works which discuss the theory at great length; it is sufficient here to say that such a system of atmospheric circulation does not find acceptance with the best meteorologists—British and Foreign.

5. DOVE'S Theory—THE LAW OF GYRATION:—The general tendency of the wind to "*veer with the sun*" is an old observation,* but now confirmed; in fact, meteorological data, accumulated with assiduous care during the last 30 years, show that the wind often makes a complete circuit in that direction—passing (in northern latitudes) from south through west, north and east, to south, in succession—or sometimes making more than one circuit in succession, occupying several days or weeks in such veering; and that it rarely veers in a contrary direction—"*against the sun*"—and rarer still makes a complete circuit in such a direction. The credit of having reduced these data into a system is due to Dove, of Berlin, one of the first meteorologists in Europe—who, by comparing observations gathered from all parts of the world, infers that the influence of the earth's rotation is not alone felt in the great system of

* Lord BACON, in his "Historia Naturalis et Experimentalis de Ventis," speaking of the order of succession of the winds, says,—"When the wind shifts in the direction of the sun's course—that is, from morn till noon, and from noon till evening, &c., it seldom retrogrades; or when it does so, it is only for a short time. When, however, it shifts in the opposite direction—that is to say, from morning till midnight, from midnight till evening, &c.—it always returns to its initial point; at all events it does so before it has gone quite round the compass. When the south wind has blown for two or three days, the north will suddenly blow towards it; but when the north wind has blown just as many days in succession, it is not succeeded by the south wind until an easterly one has blown for some time." Still earlier observations to the same effect were made by ARISTOTLE and PLINY. The latest observers are MARIOTTE, in France; STURM, ROMME, KAEMTZ, and DOVE, in Germany; and TOALDO, in Italy.

circulation which affects the whole atmosphere, but that even *local* aërial movements are modified by it; this is the basis of what he terms the LAW OF GYRATION* (or ROTATION) of the Wind—a law not peculiar to any particular region, but, in fact, the general law (with few exceptions) throughout the world—and he has shown, that the Trade winds, and the entangled relations of the winds of the temperate zone, are but the necessary and simple results of the same physical conditions.

Suppose an observer stationed at a spot, in the NORTHERN HEMISPHERE, where the excitement of the wind begins—where, for instance, currents of warm air are mounting upwards from the heated soil, and if by this agency a current sets in from the North, he will see the wind-vane settle itself at first in a direction due North and South; if the cause of this motion of the air continues to act, the air of higher latitudes must share more and more in the effects, and coming to the place of observation from a continually higher and higher latitude, it arrives with continually less and less rotatory velocity; hence, in its passage over the station, it will take a direction more and more *towards the westward*, and thus the wind-vane must gradually pass from a North direction through N.E. to East.

If the North wind has passed by degrees into an East wind, the air will assume the rotatory velocity of the place over which it is situated, and it will thus remain suspended over it in a state of relative rest. If the tendency of the air to rush towards the equator still continues, precisely the same phenomena as before indicated will be repeated.

If, however, a South wind spring up and impinge on the polar current, which has become more or less easterly, it will evidently be deflected towards the North, and the wind pass through S.E. to South. As the northward movement continues, the South wind will shift gradually round through S.W. to West, for the fresh arrivals of air (coming from the equator towards the poles) move from places which possess a *greater* rotatory velocity towards those which move *less* swiftly eastward.

A West wind will have a neutralizing effect on equatorial currents, and reduce them to rest. If the tendency *towards* the pole continues, the phenomena will always be repeated, until fresh polar currents change the West wind (through N.W.) into North, finally coming round again to N.E.

Similarly, in the SOUTHERN HEMISPHERE, winds which at their outset are South will gradually pass through S.E. towards East. An equatorial current (from the North) impinging on the polar current, which has become more or less easterly, will cause it to veer from East, through N.E. into North; and the movement continuing, the northerly wind in its progress will shift more and more through N.W. to West.

The West wind, as is the case in the Northern Hemisphere, will tend to check equatorial currents, and reduce them to relative rest; but if the polar-ward tendency continue, the phenomenon will always be repeated until fresh polar currents change the West wind (through S.W.) into South.

6. If, therefore (A), polar and equatorial currents are alternating with each other in the *northern hemisphere*, the regular shifting of the wind round the compass will be through

⟶ S., S.W., W., N.W., N., N.E., E., S.E., S. ⟶

* "DAS GESETZ DER DREHUNG."—This law is amply illustrated in the recent work of this meteorologist, "DAS GESETZ DER STURME in seiner Beziehung zu den allgemeinen Bewegungen der Atmosphäre." (The Law of Storms considered in relation to the ordinary movements of the Atmosphere.) 2nd. ed. 1861.

and the changes will take place oftener between South and West, and between North and East, than between West and North, or East and South;—for the first changes show a continuance of the exciting cause, while the latter point to a change of it—and being transition winds, they cannot blow for any length of time.

By a like course of reasoning (B), when, in the *southern hemisphere*, polar currents alternate with equatorial, the regular shifting of the wind round the compass will be successively through

⇛→ S., S.E., E., N.E., N., N.W., W., S.W., S. ⇛→

and the changes ensue oftener between North and West, and between South and East than between West and South, or East and North.

7. This is the LAW OF GYRATION,—or the *Law of the Rotation of the Wind*—and we see that the *veering* of the vane may merely indicate the existence of a steady current of air. It is a misapprehension of this fact that causes the existing confusion with reference to questions bearing on the theory of the winds. The essential difference between the veering of the vane as produced by a steady breeze and that resulting from a centripetal current, or a whirling motion with an advancing centre, is, however, that in the first instance (*i.e.* with a steady breeze) the rotation is constantly in the same direction, but in the case of the second it veers on both sides of the track and in opposite directions. If, therefore, as regards the Northern Hemisphere, the partial rotation through S., W., N., E. be called "with the sun" or *direct*, and the partial rotation through S., E., N., W. be called "against the sun," or *retrograde*, as is customary: and similarly, in the Southern Hemisphere, the partial rotation through S., E., N., W. be called "with the sun,"* and the partial rotation through S., W., N., E. be called "against the sun,"* it follows that—

Steady winds turn the vane only in a *direct* sense, or *with the sun;*

Whirlwinds, or centripetal gales, when they advance, turn the vane either with or against the sun, according to the side on which the vortex passes by the place of observation.

When steady winds from different directions approach each other, rotations commence in either way;—direct when, on the west side of the compass, a wind is more northerly than that which preceded it, and retrograde when it is more southerly. On the east side, on the contrary, the gyration is direct when a wind is more southerly than its predecessor, and retrograde when it is more northerly. Winds blowing from directly opposite points may, by arresting each other's course, produce a calm, and therefore give rise to the same phenomenon which is visible in the vortex of a centripetal current (or in the centre of a whirlwind), that is to say, a calm intervening between opposite winds.

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* Neither of these expressions accords with the seaman's view: he is accustomed to regard a movement *from left to right* as being "with the sun," for the term originated in the *northern* hemisphere, beyond the tropic, where the sun culminates in the South, and hence, looking in that direction, the sun rises on the left and sets on the right hand—i.e. *left to right*, "with the sun;" this idea he carries over every part of the globe. But, in truth, left to right, "with the sun," is erroneous in the southern hemisphere, for, to an observer there, the sun culminates in the North, and when he looks in that direction he sees the sun rise on the right hand and set on the left, hence for the *southern* hemisphere *right to left* is "with the sun." The *northern* term—*left to right* "with the sun"—is therefore scientifically inaccurate when used in the southern hemisphere; the expression in the text is consequently correct, but not in the seaman's sense.

And we thus see that the same phenomena may occur under totally different conditions.

8. Such is a brief sketch of DOVE's *law of the rotation of the winds;* and a general summary of the result of his investigations may be given in (nearly) his own words, as follow :—*

(1.) All steady winds are modified by the rotation of the earth in such a manner that equatorial currents receive a westerly deflection, and polar currents an easterly deflection.

The N.E. and the S.E. Trade winds are steady polar currents.

The Monsoons are alternations of a polar and an equatorial current twice during the year,—therefore, they are N.E. and S.W. in the northern hemisphere,—and S.E. and N.W. in the southern hemisphere.

(2.) Bodies of air set in motion from a state of rest turn the wind-vane in the direction of the meridian, as follows :—

(*a*) The polar current in the northern hemisphere, from N. to E.

(*b*) The polar current in the southern hemisphere, from S. to E.

(*c*) The equatorial current in the northern hemisphere, from S. to W.

(*d*) The equatorial current in the southern hemisphere, from N. to W.

Hence, of the winds in the northern hemisphere—

(*a*) Those from N. to E. are the polar current.

(*b*) Those from E. to S. mark the transition of a polar to an equatorial current.

(*c*) Those from S. to W. are the equatorial current.

(*d*) Those from W. to N. mark the transition of an equatorial to a polar current.

Similarly, in the southern hemisphere, the winds—

(*a*) From S. to E. are the polar current.

(*b*) From E. to N. mark the transition of a polar to an equatorial current.

(*c*) From N. to W. are the equatorial current.

(*d*) From W. to S. mark the transition of the equatorial to the polar current.

A complete rotation in the *northern* hemisphere is therefore—

⇛→ S., W., N., E., S. ⇛→ with the sun.

And in the *southern* hemisphere—

⇛→ S., E., N., W., S ⇛→ also with the sun.

(3.) The course of a steady wind may be obstructed by the deflection originating in the rotation of the earth :—

(*a*) By a wind blowing constantly in a direction perpendicular to its primitive one: such are the West India hurricanes, which, for this reason, go first from S.E. to N.W.; and those of the southern hemisphere, from N.E. to S.W.

(*b*) By an aërial current with less deflection; such are the typhoons during the S.W. monsoon, which is circumscribed farther to the eastward by the South monsoon. Of the typhoons, however, many probably

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* "Das Gesetz der Stürme," p. 187—192.

have a progressive motion from W. to E., caused by the heavy air of the trade-wind region—situated to the eastward—rushing directly towards the rarefied air of the region of the S.W. monsoon, and thereby producing a whirlwind.

(*c*) By a mechanical impediment; as in the instance of a storm (described by PIDDINGTON) which occurred in the Bay of Bengal, June, 1839.

In these cases, when the storm is an equatorial one, whirlwinds are produced in the *northern* hemisphere in a *direction contrary to that in which the hands of a watch move:* and in the *southern* hemisphere in the *same direction as the hands of a watch move.* Hence in the *northern* hemisphere the following shiftings of the wind-vane occur:—

(*a*) If the vortex (or centre) of the storm passes to the westward of the place of observation—

The rotation will be ⇝ S., W., N., E., S. ⇝ with the sun;

(*b*) If the vortex of the storm passes to the eastward—

The rotation will be ⇝ S., E., N., W., S. ⇝ against the sun.

But, in the *southern* hemisphere, when the storm is also an equatorial one:—

(*a*) If the vortex of the storm passes to the west of the place of observation—

The rotation will be ⇝ S., E., N., W., S. ⇝ with the sun;

(*b*) If it passes to the eastward—

The rotation will be ⇝ S., W., N., E., S. ⇝ against the sun.

Thus, in both hemispheres, the passage of an EQUATORIAL whirlwind-storm on the west side of the place of observation produces *normal* revolutions, *i.e.* revolutions in accordance with the law of gyration; but its passage on the east side produces *anomalous* revolutions, *i.e.* contrary to the law of gyration. POLAR whirlwind-storms move precisely in an opposite direction:—the revolution is normal when the vortex passes to the eastward, and anomalous (or abnormal) when it passes to the westward of the place of observation.

The old rule that "anomalous shiftings of the vane occur in stormy weather" is in this manner justified. It cannot, however, be ascertained from those shiftings whether an equatorial whirlwind passes on one side, or a polar one on the other;—this depends on the initial point of the shifting, and, as a consequence of the whirlwind, can never amount to more than half a circle.

(4.) The vane may shift from one direction to that immediately opposite to it—

(*a*) When steady winds oppose each other, or fight with each other, as the seaman says;

(*b*) When the vortex of a whirlwind-storm passes over the place of observation.

(5.) A whirlwind-storm may be passing even when the wind-vane does not shift at the place of observation. This happens when the place is but touched by the whirlwind. On one side the storm then appears to retrograde,—and on the other to advance:—for instance, a whirlwind (revolving in a direction contrary to that in which the hands of a watch move) is advancing from S.W. to N.E.; on the north-west side of such a storm, a N.E. wind appears

in the south-westerly regions *earlier* than in the north-easterly, whilst on the south-east side of the storm a S.W. wind actually appears to advance, *i.e.* it enters the north-easterly regions at a later period. The first, is the well-known case observed by Franklin during an eclipse of the moon. Those who, founding their theory on this and analogous instances, divide the winds into positive and negative,—into winds *par inspiration*, and *par impulsion*,—call one side of such a storm positive and the other negative.

(6.) In the temperate zones storms are caused, also, by two currents of air in juxtaposition,—one pressing laterally on the other,—and during the transition, the shifting of the vane may be either with or against the sun, but ever according to the direction of the currents impinging on each other.

(7.) Local phenomena (as land and sea breezes, winds blowing through valleys, deflections of the trade-winds along the coast, trombs, &c.) affect the wind vane according to local conditions, and they may be such as either to produce a veering of the vane in accordance with that consequent on general air-currents, or one in an opposite direction. In open regions they are more prominent during the day, when the general air-currents are less prevalent; —so also in the region of the "variables" between the trades, at the time the monsoons change, and particularly in summer, when the ascending current *(courant ascendant)* weakens the power of the horizontal currents. Indeed, it is not impossible that, setting aside local influences, one cause of a periodical shifting of the vane is to be found in the daily course of the sun; —thus, if the spot where the daily maximum of temperature occurred formed *a point of attraction* for bodies of air lying near it, the direction of the wind during the *morning* would necessarily be *westerly*, and during the *afternoon easterly*,—and thus the vane would turn in a direction contrary to the movement of the magnetic needle.

As whirlwinds are not confined to a definite locality, the probability that any given place is situated on its east side is just as great as that it should be on the west side; the same remarks also apply where whirlwinds owe their origin to local causes — and thus display a great degree of similitude as regards their course. The predominance of the gyration of the wind in a certain direction (with the sun) is consequently a phenomenon which is not connected with the whirling motion of the storm-winds, but only with the influence of the earth's rotation on progressive steady winds.

Now three things are possible:—

1. Either all revolutions of the vane through great arcs are caused by whirlwinds; and in this case,—
   - (*a*) If these whirlwinds occur first at one spot and then at another, indifferently, then there is no predominating direction in the shifting of the vane;
   - (*b*) Or, if the origin of these whirlwinds is local, and if in their progress they advance more or less along the same path, then there are, at certain places in each hemisphere, predominant shiftings of the wind-vane in the direction S., E., N., W., and in others, in the direction S., W., N., E.

2. Or, all shiftings of the wind-vane commence with the alternation of steady meridional air-currents, in accordance with the principles of Hadley's theory of the trade winds, and in consequence of opposing currents pushing through each other: then the vane traverses in the direction S., E., N., W. in the northern hemisphere,—and S., W., N., E. in the southern: *i.e.* in *both* cases the *wind veers with the sun*. The backing of the wind cannot under these conditions exceed the quadrant of a circle.
3. Or, lastly, the shiftings of the wind-vane arise, in both ways, (1) from the alternation and displacement of meridional air-currents, and (2) from a progressive whirlwind; consequently, in each hemisphere, both descriptions of rotation must occur, but that "with the sun" will predominate. The first cause—alternations of meridional currents—produces (in both hemispheres) only gyrations with the sun; and the second—*i.e.* the whirlwind—just as many with the sun as against it. Hence, however frequent whirlwinds may be, there must always be more gyrations that are direct than retrograde.

It is well known that whirlwind-storms, hurricanes, or cyclones, originate at certain places, and spread in certain directions; for instance,—

(*a*) The West India hurricanes (*Aracan* or *Hŭiran-vucan* of the coast of Mexico, *Vuthan* of Patagonia) commence on the inner edge of the N.E. trade, and even within the trade itself, especially in the latter part of summer and in autumn, the whirling motion of which is caused originally by the wind blowing from the S.E. encountering the N.E. trade, or by portions of the upper trade descending from above. They progress from S.E. to N.W. in the torrid zone, then recurving at right angles at the outer edge of the trade-winds, they move from S.W. to N.E.; during the progression the whirlwind, which revolves in a direction opposite to that in which the hands of a watch move, expands very considerably. In the region of the S.E. trade-wind of the Atlantic, whirlwind-storms occur with less frequency.

(*b*) The typhoons in the northern Indian Ocean and China Sea occur most frequently in autumn, but are also violent at the commencement of the S.W. monsoon. The direction in which they advance is rather more from E. to W. than from N.E. to S.W., especially on the south coast of China. In the southern half of the Indian Ocean they are likewise very violent, going there from N.E. to S.W., and recurving at right angles at the outer edge of the trade, whence they advance from N.W. to S.E.

The rotation of the air in the whirlwind-storms of the northern hemisphere is in the opposite direction to that in which the hands of a watch move; and in the direction with watchhands in the southern. The causes which produce these effects lie in the lateral juxtaposition of the regions of the monsoons and trade winds, as well as in the displacement of one monsoon by the other.

Under certain local conditions, a whirlwind-storm may be so modified as to assume at particular spots the form of a steady wind; although, when its course is observed over a large circuit, it shows itself to be a real whirlwind. This is the case, for instance, according to REDFIELD, with the hurricanes (*northers*) of the

northern part of the Gulf of Mexico, which, especially from September to March, at Vera Cruz, reach their greatest height four hours after they commence, and then rage for 48 hours with undiminished fury. The explanation given by REDFIELD of this long duration of the storm without changing its direction is, that the whirlwind advancing from the eastward comes in contact with and is arrested by the high land, by which means it becomes, as it were, flattened, and its circular form is partially changed to a rectilinear one. The N.E. and N.N.E. storms in the Pacific Ocean, on the coasts of Nicaragua and Guatemala, known by the names *Papagallo* and *Tehuantepec*, are, according to REDFIELD, the fine-weather side of a whirlwind-storm,—while the S.W. gales in August and September, which are called *Tapayaguas*, represent the other side.

The indications of approaching weather will be most simple in the zone of the trade-winds, because the rotation of the earth, owing to the simple circumstance of the initial and terminal points of the aërial current remaining nearly the same, does not produce a regular shifting of the vane, but its constant deflection, viz., a steady wind—that of the trade; and the storms have only one form—a rotatory one. In the region of the monsoons they will be somewhat more complicated, because *there* two aërial currents, alternating once with each other in the year, produce one annual shifting of the vane, being periodical winds; and the storms, the form of which is likewise rotatory, have consequently a less constant direction, and in fact it must differ in a certain degree from the prevalent one in order to produce a whirlwind. They must, lastly, be most complicated in the temperate zone, where the law of gyration is universally prevalent, but where storms also occur in all forms hitherto known. The temperate zone has, however, this advantage over the torrid zone, that whirlwinds produce but modified effects as compared with the fearful violence of storms of this description in the tropics, and where they are so destructive.

The relation of the winds to the temperature and pressure of the air will be discussed in a future chapter.

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9. The Trade-Wind Region in the Atlantic Ocean:*—Although this work is principally designed to place before the Shipmaster such information as may be useful in the navigation of the Indian Ocean and the China Seas—where the number of regular traders, plying exclusively from port to port in those waters, has enormously increased of late years—still, the traffic between Atlantic ports and the East is so large and of such importance, that a general but brief notice of the distribution of the Trade Winds in the Atlantic Ocean is absolutely necessary, for the speedy crossing of this region may make all the difference between a long and a short voyage.

10. The *average breadth* of the ATLANTIC TRADE-WIND REGION—estimating it to extend from the mean polar boundary of the N.E. to the mean polar boundary of the S.E. Trade-wind—is about $53\frac{1}{4}$ degrees—3195 geographical miles—*i. e.* from Lat. $27\frac{1}{4}°$ N. to Lat. 26° S.

11. No fact is better known to the navigator than that the position—and even the direction—of the Trade-winds greatly depends on the position of the sun in the

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* This is introduced, as all shipmasters may not have an "Atlantic Directory:"—such a work is published by Messrs. IMRAY and SON:—in it the physical phenomena of the Atlantic are fully described, and "sailing directions" given for all the principal ports.

Ecliptic—oscillating north and south, according as the sun has N. or S. declination. The polar boundary of the N.E. Trade has a mean oscillation of five degrees, *i. e.* from Lat. 30° N. in August to Lat. 25° N. in January, but the position in which it may generally be found at any of the four quarters of the year, and in any longitude between 15° and 75° W., is shown in the following table:—

TABLE I.—*Giving the Mean Polar Boundary of the N.E. Trade Wind in the Atlantic Ocean.**

Long. W.	WINTER Jan., Feb., March.	SPRING. April, May, June.	SUMMER. July, Aug., Sept.	AUTUMN. Oct., Nov., Dec.
	Lat. N.	Lat. N.	Lat. N.	Lat. N.
°	°	°	°	°
75	27¾	29	29½	28¼
70	26	29¼	29	27¾
65	24¾	25¾	28¾	26¼
60	22	23	25¼	25
55	21	25¾	27¾	23
50	24	27	31	26
45	27	30¼	30½	30
40	26	28	29¼	26
35	25	28¼	28¼	24¼
30	24½	25¾	31½	22¼
25	22¼	27¼	29¼	25
20	27½	31	33¼	28
15	29¾	33	34¼	29½
Mean	25¼	28	29¾	26¼

12. The steady winds of the torrid zone (*i.e.* the N.E. Trade in the northern portion, and the S.E. Trade in the southern) is divided into two parts by the intervening *Zone of Calms:* in the Atlantic ocean, not only is the oscillation of this zone very considerable—but its breadth during the northern summer is great; thus, the mean range of the equatorial boundary of the N. E. Trade varies between Lat. 10° or 12° N. (in August, September, and October) and Lat. 1° or 3° N. (in March and April), but it has been reported as far north as Lat. 17° N. and as far south as Lat. 3° S. The equatorial boundary of the S.E. Trade is more frequently found north of the equator than south of it, its mean position being in Lat. 3° or 4° N. on the western side of the Atlantic, and in Lat. 1° or 2° N. on the eastern side—and its range is small as compared with that of the N.E. Trade. The axis of the Belt of Equatorial Calms lies near the parallel of 5° N., which coincides with the greatest number of Calms as reported by MAURY; and the mean breadth of this belt, for the whole year, is about 3⅔ degrees (or 220 geographical miles), being the mean distance between the equatorial margins of the two Trade-winds. A convergence of the two winds (N.E. and S.E.) takes place on the westerly meridians, and hence the Calm-belt is narrower on the western side of the Atlantic than on the eastern. These remarks are illustrated in the following table:—

* This is a table of double entry, but the headings explain themselves,—thus, during Autumn, in long. 20° W., the northern (or polar) boundary of the N.E. Trade Wind is in lat. 28° N.,—during Summer, in lat. 33½° N.

TABLE II.—*Showing the Mean Position of the Equatorial Boundary of the N.E. and S.E. Trade-Winds in the Atlantic Ocean for the Four Quarters of the Year,—and giving the approximate Breadth of the intervening Zone or "Calm-belt."**

	Equatorial Boundary	Between Longitude								Mean Position.
		55° W. and 50° W.	50° W. and 45° W.	45° W. and 40° W.	40° W. and 35° W.	35° W. and 30° W.	30° W. and 25° W.	25° W. and 20° W.	20° W. and 15° W.	
Winter.	Of N. E. Trade	3½° N.	2¾° N.	2½° N.	1° N.	1½° N.	2½° N.	3¾° N.	5° N.	2¾° N.
	Of S. E. Trade			2¼ N.	0	0¼ N.	0¼ N.	0	0	0½ N.
	Breadth of Zone—C.			0¼	1	1¼	2¼	3¾	5	2¼
Spring.	Of N. E. Trade	6° N.	4¼° N.	4° N.	2¾° N.	3¾° N.	4° N.	5½° N.	5° N.	4½° N.
	Of S. E. Trade			3¼ N.	1 N.	1 N.	1¼ N.	1¼ N.	0¾ N.	1½ N.
	Breadth of Zone—C. & S. W.			0¾	1¾	2¾	2¾	4¼	4¼	3
Summer.	Of N. E. Trade	10½° N.	10¼° N.	10¼° N.	10¼° N.	10¾° N.	11¾° N.	11¼° N.		10¾° N.
	Of S. E. Trade			5½ N.	4½ N.	5 N.	2 N.	2 N.	1 N.	3¼ N.
	Breadth of Zone—C. & S. W.			4¾	5¾	5¾	9¾	9¼		7¼
Autumn.	Of N. E. Trade	6¼° N.	6° N.	6½° N.	6½° N.	6½° N.	6¾° N.	7° N.	5¾° N.	6½° N.
	Of S. E. Trade			5¼ N.	4½ N.	3¾ N.	2½ N.	2¼ N.	1¼ N.	3¼ N.
	Breadth of Zone—C. & S. W.			1¼	2	2¾	4¼	4¾	4½	3½

* In this table the seasons are those of the Northern Hemisphere as in Table I.; and the information contained in this table is read thus,—during winter, between Long. 30° and 25° W., the equatorial (or inner) boundary of the N.E. Trade is in Lat. 2½° N., the equatorial boundary of the S.E. Trade is in Lat 0¼° N., and the average breadth of the Calm-belt is consequently 2¼ degrees: this sufficiently explains the rest,

This differs but slightly from HORSBURGH's Table, derived from 100 voyages made within the range of the track of vessels outward and homeward bound between England and India:—

TABLE DERIVED FROM HORSBURGH. Period of the Year.	Southern boundary of the N.E. Trade-wind.	Northern boundary of the S.E. Trade-wind.	Breadth of the intervening Zone.
	° ′	° ′	° ′
1. January, February, March . .	5 35 N.	1 45 N.	3 50
2. April, May, June	7 15 N.	2 20 N.	4 55
3. July, August, September . . .	12 15 N.	3 15 N.	9 0
4. October, November, December .	7 50 N.	3 20 N.	4 30
Annual Mean	8 14 N.	2 40 N.	5 34

In Table II. it will be noticed that the "breadth of zone" is sometimes marked C. and sometimes C. and S.W.; although this is the region of Equatorial Calms, yet a portion of this zone is, from May to November, occupied by the S.W. Monsoon, and during July, August, and September it may be found as far as the parallel of 8° to 10° N.; it is wedge-shaped, with its base resting on the African coast, and its apex stretching to the meridian of 30° or 35° W.

13. The S.E Trade-wind blows with great regularity, and is generally more persistent than the N.E.; its polar boundary is given below:—

TABLE III.—*Showing the Polar Boundary of the S.E. Trade Wind in the Atlantic Ocean.*

Long.	SUMMER. Jan., Feb., March.	AUTUMN. April, May, June.	WINTER. July, Aug., Sept.	SPRING. Oct., Nov., Dec.
	Lat. S.	Lat. S.	Lat. S.	Lat. S.
°	°	°	°	°
45 W.	23½	23½	25½	26½
40	23¼	23	26	26¼
35	22	21¼	23	24
30	25¾	23	25	22
25	26¼	25¼	26¼	24¾
20	27¼	26½	27¼	27¼
15	28	28¼	29	28¾
10	28	27¼	28¼	28¾
5 W.	28¼	29	28¾	28¾
0	26¼	25	24	26
5 E.	24¾	23	23¾	24½
10	26	25	24¾	26
15	29	29	28¼	29
Mean	26	25¼	26	26

14. The *mean direction* of the N.E. Trade-wind, in the Atlantic, between Lat. 5° N. and 30° N. is N. 52½° E.; that of the S.E. Trade-wind, between Lat. 5° N. and 30° S. is S. 48° E.; and it must be remembered that between Lat. 5° N. and the Equator the N.E. Trade-wind does not blow for more than 85 days in the year.

15. These Tables (p. 13 to 15) may be aptly closed with MAURY'S SUMMARY ON THE N. ATLANTIC TRADE-WIND REGION, in which, referring to the marked difference in the prevailing direction of the wind, according to the season of the year, in the different parts of the ocean, he says that—

"As a general rule it will be observed by the navigator—

1. That the nearer to the coast of Africa and to the Equator, the more the so-called N.E. Trade-wind hauls to the South.

2. That to the *west* of Long. 45°, between Lats. 20° and 30° N., the N.E. Trades blow much more steadily in May, June, July, August, and September than they do the rest of the year; and that during the other months, but particularly in March, they blow, between these parallels, nearly alike from all points of the compass.

3. That between Lats. 15° and 20° N. they are most variable *west* of Long. 35° in the months of September, October, and November; while between the same parallels, *east* of Long. 30°, they are most variable in February, March, April, and October.

4. That between Lats. 10° and 15° N., to the *west* of Long. 35° they are steadily between E.N.E. and S.E., except in July, August, September, October, and November, when they are more variable, but especially so in the three months first named. To the *east* of Long. 35°, between these parallels, they may be said to lose their character as Trades during July, August, September, and October,—particularly in August and September—when they blow nearly alike from the four quarters. Calms, too, are more frequent here in these months.

5. That between the Equator and 10° N., to the *east* of Long. 35°, the winds assume a new feature. It may be said, almost literally, that in this part of the ocean they uniformly blow (when they blow at all), during July, August, and September, from some point between S.E. and W.; they blow most between South and W.S.W., and vary rarely from any point between North and E.S.E. To the *west* of the meridian of 35°, during the same months, they blow most between S.E. and N.E., inclining more and more to the North as you go west; and these are the months in which the winds vary most in this part of the ocean."

The S.E. Trade-wind is generally more persistent, and blows with greater strength than the N.E. Trade-wind—hence it is of rarer occurrence for a captain to record in his journal "no S.E. Trade" than "no N.E. Trade;" the "heart" of the S.E. Trade has been shown* to lie on each side of a line drawn from the Cape of Good Hope to the meridian of 36° W. on the Equator,—this is the track of all homeward-bound vessels that come from the Indian Ocean and China Seas, and they seldom have to record, "no S.E. Trade;" it is generally outward-bound vessels, and those coming from Australia and the Pacific, that are doomed to this experience, for, by having to shape *their* course on the S.W. flank of that "vein" of wind, they only fall in with it near the Equator; all, however, are in the same category as regards the N.E. Trade.

* See the reports of all homeward-bound East India and China traders; and the notice of the same by JANSEN, in MAURY'S "Physical Geography of the Sea."

It is scarcely necessary to make any remarks here on the CALM BELTS OF CANCER AND CAPRICORN; but, under all circumstances, endeavour to cross either the one or the other as direct as possible, never sailing *along the line* of one of these bands, nor even *diagonally*, if the wind will permit of a more meridional course.

16. The Trade-Winds in the Pacific Ocean:—A brief notice of the Trade-winds in the Pacific will complete our remarks on this subject. Table IV. is derived from the voyages of 92 vessels as determined by KERHALLET; Table V. is derived from MAURY'S "Nautical Monographs," No. 1.

TABLE IV.—*Showing the Distribution of the N.E. and S.E. Trades, and Equatorial Calm Belts in the Pacific Ocean.*

Months.	Polar Limit of N. E. Trade-Wind	Equatorial Boundary of N. E. Trade-Wind	Equatorial Boundary of S. E. Trade-Wind	Breadth of the Equatorial Calm Belt.	Polar Limit of S. E. Trade-Wind
	Lat. N.	Lat. N.	Lat. N.		Lat. S.
	° ′	° ′	° ′	° ′	° ′
January	21 0	6 30	3 0	3 30	33 25
February . . .	28 28	4 1	2 0	2 1	28 51
March	29 0	8 15	5 50	2 25	31 10
April	30 0	4 45	2 0	2 45	27 25
May	29 5	7 52	3 36	4 16	28 24
June	27 41	9 58	2 30	7 28	25 0
July	31 43	12 5	5 4	7 1	25 28
August	29 30	15 0	2 30	12 30	24 18
September . . .	24 20	13 56	8 11	5 45	24 51
October	26 6	12 20	3 32	8 48	23 27
November . . .	25 9	—	—	—	28 39
December . . .	24 0	5 12	1 56	3 16	20 30
1st Quarter of Year*	26 9	6 15	3 37	2 38	31 9
2nd „ „	28 55	7 32	2 42	4 50	26 56
3rd „ „	28 31	13 40	5 15	8 25	24 52
4th „ „	25 5	8 46	2 44	6 2	24 51
Yearly Mean . .	27 10	9 5	3 39	5 26	26 57

TABLE V.—*Showing the Distribution of the N.E. and S.E. Trades in the Pacific (in days, and as regards direction) between Lat. 10° N. and the Equator.*

Bands in Latitude.	Mean Direction of the Wind.				No. of Days Calm.	No. of Obs.
Lat. 10° to 5° N.	N. 54° E.	S. 44° E.	S. 33° W.	N. 46° W.		
No. of days . .	143	134	54	20	14	14,064
Lat. 5° N. to Eq.	N. 57° E.	S. 44° E.	S. 30° W.	N. 42° W.		
No. of days . .	49	206	89	12	9	46,162

* The seasons cannot be given here, for the table appertains to both hemispheres, consequently the seasons differ.

These Tables show that though the annual oscillation of the Trade-winds in the Pacific is not quite so great as it is in the Atlantic, still it is much more considerable than is generally allowed; and further, that, between Lat. 10° and 5° N., the N.E. Trade can, on the average, be expected for only 9 days (the difference between 143 and 134 days) longer than the S.E. Trade, while between Lat. 5° N. and the Equator the S.E. Trade blows for nearly two-thirds of the year.

According to COMMANDER MAURY, the S.W. Monsoon is better developed in the Pacific than in the Atlantic; and the N.E. Trade-wind of the Pacific is better developed than the S.E. Trade-wind of that ocean, or indeed than the N.E. Trade-wind of either the Atlantic or Indian Ocean.

17. The fact of the inner (or equatorial) boundary of the S.E. Trade-wind crossing the Equator and advancing into the Northern Hemisphere has been noticed by navigators from an early date,—by SELLAR in 1675, by DAMPIER, by d'APRÈS &c.; now, it is well known to meteorologists that, owing to the preponderance of land in the Northern Hemisphere and the peculiar distribution of the Oceanic Currents, the EQUATOR OF GREATEST HEAT is in that hemisphere, but far from being a regular line, parallel with the terrestrial equator. According to DOVE* the mean temperature of the northern part of the torrid zone is as follows:—

MONTHS.	LATITUDE.			
	0	10°	20°	30°
	Therm.	Therm.	Therm.	Therm.
January . .	**79·5°** F.	77·2° F.	70·0°	58·6° F.
February .	**80·2**	78·6	72·7	59·9
March . .	**80·6**	79·7	75·2	63·7
April . . .	**81·3**	81·1	79·0	68·2
May . . .	80·2	**81·3**	80·6	73·6
June . . .	79·9	**81·1**	**81·1**	77·2
July . . .	78·6	80·8	**81·7**	78·4
August . .	78·8	80·8	**81·7**	80·6
September .	79·0	**80·2**	80·6	77·5
October . .	79·0	**80·2**	79·0	72·9
November .	**79·7**	**79·7**	76·3	66·0
December .	**79·3**	78·4	73·0	59·7
Winter Mean	**80·1**	78·8	72·6	60·7
Spring „	80·5	**81·2**	80·2	73·0
Summer „	78·8	80·8	**81·3**	78·8
Autumn „	79·3	**79·4**	76·1	66·2
Annual Mean	79·7	**80·0**	77·5	69·7

This Table shows the position of the place of greatest rarefaction for the different months and quarters of the year. Thus, during the northern winter it is near the

* "Die Verbreitung der Wärme auf der Oberfläche der Erde." (The Distribution of Heat on the Surface of the Earth.) Berlin. 1852.

Equator,—during the spring it has advanced to Lat. 5° and 10° N., reaching Lat. 10° to 20° N in summer (July and August),—after this its recession (southward) commences, being found in Lat. 10° N. during the autumn, as in spring,—and finally, again attaining the Equator in winter. This is precisely the march of the Equatorial Belt of Calms and of the inner boundary of the N.E. Trade-wind.

Since then the inner boundary of the S.E. Trade-wind crosses the Equator and, from thermometrical causes passes into the Northern Hemisphere, it must advance more and more north (according to the season) following the place of greatest rarefaction; and as it advances, its direction must change to South and S.W. because it is constantly approaching parallels on the earth's surface where the velocity of rotation is diminishing as compared with the velocity of rotation at the Equator. Hence the origin of the S.W. Monsoon—alike in the Atlantic, Pacific and Indian Oceans—but best developed in the latter. Similarly, a N.W. Monsoon originates from the N.E. Trade-wind passing into the Southern Hemisphere.

18. WINDS OF THE INDIAN OCEAN.—General Remarks:—Southward of the 30° parallel the N.W. Counter-Trades or "Passage Winds" are more or less prevalent throughout the year: between them and the S.E. Trade lies the Calm-belt of Capricorn. The S.E. Trade, as in the Atlantic and Pacific Oceans, occupies the region from the Calms of Capricorn to within a few degrees of the equator—but undergoing in the Indian Ocean a slight modification on its northern border, according to the season of the year. The area northward of the S.E. Trade is occupied by the Monsoon Region.

19. Monsoons are prevalent, between the tropics, in every ocean; in the Atlantic and Pacific they occupy the place of the Trade-winds only at a certain distance from the land (100 to 300 miles)* and during certain seasons; but in the northern Indian Ocean they are the *characteristic* winds, to which the Trades are subordinate.

The distribution of land in the Indian Ocean differs widely from that in the other oceans.—As regards the Atlantic and Pacific, the continents run north and south. In the Indian Ocean, on the north there is the great central Asiatic plateau fronted by the loftiest mountains in the world,—then the two slightly elevated table-lands of Persia and Arabia, void of rivers, and comparatively destitute of vegetation,—southward of these and advancing into the ocean is the Indian peninsula, of which the Malabar (or western) coast rises abruptly from the sea, whilst the slope on the Coromandel (or eastern) side is gradual;—on the N.E. is Birmah, the Malayan peninsula and China,—the China sea is bounded by mountains on the north and by the Filipine archipelago on the east;—then come innumerable islands, many of which are lofty and mountainous;—finally, on the east of the Indian Ocean is the Australian continent, on the west the African continent:—it is this configuration of the land that has caused the Indian ocean to be regarded as only *half an ocean*, and it is this preponderance of the terrestrial over the oceanic element that disturbs the regularity of the Trade-winds and produces opposite seasons (wet or dry) to places even on the same parallel.

Thus, it is the preponderance of the land and the difference of temperature constantly existing between it and the neighbouring ocean which produce the season-breezes—known as Monsoons.† No other winds than these, and land and sea breezes,

* Monsoons are prevalent, in a modified form, alike on the west coast of Africa and the west coast of America, *during the summer* of the region.

† Arabic, *mausim*, season.

are recognised in the China sea and Indian archipelago; but in the Indian ocean, the Monsoon region is limited to its northern part—extending from Lat. 13° or 10° S. to the Asiatic continent.

Speaking in general terms, it may be said that, north of the equator, a north-easterly wind prevails when the sun has southern declination, and a south-westerly wind when the sun's declination is north,—the former is the N.E., and the latter the S.W. Monsoon of the region; but between the equator and Lat. 12° S. a N.W. Monsoon is prevalent when the sun has south declination, and a S.E. Monsoon when his declination is north: thus in each hemisphere there are two season-winds—of variable duration, according to the position of the place and the surrounding physical features:—in no case does one Monsoon terminate abruptly and the other commence forthwith, but there is a period of *change* known as the *breaking up* of the Monsoon; when one season-wind is about to cease it decreases in force and is occasionally replaced by calm; the atmosphere at sea and on the land shows evidence of disturbance; the sky is overcast and the air becomes sultry, oppressive, and foggy; the clouds of the upper region move in the direction of the succeeding Monsoon; and as the change progresses the wind becomes more and more variable. The following description of this phenomenon, "the breaking up of the Monsoon," is aptly depicted by Sir J. E. Tennent, in his work on "Ceylon."*

"Meanwhile the air becomes loaded to saturation with aqueous vapour drawn up by the augmented force of evaporation acting vigorously over land and sea: the sky, instead of its brilliant blue, assumes the sullen tint of lead, and not a breath disturbs the motionless rest of the clouds that hang on the lower range of hills. At length, generally about the middle of the month, but frequently earlier, the sultry suspense is broken by the arrival of the wished-for change. The sun has by this time nearly attained his greatest northern declination, and created a torrid heat throughout the lands of Southern Asia and the peninsula of India. The air, lightened by its high temperature and such watery vapour as it may contain, rises into loftier regions and is replaced by indraughts from the neighbouring sea, and thus a tendency is gradually given to the formation of a current bringing up from the south the warm, humid air of the Equator. The wind, therefore, which reaches Ceylon comes laden with moisture, taken up in its passage across the great Indian Ocean. As the monsoon draws near, the days become more overcast and hot, banks of clouds rise over the ocean to the west, and in the peculiar twilight the eye is attracted by the unusual whiteness of the sea-birds that sweep along the strand to seize the objects flung on shore by the rising surf.

"At last the sudden lightnings flash among the hills and sheet through the clouds that overhang the sea, and with a crash of thunder the monsoon bursts over the thirsty land, not in showers or partial torrents, but in a wide deluge, that in the course of a few hours overtops the river banks and spreads in inundations over every level plain.

"All the phenomena of this explosion are stupendous; thunder, as we are accustomed to be awed by it in Europe, affords but the faintest idea of its overpowering grandeur in Ceylon, and its sublimity is infinitely increased as it is faintly heard from the shore, resounding through night and darkness over the gloomy sea. The light-

* "Ceylon: An account of the Island—Physical, Historical, and Topographical, &c." By Sir James Emerson Tennent, K.C.S. L.L.D. (1859.)

ning, when it touches the earth where it is covered with the descending torrent, flashes into it and disappears instantaneously; but when it strikes a drier surface, in seeking better conductors, it often opens a hollow like that formed by the bursting of a shell, and frequently leaves behind it traces of vitrification. In Ceylon, however, occurrences of this kind are rare, and accidents are seldom recorded from lightning, probably owing to the profusion of trees, and especially of cocoa-nut palms, which, when drenched with rain, intercept the discharge, and conduct the electric matter to the earth. The rain at these periods excites the astonishment of a European; it descends in almost continuous streams, so close and so dense that the level ground, unable to absorb it sufficiently fast, is covered with one uniform sheet of water, and down the sides of acclivities it rushes in a volume that wears channels in the surface. For hours together, the noise of the torrent as it beats upon the trees and bursts upon the roofs, flowing thence in rivulets along the ground, occasions an uproar that drowns the ordinary voice and renders sleep impossible."

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20. Before proceeding to give a detailed account of the winds in the different regions of the Indian Ocean, it may be useful to draw up a **Summary of the Winds in the Monsoon Region**; they are as follow:—

During the SUMMER MONTHS of the Northern Hemisphere the S.E. Trade-wind is prevalent in the southern part of the torrid zone,*—and the S.W. Monsoon blows in full force in its northern part.

During the WINTER MONTHS of the Northern Hemisphere the N.W. Monsoon prevails in the southern part of the torrid zone,—and the N.E. Trade-wind is in full strength in its northern part.

The N.E. Trade-wind, however, is, in these regions, called the N.E. Monsoon,—and the S.E. Trade-wind, the S.E. Monsoon. As shown in sec. 19, p. 19, the N.E. Monsoon gradually and by degrees glides into the N.W. Monsoon,—and the S.E. Monsoon into the S.W. Monsoon. And thus the Monsoons of the Indian Ocean are not separated by any such distinctly-defined *belt of calms* as is interposed between the Trade-winds of the Atlantic and Pacific Oceans. A Belt of Calm is to be found in the middle of the Indian Ocean, but it exists under different circumstances from that in either of the two other oceans,—and its range is more varied,—as might be expected where the winds are *seasonal* and not perennial.

In the SPRING and AUTUMN of the Northern Hemisphere—in the months when the Monsoons change—calms and variable winds prevail in the open ocean; and daily land-and-sea breezes along the coasts, from which, however, they extend but a few leagues; as soon as the Monsoon becomes regular and blows in its strength the distinctive land-and-sea breezes may be said to cease. In this ocean the land-breeze usually commences about midnight and terminates at sunrise,—the sea-breeze blowing from about mid-day until near sunset; both are moderate, but the sea-breeze is much fresher than that from the land.

The season of change from one Monsoon to the other varies in different parts of the Indian Ocean. This can be readily conceived from the physical characters (see sec. 19, p. 19) to which we have already adverted; being much more exposed than the other oceans to the disturbing influences consequent upon proximity to land,

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* The torrid zone extends from Lat. 23½° N. to Lat. 23½° S., and may be considered as divided into two parts—a northern and a southern—by the equator.

the winds are consequently affected in a proportionate degree by *local* conditions. Thus the S.W. Monsoon stretches into the Northern Hemisphere much further to the North (as far as Lat. 30°) than the N.W. Monsoon into the Southern Hemisphere. Along the Arabian and East African coasts, and also along the N.W. coast of Australia the Monsoons assume in each case a direction which is dependent on the contour of the land and the peculiar physical features of the interior of the continents. In the Red sea the Monsoons blow alternately up and down, following the direction of the long, trough-like valley, within which the currents of air are confined. In no case is it correct to say that any one of these Monsoons blows for six months; they may prevail each for five months, but in many places not for more than four months—the intervening period being characterized by variable winds, with alternating calms, or squalls, and occasional cyclones.

The Monsoons of the China Sea—(*i.e.* N. of the Equator)—are not entirely similar to those of the Indian Ocean; they may be divided into three periods—

1. The N.E. Monsoon, in October, November, December, and January,—changing in February.

2. The East Monsoon, in March and April,—changing in May.

3. The S.W. Monsoon, in June, July and August,—changing in September.

In the Java Sea and among the islands of the Indian Archipelago (*i.e.* S. of the Equator) S.-Easterly winds prevail while the sun is in the Northern Hemisphere, and these are replaced by N.-Westerly during the stay of that luminary in the Southern Hemisphere; the former are known as the East Monsoon and the latter as the West Monsoon—and are characteristic of all that region by which the South Pacific communicates with the Indian Ocean. Comparing together the seasons of the two tropics, the West Monsoon (S. of the Equator) corresponds with the N.E. Monsoon of the Indian Ocean and China Sea,—the East Monsoon is the representative of the S.W. Monsoon.

21. The **Seasons** (wet and dry) within the Monsoon region are, in a great measure, determined by the direction of the wind (*i.e.* whether the direction of the air-current has come over the land or over the ocean); or perhaps it would be more strictly accurate to say that they are concurrently dependent on the Monsoons and the lay of the land. The west coast of India (Malabar coast) has its rainy season during the prevalence of the S.W. Monsoon; no portion of the rain at this season passes the Ghauts or central table land of India. Along the east, or Coromandel coast of this peninsula it is the N.E. Monsoon that brings rain, which waters the country to the summit of the eastern flank of the Ghauts. Thus the two coasts of the peninsula have their seasons reversed; one has the dry season when the other has the rainy season, and reciprocally: similar facts appertain to all countries within the Monsoon region of the Indian Ocean,—and even in a diminished degree to the islands—especially such as Ceylon, Borneo, and those of the largest class.

22. We may appropriately close this chapter with the following Table of the Winds and Calms in the Indian Ocean, from Maury's "Nautical Monographs," No. 1;—it gives the *total number of observations in each band of latitude, the mean direction of the wind from each quarter, and the average annual duration of each wind in days.* It is a table to which we shall have occasionally to refer.

Bands in Latitude.	Mean direction of the Wind.				No. of days of Calm.	No. of Obs.
Lat. 25° to 20° N.	N. 41° E.	S. 42° E.	S. 43° W.	N. 40° W.		
No. of days . . .	84	54	148	66	13	1874
Lat. 20° to 15° N.	N. 42° E.	S. 47° E.	S. 46° W.	N. 44° W.		
No. of days . . .	116	36	145	57	11	6800
Lat. 15° to 10° N.	N. 46° E.	S. 46° E.	S. 47° W.	N. 45° W.		
No. of days . . .	127	52	123	51	12	7483
Lat. 10° to 5° N. .	N. 44° E.	S. 47° E.	S. 50° W.	N. 52° W.		
No. of days . . .	111	42	140	60	12	8841
Lat. 5° N. to Eq. .	N. 41° E.	S. 41° E.	S. 46° W.	N. 51° W.		
No. of days . . .	82	60	138	67	18	9369
Lat. Eq. to 5° S. .	N. 46° E.	S. 42° E.	S. 44° W.	N. 51° W.		
No. of days . . .	49	124	96	71	25	14,264
Lat. 5° S. to 10° S.	N. 53° E.	S. 48° E.	S. 38° W.	N. 51° W.		
No. of days . . .	51	178	63	54	19	16,018
Lat. 10° S. to 15° S.	N. 60° E.	S. 45° E.	S. 41° W.	N. 50° W.		
No. of days . . .	37	241	47	27	13	18,028
Lat. 15° S. to 20° S.	N. 67° E.	S. 50° E.	S. 34° W.	N. 46° W.		
No. of days . . .	43	272	34	10	6	17,340
Lat. 20° to 25° S. .	N. 62° E.	S. 49° E.	S. 29° W.	N. 42° W.		
No. of days . . .	83	215	40	18	9	31,965
Lat. 25° to 30° S. .	N. 54° E.	S. 48° E.	S. 36° W.	N. 40° W.		
No. of days . . .	108	146	62	39	10	33,160
Lat. 30° to 35° S. .	N. 45° E.	S. 43° E.	S. 44° W.	N. 48° W.		
No. of days . . .	75	84	113	83	10	26,249
Lat. 35° to 40° S. .	N. 39° E.	S. 44° E.	S. 41° W.	N. 51° W.		
No. of days . . .	49	52	128	129	7	56,336
Lat. 40° to 45° S. .	N. 32° E.	S. 39° E.	S. 54° W.	N. 48° W.		
No. of days . . .	47	20	126	167	5	18,623
Lat. 45° to 50° S. .	N. 38° E.	S. 49° E.	S. 53° W.	N. 51° W.		
No. of days . . .	62	39	97	161	6	6333

CHAPTER III.

WINDS IN THE INDIAN OCEAN.

23. The WIND REGIONS of the Indian Ocean may be classed under four well-marked heads, which, commencing from the south, are—

1. The Region of the N.W. PASSAGE-WINDS, usually found to the southward of the 32nd parallel;
2. The Region of S.E. TRADE-WIND, between 32° or 30° S., and 12° to 10° S.;
3. The Region of the S.E. and N.W. MONSOON, between 12° or 10° S. and the Equator or 3° N.;
4. The Region of the N.E. and S.W. MONSOON between the Equator and the Asiatic Continent;—

Each of these *wind-regions* will be treated separately, after which a general description of the *winds along the coast* will be given in detail.

It may be as well, at this point, to draw attention to and explain the CHART

DIAGRAMS OF THE WINDS which have been prepared for this work: they are drawn for each of the four quarters of the year,—

CHART DIAGRAM No. I. embracing October, November, and December.
„ No. II. „ January, February, and March.
„ No. III. „ April, May, and June.
„ No. IV. „ July, August, and September.

By this arrangement, Nos. I. and II. give the period of the N.E. Monsoon, and Nos. III. and IV. the period of the S.W. Monsoon. *The direction of the arrows shows the point towards which the stream of air is moving.* These diagrams are chiefly compiled from the BOARD OF TRADE and MAURY'S Wind-Charts, modified by the observations contained in the Log-books in the possession of the Author, which contain about 300,000 eight-hourly observations. The area of the ocean is generally divided into squares of ten degrees of latitude and ten degrees of longitude, except where well-marked differences in the direction of the air-currents require a subdivision into squares of five degrees of latitude and longitude; the numbering of the ten degree squares of the Board of Trade Wind Charts, has also been retained in the letter-press, for the purpose of reference.

24. REGION OF THE N.W. PASSAGE-WINDS—SOUTHWARD OF LAT. 32° S.

In the most southerly portion of this region, *i.e.* in latitudes higher than 55° S. (the Polar region), winds from the N. and S. are equally prevalent with a greater tendency to blow from the *eastward* during the *summer* (December to March), but from the *westward* during the *winter* (March to December).

Between lat. 40° and 50° S. the winds are generally from the westward—between W.N.W. and W.S.W., the former predominating (see Table, p. 23); easterly winds are frequent during the summer, but calms and light baffling airs are rare; the storms of this region are at times very heavy and may be expected at any season. This part of the ocean is represented on the CHART DIAGRAMS by *areas* Nos. 56 to 65, both inclusive.

Between Lat. 30° and 40° S. the winds are still, as a rule, westerly, but the influence of the African and Australian continents is very perceptible—as indeed is the effect of the warm current from the Indian Ocean—producing a diversion of the main stream of air towards the region of greatest rarefaction. This is well seen in the CHART DIAGRAMS, I., II., III., and IV. (*areas* Nos. 46 to 55, both inclusive) where, in mid-ocean, the prevalent winds may be said to be between N.W. and S.W.; but on the African side of the ocean, westward of long. 70° E., easterly winds (E.N.E. to S.S.E.) are very common from November to March; during April, May, and June, these easterly winds scarcely extend beyond the 45th meridian, and during July, August, and September, they are very rarely experienced. Similarly, the areas in the vicinity of the Australian continent are characterized by winds between W.N.W. and S.S.W.—drawing towards and along the land. Easterly winds may, however, be expected more or less along the whole of this band (lat. 30° to 40° S.) during the Southern summer—December to February.

Between the parallels of 25° and 35° S. is situated the polar boundary of the S.E. Trade-wind, oscillating with the march of the sun in declination; between these parallels is also the place of the CALM BAND OF CAPRICORN—its mean position and average breadth being shown on the CHART DIAGRAMS, as well as its tendency to

expand, where it nears the African coast: by reference to Table, p. 23, it will be seen that in this band there are 10 calm days in the year, on an average. Between Lat. 35° and 40° S. the N.W. and S.W. winds blow an equal number of days (129 each),—the S.W. predominating over the N.W. between Lat. 35° and 30° S. in the ratio of 113 to 83. Considerable unsteadiness in the S.E. Trade is shown on its polar limit between 30° and 25° S., by not being prevalent more than 146 days, while winds between N. and E. are experienced for 108 days.

25. The Region of the S.E. Trade-wind.

The region of the S.E. Trade-wind in the Indian ocean is comprised between the Calm Belt of Capricorn and lat. 12° to 10° S. (See Chart Diagrams I., II., III., IV., *areas* 30 to 36, and 38 to 44); the area of the ocean between 50° E. and the African coast is only partially affected by this wind,—the disturbing cause being the high land of Madagascar in close proximity to the African continent; but the greatest modification of the Trade-wind occurs in the Mozambique Channel, as will be shown presently. The S.E. Trade-wind does not touch the west coast of Australia—the general winds on that side of the Southern Indian Ocean, and for fully 400 miles from the land, being from N.N.W. to S.S.W. according to the season.

26. Off the Cape of Good Hope and the Eastern Coast of South Africa. Lat. 50° S. to the Equator, Long. 15° to 60° E.

A glance at the four Chart Diagrams will convince the reader that there are at least three systems of winds prevalent, more or less, over the oceanic area bounded by the Equator and Lat. 50° S., and by the meridians of 10° and 60° E. One of a very peculiar character sweeps from the neighbourhood of Cape Aguilhas to the northern part of Mozambique, and this, with but slight interruptions, is maintained *all the year round;* it appears closely to follow the coast-line,—or more properly speaking, the line of table-land, which runs nearly parallel with the coast, and at a distance from it of about 100 or 150 miles. This air-current terminates in the summer (Southern Hemisphere) near the centre of the Mozambique Channel: in the winter it is continued to the Equator.

The northern part of the area, skirting the African coast, is characterized during the southern summer, from October to March, by N.E. winds, but winds from E.N.E. are found as high as 30° S. lat. during the six months: during the succeeding six months these winds are replaced by the S.E. trade.

It will be seen on Chart Diagrams Nos. I. and II. that during the six months of summer, in the northern part of the Mozambique Channel, there is a point of convergence of the winds which sweep along the eastern coast of Africa,—in fact, that in this immediate locality there is a rarefying surface producing, in all probability, an ascending and upward current; notwithstanding that a N.E. wind penetrates to the parallel of Cape Corrientes, during the months of October to December, the directions of the arrows on *areas* Nos. 38 and 31 indicate that the wind along the eastern coast of Africa really converges to the north of the Mozambique, and that *there* N.E. and S.W. currents meet and ascend—and, as a consequence, frequent calms ensue in that part.

In the Mozambique Channel it is difficult to say what Monsoons are prevalent; but that which goes under the name of the N.E. is variable between N.E. and N.W.—

it commences in November and ends in March: variable winds are more frequent in the southern part of the channel during this season than in the northern, for to the north of Mozambique the winds are generally from N.E. to N., accompanied with rain and squalls. At the southern entrance to the channel the variable N.E. to N.W. winds not unfrequently encounter the fresh S. and S.E. winds blowing on the south coast of Madagascar; under these circumstances severe gales of the rotatory type may be experienced, and the navigator should be prepared for them. This is the rainy season in the Mozambique Channel.

The so-called S.W. Monsoon commences in the Mozambique Channel in April and terminates towards November; this is the fine season. At the southern entrance to the channel the winds are S. and S.S.W., becoming more westerly towards the northern entrance, and finally uniting with the S.W. Monsoon, which is at this season prevalent over the northern part of the Indian Ocean: but at times these winds are variable, as, for instance, from S.W. to S.E. and E.S.E.—those from the last direction being squally and strong off the south end of Madagascar. Near the coast of Africa this is the period of land-and-sea breezes. In mid-channel both Monsoons are more regular than along the coast.

South of the parallel of 30° S. is the general region of the N.W. "passage-winds:" these also require a separate quarterly notice; they are of great importance to all commanders sailing to Australia, as the track to that important colony lies through the heart of these winds, and the voyage to India and China is also accelerated by pursuing this track. We have already alluded to E.N.E. winds being found as high as 30° S. lat. (see CHART DIAGRAM No. I., *areas* 38, 39). On the same CHART DIAGRAM, *areas* 47, 48, 49 are characterized by W.S.W. winds—*exactly the opposite;* here to all intents and purposes there is *an ascending current*, and it would appear that the surface of the ocean in the neighbourhood of the parallel of 30° S. and between long. 30° and 50° E. becomes during the three months, October to December, sufficiently heated, as compared with localities north and south of it, to produce an indraught of cooler air from E.N.E. and W.S.W. This does not occur in the more open spaces of the Indian Ocean to the eastward. It is in the neighbourhood of the parallels 30° to 35° S. that COM. MAURY places the Calms of Capricorn, and it is well known that he explains these, as well as the Calms of Cancer, by a *descending current* or rather by two *descending currents* resulting from the meeting of two opposite currents in the upper regions of the atmosphere, which come out on the surface, as two opposite winds *blowing away from each other*, thus ←≋ - ≋→

The second meteorological *axiom* announced by CAPT. CHARLES WILKES, U.S.N., in his "Theory of the Wind," is as follows: "that if the atmosphere is disturbed by any change of temperature, the *denser and colder* portions seek the warmer, *from every direction*, to restore the equilibrium *in the most direct lines it can follow*."

It is not intended on this occasion to enter into any examination of the controversy between COM. MAURY and CAPT. WILKES; our object is of a more practical nature —to show the navigator the principal winds he may meet with, in various localities, as he prosecutes his voyages, and the connexion that exists between these winds and certain other physical phenomena, by which he may the more readily take advantage of such winds as may be suitable for his purpose.

In immediate connexion with the locality under consideration, HORSBURGH has this remark: "The late CAPT. J. WILSON, of the Company's ship *Hythe*, a very scientific officer, has ascertained by careful observation that the temperature of the *central*

part of the stream of westerly current which prevails upon the verge of Cape Agulhas bank, is about 8° or 9° higher than that of the sea beyond the stream of current, and as the maximum of temperature is in the middle of the stream of current, a ship may be kept in it by attending to changes of temperature in the surface water, and hereby be enabled to accelerate her progress to the westward during adverse winds."

MAURY, in his "Physical Geography of the Sea," edition 1864, page 195, sections 393-4, speaking of a current of warm water in the Indian Ocean, says, "There is sometimes, if not always, another exit of warm water from the Indian Ocean. It seems to be an overflow of the great intertropical caldron of India,—seeking to escape thence, it works its way polarward, more as a drift than as a current: this Indian overflow is very large . . . and finds its way south, midway between Africa and Australia, and appears to lose itself in a sort of Sargossa Sea, thinly strewed with patches of weed. Nor need we be surprised at such a vast flow of warm water as these *three* currents indicate from the Indian Ocean, when we recollect that this ocean is land-locked on the north, and that the temperature of its waters is frequently as high as 90° Fahr. There must therefore be immense volumes of water flowing into the Indian Ocean to supply the waste created by these warm currents.

"On either side of this warm current that escapes from the intertropical parts of the Indian Ocean, but especially on the Australian side, an ice-bearing current is found wending its way from the Antarctic regions with supplies of cold water to modify climates and restore the aqueous equilibrium in that part of the world."

On turning to the chart of *sea drift* (Currents of Indian Ocean), we find indicated a stream of warm water flowing from the eastward between Australia and Borneo; this is divided into *three* branches;—one goes north to the Arabian Sea and Bay of Bengal, at least during a part of the year; another goes south, to the Sargossa Sea before spoken of; and a third moves west,—a prolongation of this forms the Agulhas current before mentioned: and as the temperature of the *central* part of this current is 8° or 9° higher than that of the water on either side, so it is to be inferred, and most probably such inference is not far from the truth, that the Indian Ocean is parcelled out by these currents into portions of warm and cold, or at least *cool* water. We have now only to apply WILKES' axiom before quoted, and we see at once, that according to this axiom, the wind must blow from the cooler *towards* the warmer areas; such a warm area most probably exists in the neighbourhood of 30° S. between the *areas* Nos. 38, 39, and 40 on the north, and *areas* 47, 48, and 49 on the south; in fact, this supposed warm area is in the line of the *warm water current*.

Whatever evidence may exist in support of MAURY'S idea, that the Calms of Capricorn and Cancer are produced by opposite winds meeting in *the higher regions of the atmosphere* and seeking the surface by a *downward* current,—*here*, in the region of the southern calms, there is evidence of at least one movement of an opposite character,—for the *meeting* of the E.N.E. and W.S.W. winds could not result in any way from a descending current, nor is it easy to see how two *parallel* but *oppositely directed* currents could be produced by such means; the current exhibited on the CHART DIAGRAM being of this character, as will be shown further on. To proceed with the analysis of winds:—

During the next three months, *i.e.* from January to March, the same opposition of the E.N.E. and W.S.W. winds obtain, although somewhat considerably modified by

the position of the sun,—see CHART DIAGRAM No. II. Between Lat. 20° and 40° S. (in *areas* Nos. 40, 49, and 48) the prevalent winds are from E.N.E. or N.N.E., while in *area* No. 39 and also in 49 we have it from E.S.E. It is in the parallels between 40° and 50° S., that the opposing wind from W.S.W. occurs, and this would indicate that the partial belt, or zone of warm water, above mentioned, had *receded from the Equator with the sun.*

During the winter season in the southern hemisphere, this peculiar arrangement of the winds, arising from the presence of warm and cold water, disappears. Between April and June the S.E. Trade is fully established over the northern part of CHART DIAGRAM No. III.,—and the breadth of the sweep of winds along the African coast is greatly augmented; it may be seen stretching as far as areas 49 and 39, and the arrow in 40 clearly shows the tendency of the stream of air to the great rarefying surface of the central part of South Africa.

During the months of July, August and September,—the Southern winter—a very remarkable arrangement of the wind occurs, as seen in CHART DIAGRAM IV. Taking the space between lat. 20° and 30° S. as a sort of central area, we have the winds blowing towards the north on the north of it, and towards the south on the south of it;—those blowing towards the north are clearly the S.E. Trade, which at this season reaches the Equator as the S.E. Monsoon. It would appear that some powerful force exists at this period of the year, *considerably to the south of Africa*, and that this force draws the air from the north of 30° S. (*area* 40) in a curved sweep touching the southern extremity of Madagascar (*area* 39) and merging into a general N.N.E. current, as seen in *areas* 48, 58, and 39; how far this northerly current extends, or in what it results, we have at present no evidence to show, except that it probably has its explanation in the warm water current, which flows almost due south on the meridian of the Cape at this period of the year.

We have thus noticed the three principal systems of winds, as indicated by the CHART DIAGRAMS; there is, however, another feature of no little interest, exhibited on all the diagrams; it is a kind of *out-blow* in the neighbourhood of the Cape of Good Hope, as shown by the arrows in the upper corners of *areas* 46 and 47; the *different* directions of the arrows clearly indicate the *coldness* of the land in the neighbourhood of the Cape and of South Africa, as compared with the warmth of the adjoining waters.

It is probable that this out-blow, which is seen on the four CHART DIAGRAMS, and consequently exists all the year round, is occasioned in some degree by the current of *cold water* which CAPT. SIR JAMES CLARKE ROSS found running in a northerly direction along the west coast of Africa. We give the following abstract from that officer's journal.

"March 7. A gradual diminution of temperature of air and sea as we approached the coast of Africa.—At midnight, entered a cold mist,—water discoloured, but no soundings with 130 fathoms of line."

"March 8. Latitude 32° 21′ S., Longitude 17° 6′ E.—45 miles from Paternoster Point,—soundings 127 fathoms.—Expected an *elevation* of temperature, both of air and sea, on approaching the African coast, by reason of the radiation of heat from its shores,—by 1 P.M. the temperature of the sea had fallen from 70° to 56.5°, that of the air being 65°.—The cause of the depression of temperature became evident on sighting Cape Paternoster, for a current increasing in strength and coldness as we neared the land was found to exist. The following is a summary of the experiments

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on it: The current barely reaches 40 miles from shore—where the sea is more than 300 fathoms deep—but spreads over double that distance in shallower parts;—45 miles from land, at a depth of 120 fathoms, the temperature of the water was 40°, that of the surface being 56°; and 60 miles off land, at 200 fathoms, it was 43·5°, the surface being 61°;—thus a northerly current of very limited extent, but of considerable force, exists from the Cape of Good Hope along the west coast of Africa, which in general terms may be represented by a volume of water 60 miles wide and 200 fathoms deep, averaging a velocity of a mile an hour . . . . running between the shores of Africa and the waters of the adjacent sea. The mist which hangs over the stream of cold water is occasioned by the condensation of the vapour of the superincumbent atmosphere whose temperature is generally so many degrees higher than that of the sea."

The temperature of the atmosphere first quoted is 65°, that of the surface being 8·5° lower; at 45 miles from land we find the surface temperature also 56°, but at 60 miles, *i.e.* 15 miles further, it is as high as 61°; it is probable the temperature increased still further out at sea, so that the natural effect of the heated sea-water (adjacent to the cold current) would be to draw the air from the coast, *i.e.* to produce the western part of the out-blow noticed, the eastern part being due to the general westerly current.

Having sketched out the general distribution of the winds in the western part of the southern Indian Ocean, the next consideration is to specify the phenomena of each area of ten degrees square, and in so doing first to pass in review the stream of air sweeping along the eastern coast of Africa,—next, the opposing winds in the neighbourhood of the 30th parallel,—and lastly the S.E. Trade.

CHART DIAGRAM No. I., October, November, December. (The *Southern* Spring.)

Winds along the Eastern Coast of Africa:—

* 46*b*. Area included between Lat. 30° and 35° S., Long. 15° and 20° E.
Prevailing wind, S.S.E.
Frequent winds, E.S.E.—S.E.—S.S.E. (442.) The wind in this *area* blows mostly towards and along the land.

46*d*. Area included between Lat. 35° and 40° S., Long. 15° and 20° E.
Prevailing wind, W.N.W.
Frequent winds, S.S.E.—S.S.W.—W.S.W. (442.) The prevailing wind in this *area* is a portion of the general stream from westward between the parallels of 30° and 40° S.

47. Area included between Lat. 30° and 40° S., Long. 20° and 30° E.
Prevailing wind, W.S.W.
Frequent winds, S.S.W.—W.N.W.—E.S.E. (441.) Here there is an indication of the stream of air sweeping round the southern part of Africa, as well as a tendency to the *area* of heated water mentioned on p. 27; the E.S.E. wind is in the direction of the same wind that blows outward from the land in *area* No. 46.

38*d*. Area included between Lat. 25° and 30° S., Long. 35° and 40° E.
Prevailing winds, S.S.W.—S.S.E.—E.N.E.

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* The numbers *before* the word "area" refer to the numbers on the CHART DIAGRAMS which accompany this work: the numbers in brackets are those on the Board of Trade Wind Charts.

Frequent winds, N.N.E.—E.S.E. (404.) In this *area* the winds generally set towards the African coast, although one of the prevailing winds is along shore, this is very similar to the winds in the adjoining *area*, and is in decided contrast with those in *area* No. 48, where the set is outward, from the land.

38*c*. Area included between Lat. 25° and 30° S., Long. 30° and 35° E.
Prevailing wind, S.S.W.
Frequent winds, E.S.E.—E.N.E. (404.)

38*b*. Area included between Lat. 20° and 25° S., Long. 35° and 40° E.
Prevailing wind, N.E.
Frequent winds, S.—S.S.E. and E. (404.) The winds from the *eastward* seem to indicate a point of convergence or rarefaction on this part of the African continent.

31*c*. Area included between Lat. 15° and 20° S., Long. 40° and 45° E.
Prevailing wind, S.S.E.
Frequent winds, S.—S.S.W.—S.W.—N.N.E. (367.)

31*a*. Area included between Lat. 10° and 15° S., Long. 40° and 45° E.
Prevailing wind, N.N.W.
Frequent wind, E.N.E. (367.)

31*b*. Area included between Lat. 10° and 15° S., Long. 45° and 50° E.
Prevailing wind, N.E.
Frequent winds, S.E.—E.S.E.—E.—N.N.E. (367.)

In the three latter *areas* we see the play of the winds in the northern part of the Mozambique Channel. In *area* 31*a* the prevailing wind is *outward* from the land, but in the other two *towards* it. *Areas* 31*a* and 31*b* are subject to *frequent calms*.

The so-called N.E. Monsoon :—

22*d*. Area included between Lat. 5° and 10° S., Long. 35° and 40° E.
Prevailing wind, N.E.
Frequent winds, S.E.—E.—E.S.E. (332.) Stream of air from eastward.

23. Area included between Lat. 0° and 10° S., Long 40° and 50° E.
Prevailing wind, N.E. and S.S.E.
Frequent winds, N.N.E.—E.N.E.—E.—E.S.E.—S.E.—S. (331.) In this area the set of the wind *towards the land* is unmistakeable. Calms are very frequent during the three months. Similar remarks appertain to *areas* 31*a* and 31*b*, to which the N.E. Monsoon probably extends.

Opposing currents of air in the neighbourhood of 30° *S :—*

39. Area included between Lat. 20° and 30° S., Long. 40° and 50° E.
Prevailing wind, E.N.E.
Frequent winds, S.S.E.—S.E.—E.S.E.—E.—N.E.—N.N.E. (403.)

40. Area included between Lat. 20° and 30° S., Long. 50° and 60° E.
Prevailing wind, E.N.E.
Frequent winds, E.S.E.—E.—N.E.—N.N.E. (402.) It will be observed that in *area* No. 39 there is a greater spread of wind than in *area* 40; in both, however, the general stream is from *eastward;* and probably as it approaches the land it is more divided, being subject to more numerous influences.

48. Area included between Lat. 30° and 40° S., Long. 30° and 40° E.
Prevailing wind, W.S.W.
Frequent winds, S.S.W.—S.W.—W.N.W.—N.N.W.—N.N.E.—E.N.E. (440.)

49. Area included between Lat. 30° and 40° S., Long. 40° and 50° E.
Prevailing wind, W.S.W.
Frequent winds, S.S.W.—W.N.W.—N.N.W.—N.N.E. (439.)

50. Area included between Lat. 30° and 40° S., Long. 50° and 60° E.
Prevailing wind, N.N.W.
Frequent winds, S.S.E.—S.S.W.—W.S.W.—W.N.W. (438.)

The direction of the arrows in the three last *areas* indicate a general movement of the air from the *westward*, and consequently in a nearly opposite direction to the movement of the air in *areas* 39 and 40. The movement of the air in *area* 38 is precisely of the same character as in *areas* 39 and 40, viz., from the *eastward*, while that in *area* 47 is of the same character as the movements in 48, 49, and 50; it is clear, therefore, that to the south of Lat. 30° S. we have generally an opposite stream of air to that immediately north of the same parallel.

The wind in *area* No. 48 blows during the three months almost directly along and *outwards* from the land, and the same directions are preserved (nearly) in *area* No. 49. In *area* No. 50 it is altered, the general winds being from N.N.W. to W.S.W., although the prevailing wind is towards N.N.W.

The winds in *areas* 58, 59, and 60 are very similar in their character to those in *areas* 48, 49, and 50, as will be seen below.

58. Area included between Lat. 40° and 50° S., Long. 30° and 40° E.
Prevailing wind, W.S.W.
Frequent winds, N.N.W.—W.N.W.—N.N.E. (476.)

59. Area included between Lat. 40° and 50° S., Long. 40° and 50° E.
Prevailing wind, W.S.W. and W.N.W.
Frequent winds, N.N.W. (475.)

60. Area included between Lat. 40° and 50° S., Long. 50° and 60° E.
Prevailing wind, W.N.W.
Frequent winds, W.S.W—N.N.W. (474.)—The wind in *areas* 56*b*, 57*a*, 57*b*, is part of the same N.W-ly stream of air.

56*b*. Area included between Lat. 40° and 45° S., Long. 15° and 20° E.
Prevailing wind, N.N.W.
Frequent winds, S.W.—W.S.W.—W.—W.N.W. (478.)

57*a*. Area included between Lat. 40° and 45° S., Long. 20° and 25° E.
Prevailing wind, W.
Frequent winds, S.SW.—W.N.W.—N.N.W. (447.)

57*b*. Area included between Lat. 40° and 45° S., Long. 25° and 30° E.
Prevailing wind, W.S.W.
Frequent winds, W.N.W., N.N.E., and N.N.W. (477.) The last two are, however, far less common than the prevalent W.S.W. to W.N.W. winds.

The South East Trade.

The only instances of the S.E. Trade during the three months occur in *areas* 24 and 32. In the first (or northern) of these *areas* the prevalent wind is S.; in the southern it is S.E.

24. Area included between Lat. 0° and 10° S., Long. 50° and 60° E.
Prevailing wind, S.
Frequent winds, S.E.—S.W.—W.—N.E (330.)

32*b*. Area included between Lat. 10° and 15° S., Long. 55° and 60° E.
Prevailing wind, S.E. (366.)

32*d*. Area included between Lat. 15° and 20° S., Long. 55° and 60° E.
Prevailing wind, S.E.
Frequent wind, E. (366.)

In *area* 23 the S.E. Trade shows itself, but is overpowered by other streams of air.

Chart Diagram No. II., January, February, March. (The *Southern* Summer.)

The stream of air sweeping the coast of Africa:—

46*b*. Area included between Lat. 30° and 35° S., Long. 15° and 20° E.
Prevailing winds, S.S.E. and S.S.W.
Frequent winds, E.S.E.—S.E.—S. (442.) The general direction of the wind in this *area* is scarcely altered during these three months as compared with its direction during October, November, and December, (see same *area* on p. 29,) it is now perhaps more parallel with the coast than blowing towards the land. The same kind of *out-blow* mentioned on p. 28 is however apparent.

46*d*. Area included between Lat. 35° and 40° S., Long. 15° and 20° E.
Prevailing wind, E.S.E.
Frequent winds, S.S.E.—S.E.—S.S.W.—W.S.W.—W.N.W. (442.) As regards this *area*, it is not a little remarkable that while the *prevailing* wind during January, February, and March is exactly the *opposite* of that during October, November, and December, *the frequent winds should be nearly the same;* the legitimate conclusion is that the *same* winds prevail between Lat. 35° and 40° S. and Long. 15° and 20° E. *during the summer six months of the southern hemisphere.* The *area* is one that is sailed over by many ships proceeding to Australia, and by nearly all bound to India and China; it will be seen that the wind mostly blows towards the African continent.

47. Area included between Lat. 30° and 40° S., Long. 20° and 30° E.
Prevailing wind, W.S.W.
Frequent winds, E.N.E.—E.S.E.—S.S.E,—S.S.W.—W.N.W.—N.N.E. (441.) Of these winds the E.N.E., S.S.E., and W.N.W., are more frequent than the other three, so that the *wind-star* in the chart of the Board of Trade presents a very *flattened* appearance, being drawn out in its greatest length towards E.N.E. and W.S.W. But there is evidence that at this season of the year, there is a considerable tendency towards *Easterly* winds.

38*d*. Area included between Lat. 25° and 30° S., Long. 35° and 40° E.
Prevailing wind, S.S.E.
Frequent winds, S.—E.S.E.—E.N.E. (404.) The character of a system of *on-shore* winds is maintained in this *area* during the southern summer.

38*e*. Area included between Lat. 25° and 30° S., Long. 30° and 35° E.
Prevailing wind, S.S.W.
Frequent winds, S.—S.S.E.—E.S.E.—E.N.E.—N.N.E. (404.) In this *area*, during the summer, winds along-shore are prevalent.

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38*b*. Area included between Lat. 20° and 25° S., Long. 35° and 40° E.
Prevailing wind, S.
Frequent winds, S.E.—S.S.E. (404.) The tendency of the winds in this *area* during the summer is towards the rarefying surface northward of the Mozambique Channel.

The so-called North-East Monsoon :—

31. Area included between Lat. 10° and 20° S., Long. 40° and 50° E.
Prevailing wind, N.N.W.
Frequent winds, N.W.—W.N.W.—S.S.W.—S.S.E.—E.S.E.—E.N.E.—N.N.E. (367.)

As in the spring months, so in the summer months of the Southern Hemisphere, the winds in the northern part of the Mozambique Channel are subject to very considerable variations. The frequent winds indicate that *three* systems alternate here : (1) that of the wind sweeping along the coast; (2) that of the N.E. monsoon; and (3) that of the wind towards the interior of Madagascar—of which the prevailing wind of the *area* is a component part. In addition, it must be borne in mind that calms are *very* frequent at this period.

23. Area included between Lat. 0° and 10° S., Long. 40° and 50° E.
Prevailing wind, N.N.E.
Frequent winds, E.S.E.—E.N.E.—N.E.—N.—N.W. (331.)

22*d*. Area included between Lat. 5° and 10° S., Long. 35° and 40° E.
Prevailing wind, N.E. (332.)

The winds of the above *areas* (31, 23, and 22*d*) are those of the Monsoon, many of them being evidently part of the N.W. Monsoon winds prevalent at this season south of the Equator; but whether any characteristic wind marks the Mozambique Channel during the summer is very doubtful.

Easterly Winds North of Lat. 40° S. :—

32*b*. Area included between Lat. 10° and 15° S., Long. 55° and 60° E.
Prevailing wind, E.
Frequent winds, N.E.—N. (366.)

32*d*. Area included between Lat. 15° and 20° S., Long. 55° and 60° E.
Prevailing wind, E.
Frequent winds, E.S.E.—E.N.E.—N.E. (366.)

40. Area included between Lat. 20° and 30° S., Long. 50° and 60° E.
Prevailing wind, E.N.E.
Frequent winds, E.S.E.—E.—S.E.—S.S.E. (402.)

39. Area included between Lat. 20° and 30° S., Long. 40° and 50° E.
Prevailing wind, E.S.E.
Frequent winds, S.S.E.—E.—E.N.E.—N.E.—N.N.E. (403.)

Similar remarks to those made on the spring wind (October, November, December) will apply to January, February, and March, for *areas* 40 and 39.

48. Area included between Lat. 30° and 40° S., Long. 30° and 40° E.
Prevailing wind, E.N.E.
Frequent winds, N.N.E. — E.S.E. — S.S.E. — S.S.W. — W.S.W. (440.)
During the summer months (January, February, March) the general blow of the winds in this *area* is nearly the opposite to that which is recorded for

October, November, and December. On page 31 it is noticed that in *area* No. 48 the winds blow *outwards* from the land during the spring months. In the summer they blow *inwards*, towards and along the coast of Africa; in fact there are two distinct systems traceable—that along the African coast, and a general stream from the eastward, gradually becoming north-easterly.

49. Area included between Lat. 30° and 40° S., Long. 40° and 50° E.

Prevailing winds, N.N.E. and S.S.W.

Frequent winds, E.S.E.—E.N.E.—S.S.E.—W.S.W.—N.N.W.—W.N.W. (439.) The numerous arrows inscribed on this *area* are sufficient to show that the locality is subject to great variations in the direction of the wind during the three summer months. There is, however, a preponderance towards the African coast, and this combined with one of the prevalent winds coming from N.N.E., will enable us to include it in the stream of air shortly to be noticed blowing in a somewhat contrary direction to that sweeping along the coast. On the whole, the winds in this *area* during the southern summer are very variable, and of all the *areas* between Lat. 0° and 50° S., Long. 10° and 60° E., this is the most likely one in which vessels either outward or homeward bound may fall in with *head winds* during the three months:—If proceeding towards the Mauritius, a head wind may be experienced from E.N.E. or thereabouts; if coming eastward round the Cape, the head wind may be W.S.W.; the chances are, that the wind may spring up from almost any of the other six points recorded above as frequent winds, but with no degree of certainty from either N.N.E. or S.S.W. It may be regarded, therefore, as a tedious *area* to sail across, owing possibly to this fact, that when the sun takes up his position over the southern tropic, the heated water (alluded to on page 27) advances towards the south, giving an almost entirely new direction to the winds of *areas* Nos. 49 and 48, and creating streams of air the tendency of which is to oppose one another. It would, however, be better to trim the ship to sail on the best course compatible with the general sweep of wind, which we now proceed to notice.

Westerly Winds South of Lat. 40° *S.*:—

56*b*. Area included between Lat. 40° and 45° S., Long. 15° and 20° E.

Prevailing wind, W.S.W.

Frequent winds, W.N.W.—N.N.W. (478.)

57. Area included between Lat. 40° and 50° S., Long. 20° and 30° E.

Prevailing wind, W.N.W.

Frequent winds, S.S.W.—W.S.W.—N.N.W.—N.—N.N.E.—E.N.E. (477.)

58. Area included between Lat. 40° and 50° S., Long. 30° and 40° E.

Prevailing wind, W.S.W.

Frequent winds, S.S.W.—W.N.W.—N.N.W.—N.N.E. (476.)

59. Area included between Lat. 40° and 50° S., Long. 40° and 50° E.

Prevailing wind, W.S.W.

Frequent winds, W.N.W.—N.N.W.

Occasionally, N.N.E. (475.)

60. Area included between Lat. 40° and 50° S., Long. 50° and 60° E.

Prevailing wind, N.N.W.

Frequent winds, W.S.W.—W.N.W. (474.)


WIND CHART of the INDIAN OCEAN
20°
40°
60°
80°
100°
ARABIA
ARABIAN SEA
HINDOSTAN
Calcutta
B. OF BENGAL
BIRMAH
Canton
Hainan
Palawan
CHINA SEA
RED SEA
Aden
G. of Aden
Socotra
Bombay
Deccan
Laccadivh Archo
Madras
Andaman Isles
Rangoon
Cochin China
SIAM
G. of Siam
Nicobar Is
Ceylon
Malay Pen.
Natuna
SUMATRA
BORNEO
Java Sea
JAVA
Maldivh Islds
AFRICA
Amirantes Is
Seychelle Archo
Chagos Archo
Christmas I.
Sumbawa
Sumba
Keeling Is
Saya de Malha Bank
Comoro Is
Tromelin I.
Cargados Garajos
MADAGASCAR
Mauritius
Rodrigues I.
Reunion
C. of Good Hope
AUSTRALIA
C. Leeuwin
King George Sd
Amsterdam
St. Paul
Northern limit of reported Ice or Icebergs
Crozet Is
Pr. Edward Is
Marion
Kerguelen I.
Mc. Donald Is
LONDON, James Imray & Son.

The *general* direction of the wind in the above five *areas* is from W.N.W. to W.S.W., in comparison with which scarcely any winds are experienced from the eastern horizon. The only well-marked instance of a series of winds opposite to those from W.N.W.—viz. E.S.E.—is found in *area* 48; the phenomena are, however, incompatible with the notion of a *descending* current, resulting from opposite streams of air.

In *area* 50 there is a somewhat similar play of winds to that in *area* 49, and the well-marked distinction between an easterly and westerly movement at this season probably commences in the former *area*, or perhaps it would be better to regard *areas* 50 and 49 as of an intermediate character, separating the easterly current to the north, and the westerly current to the south. The winds are as under.

50. Area included between Lat. 30° and 40° S., Long. 50° and 60° E.

Prevailing wind, N.N.W.

Frequent winds, partaking of the westerly movement, W.N.W.—W.S.W. —S.S.W.

Frequent winds, partaking of the easterly movement, S.S.E.—E.S.E.—E.N.E.—N.N.E. (438.)

It will be observed that the prevalent winds of *areas* 50 and 60 are identical,—they would indicate that, in addition to the two streams above alluded to, a stream of air towards S.S.E. existed in these *areas* during the three months: indeed, referring to Chart Diagram No. I., *area* 50, it appears that, more or less, during the *southern summer*, the wind has a tendency to blow in this direction.

The N.W. Monsoon:—There is only one more *area* to notice,—24, Lat. 0° to 10° S., Long. 50° to 60° E., the prevalent wind of which is N.W.,—the remaining winds bear but a small proportion to this, which is the characteristic wind of the region.

Allusion is made to the *change in the direction of the wind* that is effected over the *area* embraced by that part of the Chart Diagrams during the winter season of the southern hemisphere, as compared with the summer, more especially as regards the establishment of the S.E. Trade, embracing the western portion of the Southern Indian Ocean to the Equator,—and also the remarkable influence which is exerted on the so-called N.W. passage winds to the south-eastward of the Cape of Good Hope, particularly during the months of July, August, and September.

Chart Diagram No. III., April, May, June. (The *Southern* Autumn.)

Winds along the Southern and Eastern Coasts of Africa:—

The augmentation of the number of *areas* in which this *coasting wind* is found, during the months of April, May, and June, shows most distinctly that not only is its prevalence *increased*, but it extends much farther from the shore than at other seasons. It is during the southern autumn, therefore, that the mariner may expect to find this particular wind not only sweeping over a greater extent of surface, but most probably blowing with greater strength.

46*b*. Area included between Lat. 30° and 35° S., Long. 15° and 20° E.

Prevailing wind, E.S.E. (442.)

Other winds, chiefly between S.S.E. and W.N.W., may be expected, but are insignificant as compared with the E.S.E. wind, which blows *outward* from the land.

46*d*. Area included between Lat. 35° and 40° S., Long. 15° and 20° E.

Prevailing winds, S.S.W. and W.S.W.

Frequent winds, N.N.E.—E.S.E.—S.E.—S.S.E.—S.—S.S.W.—S.W.—W.S.W.—W.—W.N.W. (442.) Although the winds in this *area* are so numerous, yet the prevailing direction is towards the Cape: from the great spread of the wind in this *area* it is not at all unlikely that a stream sets from the southward towards the Cape, and that, as it approaches the land, it is divided into two branches, one passing *outwards* toward the N.W., the other *outwards* toward the N.E.; this kind of movement is shown on the CHART DIAGRAM, and it is more or less established from January to June inclusive (*i.e.* during the summer and autumn months), while the sun is receding from the southern tropic.

In anticipation of any remarks to be offered on this *area*, when treating of CHART DIAGRAM No. IV., it may be here observed, that during the months of July, August, and September, the direction of the wind in *area* 46*d* is so altered, as to blow rather *along* than *towards* the land. This fact is worthy of notice, because it may be seen by reference to the four CHART DIAGRAMS that during nine months of the year—between Lat. 35° and 40° S., Long. 15° and 20° E.—the wind blows almost directly towards the southern extremity of the African continent; but before it arrives there, it diverges into two well-marked streams—one towards W.N.W. or N.W., the other towards E.S.E., while there is also, from October to June, a general tendency of the wind *towards* the land.

57*a*. Area included between Lat. 40° and 45° S., Long. 20° and 25 E.

Prevailing wind, W.S.W.

Frequent winds, S.S.W.—E.N.E. (477.)

57*b*. Area included between Lat. 40° and 45° S., Long. 25° and 30° E.

Prevailing wind, W.

Frequent winds, W.S.W.—E.N.E.—N.N.E.—W.N.W.

58*a*. Area included between Lat. 40° and 45 S., Long. 30° and 35° E.

Prevailing wind, S.W.

Frequent winds, W.S.W.—W.—N.N.E. (476.)

47. Area included between Lat. 30° and 40° S., Long. 20° and 30° E.

Prevailing wind, W.N.W.

Frequent winds, W.S.W.—W.—S.S.W.—N.N.E. (441.) The direction of the prevailing wind is that of the general sweep of the so-called N.W. passage winds, while the directions of the frequent winds are more or less in accordance with the sweep round the African coast. The N.N.E. stream is also observable;—there are more calms met with in this than in the neighbouring *areas*.

The sun is now north of the Equator, and the general stream of air is from the *westward*, although easterly winds are sufficiently conspicuous to be embarrassing to vessels running down their easting.

48. Area included between Lat. 30° and 40° S., Long. 30° and 40° E.

Prevailing wind, S.S.W.

Frequent winds, S.—S.W.—W.N.W.—N.N.W.—N.—N.N.E.—N.E.—E.N.E.—E.S.E.—S.S.E. (440.) The direction of the wind in this *area* is very variable, more especially from January to June. It has already been remarked that the general direction is reversed in January, February and March, as compared with October, November and December—being

from the land during the latter period, and *to* it during the former. In April, May and June, the wind can hardly be said to blow either to or from the land, being somewhat similar in form to that of *area* No. 47. The prevailing wind is from S.S.W., the next in length of duration is exactly opposite, viz., from N.N.E., and the third, from E.N.E. It is clear, therefore, that at least two streams of air prevail here at this season,—that from S.S.W. being part of the African *along-shore* wind, while that from N.N.E. and E.N.E. (tending towards the south) is more strikingly developed in July, August and September, although indications of it exist all the year round. The general westerly current is perceptible in the wind from W.N.W.

49. Area included between Lat. 30° and 40° S., Long. 40° and 50° E.
Prevailing wind, S.S.W.
Frequent winds, N.N.E. — W.N.W. — S.S.E.—S.W.—W.S.W.—W.—N.W.—N.N.W.—N.—N.E.—S. (439.) This *area* during the three months partakes of precisely the same character as *area* 48. The winds are subject to considerable variations, but generally prevalent between S.S.W. and N.N.E., round by west.

39. Area included between Lat. 20° and 30° S., Long. 40° and 50° E.
Prevailing winds, S.S.E.—E.S.E.
Frequent winds, S.S.W.—S.—S.E.—E.—E.N.E. (403.)

38. Area included between Lat. 20° and 30° S., Long. 30° and 40° E.
Prevailing wind, S.
Frequent winds, S.S.W.—S.S.E.—S.E.—E.S.E.—E.—E.N.E.—N.N.W. (404.) The merging of the African *along-shore* wind into the S.E. Trade is so apparent in *areas* 39, 38, that no further remarks are required, and the remaining *areas* will be described in connexion with that Trade-wind.

The South-East Trade-Wind :—

During the three months of April, May and June, the S.E. Trade sweeps over the whole of the northern part of the Southern Indian Ocean, *i.e.* from the parallel of 28° S. to the Equator. In the region under discussion (viz., the westernmost portion of the Indian Ocean) the S.E. Trade has this peculiar modification,—it blows from S.E. to S., with a tendency near the Equator to merge into the *S.W. Monsoon*.

In all the *areas* bounded by the Equator and Lat. 20° S., Long. 35° and 60° E., the prevailing wind is either S.E. or S.S.E.

40. Area included between Lat. 20° and 30° S., Long. 50° and 60° E.
Prevailing wind, E.S.E.
Frequent wind, E.N.E.—E. (402.)

32*d*. Area included between Lat. 15° and 20° S., Long. 55° and 60° E.
Prevailing wind, E.
Frequent winds, E.S.E.—S.E.—S.S.E.—S.W.—S. (366.)

32*b*. Area included between Lat. 10° and 15° S., Long. 55° and 60° E.
Prevailing wind, S.E.
Frequent winds, E.—E.S.E. (366.)

32*a*. Area included between Lat. 10° and 15° S., Long. 50° and 55° E.
Prevailing wind, S.E.
Frequent wind, S.S.E.

31*b*. Area included between Lat. 10° and 15° S., Long. 45° and 50° E.
Prevailing wind, S.E.
Frequent winds, S.S.E.—S.—S.S.W. (367.)

30*d*, 31*c*, 31*a*, 22*d*. Areas included between Lat. 5° and 20° S., Long. 35° and 45° E.
Prevailing wind, S.S.E.
Frequent winds, S. and S.E.

24. Area included between Lat. 0° and 10° S., Long. 50° and 60° E.
Prevailing wind, S.E.
Frequent winds, S.—S.S.E. (330.)

23. Area included between Lat. 0° and 10° S., Long. 40° and 50° E.
Prevailing wind, S.E.
Frequent winds, S.—S.S.E.—E.S.E. (331.)

The easterly winds between Lat. 20° *and* 40° *S.*, which were so conspicuous during January, February, and March, are only to be recognised as mere frequent or occasional winds in April, May, and June, and by no means as prevalent ones.

The westerly winds south of Lat. 30° *S.* are only predominant in *areas* 50, 59, and 60.

50. Area included between Lat. 30° and 40° S., Long. 50° and 60° E.
Prevailing wind, W.N.W.
Frequent winds, N.N.E.—N.—N.N.W.—N.W.—E.S.E.—S.S.E.—S.—S.S.W.—W.S.W. (438.)

59. Area included between Lat. 40° and 50° S., Long. 40° and 50° E.
Prevailing wind, W.S.W.
Frequent winds, S.S.W.—W.N.W.—N.N.W.—N.N.E. (475.)

60. Area included between Lat. 40° and 50° S., Long. 50° and 60° E.
Prevailing wind, W.S.W.
Frequent winds, S.S.W.—W.—W.N.W.—N.W.—N.N.W. (474.)

CHART DIAGRAM No. IV., July, August, September. (The *Southern* Winter.)

The winds at this season admit of the same four-fold arrangement as in CHART DIAGRAM No. II., viz., the winds along the African shore,—the S.E. Trade, the easterly stream,—and the westerly winds forming the so-called N.W. passage winds. Of these, the first three are most strikingly developed, but the last is not so prominent in this part of the Indian Ocean as might be expected.

Winds along the Southern and Eastern Coasts of Africa:—

46*b*. Area included between Lat. 30° and 35° S., Long. 15° and 20° E.
Prevailing wind, E.S.E.
Frequent winds, S.E.—S.S.E.—S.S.W.—W.S.W.—W.N.W. (442.)

Upon comparing these frequent winds with others in the same *area* at the various seasons, we find that during the three months, July, August and September, the wind blows more *towards* the land, or from the S. and W., than at the other periods of the year. The following table will place this in a clear light, and show at a glance the winds that may be expected at any season in making the Cape.

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Seasons	Spring.	Summer.	Autumn.	Winter.
Prevailing winds ...	S.S.E.	S.S.E. S.S.W.	E.S.E.	E.S.E. .....
Frequent winds ...	E.S.E. S.E. ..... S.S.W.	E.S.E. S.E.	Unimportant.	..... S.E. S.S.E. S.S.W. W.S.W. W.N.W.

46*d*. Area included between Lat. 35° and 40° S., Long. 15° and 20° E.

Prevailing wind, W.N.W.

Frequent wind, W.S.W. (442.)

The arrangement of the wind in the two *areas* Nos. 46*b*, 46*d*, for July, August, and September, is somewhat similar to that for October, November, and December, see CHART DIAGRAM No. I. and p. 29; thus it would appear that during the six months from July to December, inclusive, the same meteorological forces are in operation in the neighbourhood of the Cape. The collected results are as under:—

Seasons	Spring.	Summer.	Autumn.	Winter.
Prevailing winds ...	W.N.W.	E.S.E.	S.S.W. W.S.W.	W.N.W. .....
Frequent winds.....	S.S.E. S.S.W. W.S.W.	S.S.E. S.S.W. W.S.W. W.N.W.	S.S.E. S.S.W. W.S.W. W.N.W.	.... W.S.W. .....

The prevailing wind of winter and spring appears only as a subordinate wind in the summer and autumn. The similarity between the winds of winter and spring is very apparent, also the difference that exists between these seasons and summer.

56*b*. Area included between Lat. 40° and 45° S., Long. 15° and 20° E.

Prevailing wind, W.N.W.

Frequent winds, S.E.—S.W.—W.S.W.—W.—N.N.W. (478.)

This *area* has been considered previously under the head of "Westerly winds." In consequence however of the great northerly stream of air, shortly to be noticed, it must now be considered as a part of the wind sweeping along the African Coast. The following Table shows the changes the wind undergoes here at different seasons:—

Seasons	Spring.	Summer.	Autumn.	Winter.
Prevailing winds ...	N.N.W.	W.S.W.	W.S.W.	W.N.W.
Frequent winds.....	..... S.W. W.S.W. W. W.N.W.	.... W.N.W. N.N.W.	.... W.N.W.	S.E. S.W. W.S.W. W. ..... N.N.W.

47. Area included between Lat. 30° and 40° S., Long. 20° and 30° E.
Prevailing winds, W.S.W.—W.N.W.
Frequent winds, S.S.W.—S.W.—W.—N.N.W.—N.N.E. (441.)

The *wind-stars* of this *area*, in the Board of Trade Charts, from April to December, inclusive, present a somewhat similar appearance to each other, which is greatly in contrast with the flattened *wind-star* of January, February, and March. The *area* is an important one, as both our outward and homeward-bound vessels generally pass through it. The following Table exhibits the variations of wind (at different seasons) that take place within its boundaries :—

Seasons	Winter.	Spring.	Summer.	Autumn.
Prevailing winds ...	W.S.W. W.N.W.	W.S.W.	W.S.W.	W.N.W. .....
Frequent winds.....	S.S.W. .... N.N.E. N.N.W. ..... W. ..... S.W.	S.S.W. ..... E.S.E. .... W.N.W.	S.S.W. S.S.E. E.S.E. E.N.E. .... W.N.W.	S.S.W. .... W. W.S.W. .....

38. Area included between Lat. 20° and 30° S., Long. 30° and 40° E.
Prevailing wind, S.
Frequent winds, S.S.W.—S.S.E.—S.E.—E.S.E.—E.—E.N.E.—N.E.—N.N.E.—N.N.W. (404.)

It will be seen on consulting the CHART DIAGRAM, that the along-shore winds merge into the S.E. Trade as is the case during April, May, and June (see p. 37).

The South-East Trade :—

The *areas* on our diagrams over which the S.E. Trade sweeps during the winter of the southern hemisphere, are nearly the same as those over which it sweeps during the autumn, viz. Nos. 22, 23, 24, 31, 32, and 40. In these *areas*, with the exception of Nos. 31 and 40, the prevailing wind is S.E., in 31 it is S.S.E., and in 40 E.S.E. ; the commander may therefore fully reckon upon S.E. breezes (as is well known) during July, August and September, between the Equator and Lat. 20° S., Long. 35° and 60° E., also between Lat. 20° and 30° S., Long. 50° and 60° E. ; this, however, forms but a small part of the S.E. Trade that sweeps over the Indian Ocean. No further remarks are necessary on the *areas* above mentioned.

Easterly Winds between Lat. 20° and 30° S. :—

These winds scarcely show during the winter season of the southern hemisphere. The easterly stream of air so well marked between 20° and 30° S. Lat. in the Indian Ocean during April, May, and June, and to which we shall direct further attention, now only occurs as a very subordinate wind. The E.N.E. wind of *area* 39 is the only well-marked remnant of this easterly wind, and an inspection of the CHART DIAGRAM will show that it forms a portion of the stream *to the southward*, which

was somewhat obscurely indicated during the autumn, and is now strongly developed and most decidedly well marked.

39. Area included between Lat. 20° and 30° S., Long. 40° and 50° E.

Prevailing wind, E.N.E.

Frequent winds, N.N.E.—N.E.—E.—E.S.E.—S.S.E.—S.S.W. (403.)

During the months of April, May, and June, the winds in this *area* (39) certainly form a portion of the great S.E. stream of the Trades; now (July, August, and September) they appear to form a part of the great N.N.E. stream, that sweeps over the southern part of the ocean towards the *south*. The change the direction of the wind undergoes in the winter, as compared with the autumn, will be seen in the following arrangements:—

Autumn.....S.S.W.—S —S.S.E.—S.E.—E.S.E.—E.—E.N.E.
Winter..... S.S.W.— * —S.S.E.— * —E.S.E.—E —E.N.E —N.E.—N.N.E.

which shows that the S.E. winds are less numerous, while the northerly winds become more so. The asterisks indicate that the S. and S.E. winds have not been met with in winter to the same extent as in autumn.

The great Southerly Sweep of Winds, South of Africa:—

An inspection of Chart Diagram No. IV., *areas* Nos. 39, 48, 57*a*, 57*b*, 58*a*, 58*b*, 59*a*, 59*b*, and 60*a*, shows that over these portions of the Indian Ocean, the wind is drawn by some powerful force *towards the south*. While the general body of the S.E. Trade tends towards the N.W., the general body of the air south of Madagascar and the Cape tends towards S.S.W. It is difficult in the present state of our geographical knowledge to point out the locality of such a force. It is not a little remarkable that this stream of air is moving *southerly* in the *winter*, and may perhaps receive its explanation in the large condensation that takes place in the Antarctic Regions at this season. Professor Dove has shown that the condensation of aqueous vapour raises the temperature, and Mr. Hopkins* insists that this raising of the temperature produces the most powerful winds. While, however, this is a very interesting subject for investigation, the great object we have to deal with now is the practical application of it to the wants of the seaman. We shall therefore simply analyse the facts as they stand before us.

Area No. 39, see above.—It will be remarked that a very decided change of wind has taken place in this *area* since the autumnal months of April, May and June; then the prevalent winds formed a portion of the S.E. Trade; now, the *southern* force acts, and it is likely this *area* is situated in the most northern part of the great southerly stream.

48. Area included between Lat. 30° and 40° S., Long. 30° and 40° E.

Prevailing wind, N.N.E.

Frequent winds, N.N.W.—W.N.W.—W.S.W.—S.S.W. (440.) The prevailing wind above is exactly opposite to the prevailing wind of this *area* in April, May and June;—and the wind blows much more from the land than at that season.

57*a*. Area included between Lat. 30° and 40° S., Long. 20° and 25° E.

Prevailing wind, N.N.E.

Frequent winds, E.—W.S.W.—W.N.W. (477.)

57*b*. Area included between Lat. 40° and 45° S., Long. 25° and 30° E.

* Hopkins, "On Winds and Rain."

Prevailing wind, N.N.E.
Frequent winds, E.S.E.—W.N.W.—S.S.W. (477.)

58*a*. Area included between Lat. 40° and 45° S., Long. 30° and 35° E.
Prevailing wind, N.N.E.
Frequent winds, E.N.E.—N.E.—N.—S.—W.S.W. (476.)

58*b*. Area included between Lat. 40° and 45° S., Long. 35° and 40° E.
Prevailing wind, N.N.E.
Frequent winds, N.—W.N.W. (476.)

59*a*. Area included between Lat. 40° and 45° S., Long. 40° and 45° E.
Prevailing winds, N.N.E.—N.N.W.
Frequent winds, W.N.W.—W.S.W. (475.)

59*b*. Area included between Lat. 40° and 45° S., Long. 45° and 50° E.
Prevailing wind, N.N.E.
Frequent winds, N.N.W.—E.N.E.—W.S.W. (475.)

60*a*. Area included between Lat. 40° and 45° S., Long. 50° and 55° E.
Prevailing wind, N.N.E.
Frequent winds, S.S.W.—W.N.W.—N. (474.)

The Westerly Winds South of Lat. 30° *S.*:—

In consequence of the great southerly sweep just indicated, the *areas* over which the westerly winds blow are greatly reduced in number; it will be sufficient here to notice the prevalent and frequent winds of these *areas*.

49. Area included between Lat. 30° and 40° S., Long. 40° and 50° E.
Prevailing wind, N.N.W.
Frequent winds, N.N.E.—W.N.W.—W.S.W.—S.S.W. (439.)

50. Area included between Lat. 30° and 40° S., Long. 50° and 60° E.
Prevailing wind, W.N.W.
Frequent winds, N.N.W.—W.S.W.—S.S.W. (438.)

60*b*. Area included between Lat. 40° and 45° S., Long. 55° and 60° E.
Prevailing wind, W.N.W.
Frequent winds, N.N.W.—N.W.—W.S.W. (474.)

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27. It remains now to discuss, briefly, that part of the central and northern Indian Ocean over which the MONSOONS are prevalent—Lat. 10° S. to 30° N., Long. 50° to 100° E.

CHART DIAGRAM No. I., October, November, December.

The *S.E. Trade* is now the general wind between Lat. 30° S. and 5° S.

A brief remark may here be made on a very interesting phenomenon that takes place in connexion with the streams of air, situated more or less in the neighbourhood of the Calms of Capricorn. It is the divergence of the S.E. and E. streams between 20° and 30° S. into two well-defined branches,—the S.E. into the branch flowing northward, past Madagascar, and along the African Coast to 10° N., where it becomes a S.W. wind—and the E. into the branch flowing southward, past the southern extremity of Madagascar as an E.N.E. wind, off the extremity of Africa as a N.N.E. wind, and finally becoming N.N.W. in *areas* 58 and 59. It would appear that it is the African Coast that *turns the two streams aside*, but under what circumstances and to what region of rarefaction is not quite clear.

The intimate connexion that subsists between the winds in the region bounded by the parallels of 10° S. and 10° N., Long. 40° to 100° E., necessitates a separation of that part of the ocean from the more northerly *areas*.

Regions of Westerly and South-Westerly Winds :—

In *areas* 15, 16, 17, 18, 19, 23, 24, 25, 26, 27, and 28, there are several distinct systems of wind—the most marked being a Westerly stream directed towards the Indian Archipelago (see *areas* 17, 18, 19, 25, 26, 27, and 28). A N.Wly. stream of air is also directed towards the Equator, and approaches, at times, very close to the S.E. Trade, and occurs likewise in *areas* 15, 16, 17, 18, and 19. A S.W. wind is not unfrequent in *areas* 15, 16, 17, 18, 19, 25, 26, 27, and 28; and a N.E. wind in *areas* 15, 16, 18, 19, 23, and 24. This is clearly the N.E. Monsoon, which penetrates as far as the parallel of Cape Corrientes during the southern spring.

15. Area included between Lat. 10° and 0° N., Long. 50° and 60° E.
Prevailing wind, N.E.
Frequent winds, S.W.—W.—N.W.—N. (31.) The frequent S.W. wind is evidently the closing portion of the S.W. Monsoon, and may be looked for mostly in October.

16. Area included between Lat. 10° and 0° N., Long. 60° and 70° E.
Prevailing wind, N.E.
Frequent winds, S.W.—N.W.—N. (30.) The N.W. wind is much more prevalent in this *area* than in No. 15.

17. Area included between Lat. 10° and 0° N., Long. 70° and 80° E.
Prevailing wind, N.W.
Frequent winds, S.W.—W.—N.N.W.—N. (29.) It is in this *area* that the Westerly wind is first perceptible, north of the Equator. The N.E. Monsoon is scarcely experienced here; the S.W. is also much subdued,—the prevailing wind being N.W., which blows more or less during the three months along the Malabar coast.

18. Area included between Lat. 10° and 0° N., Long. 80° and 90° E.
Prevailing wind, W.
Frequent winds, S.W.—N.W.—N.—N.E.—E. (28.) Approaching the Indian Archipelago there is a much greater play of the winds.

19. Area included between Lat. 10° and 0° N., Long. 90° and 100° E.
Prevailing wind, W.
Frequent winds, S.W.—N.W.—N.—N.E.—E.—S.E. (27.)

25. Area included between Lat. 0° and 10° S., Long. 60° and 70° E.
Prevailing wind, W.
Frequent winds, S.E.—S.W.—N.W.—E.S.E. (329.) Calms are frequent. It is in this *area*, south of the Equator, proceeding from west to east, that there is the earliest indications of the westerly stream towards the Indian Archipelago.

26. Area included between Lat. 0° and 10° S., Long. 70° and 80° E.
Prevailing wind, S.W.
Frequent winds, W.—W.N.W.—S.E. (328.) Of these frequent winds that from the west is nearly as prevalent as the S.W. Calms are less frequent.

27. Area included between Lat. 0° and 10° S., Long. 80° and 90° E.
Prevailing winds, W.—S.E.
Frequent winds, S.W.—N.W.—E. (327.) In this *area* the S.E. Trade is quite as prevalent as the westerly wind, but it is characterized by the greatest number of calms that are met with between the Equator and 10° S. Lat.

28. Area included between Lat. 0° and 10° S., Long. 90° and 100° E.
Prevailing wind, S.E.
Frequent winds, S.S.E.—S.—S.W.—W.—N.W.—E. (326.)

The S.E. Trade is by far the most prevalent, then the streams from S.S.E. and S.W.; with the exception of the easterly and westerly streams of air, the wind blows mostly from the *South*. Calms are very prevalent.

The North-East Monsoon:—

It will be seen that the N.E. Monsoon blows, at least during a portion of the three months (October, November, December), a N.E. wind from the northern parts of the Bay of Bengal and the Arabian Sea, towards the Equator. The Peninsula of Hindostan separates the Northern Indian Ocean into two parts;—in the eastern portion the Monsoon *blows as far as the Equator*. Between the Equator and 10° S. lies the region of calms—and here it is that a very remarkable arrangement of the winds obtains. The N.E. Monsoon north, and the S.E. Trade south of the Equator, are similarly disposed to the N.E. and S.E. Trades of the Atlantic, which meet under the "Cloud-ring." While, however, we have the N.E. Monsoon thus blowing towards the Calm Belt, there is also a *north-west* wind meeting the S.E. Trade in the same region. It is in the western portion of the Indian Ocean that the N.E. Monsoon crosses the Equator;—it appears to blow steadily from the head of the Arabian Sea, not only in the open ocean, but along the coasts of Arabia and Africa, penetrating the Mozambique Channel as far as Cape Corrientes. It is only on the western shores of Hindostan that the N.E. Monsoon is interrupted by the N.W. wind.

1*d*. Area included between Lat. 25° and 20° N., Long. 55° and 60° E.
Prevailing wind, E.
Frequent winds, N.E.—S.—S.W. (103.)

2*d*. Area included between Lat. 25° and 20° N., Long. 65° and 70° E.
Prevailing wind, N.E. (102.)

8. Area included between Lat. 20° and 10° N., Long. 50° and 60° E.
Prevailing wind, N.E.
Frequent winds, E.—S.W.—W. (67.)

9. Area included between Lat. 20° and 10° N., Long. 60° and 70° E.
Prevailing wind, N.E.
Frequent wind, N.N.E. (66.)

10*a*. Area included between Lat. 20° and 15° N., Long. 70° and 75° E.
Prevailing wind, N.E.
Frequent wind, N.W. (65.) The N.W. wind is well marked.

11. Area included between Lat. 20° and 10° N., Long. 80° and 90° E.
Prevailing wind, N.E.
Frequent wind, N.N.E. (64.)

12. Area included between Lat. 20° and 10° N, Long. 90° and 100° E.
Prevailing wind, N.E.
Frequent winds, E.—N. (63.)

In this *area* the wind blows from the land.

The N.W. Stream on the West of Hindostan :—

10*a*. See above.

10. Area included between Lat. 15° and 10° N., Long. 70° and 75° E.
Prevailing wind, N.W.
Frequent wind, N. (65.)

10*d*. Area included between Lat. 15° and 10° N., Long. 75° and 80° E.
Prevailing wind, N.W.
Frequent wind, S. (65.)

Winds at the Head of the Arabian Sea :—

1*b*. Area included between Lat. 30° and 25° N., Long. 55° and 60° E.
Prevailing winds, N.W.—E.—W.—S.
Frequent winds, S.S.E.—S.W. (103.)

In this *sub-area*, during the three months, not only is there a very great play of winds, but frequent calms; it is generally in similar localities that we find such great diversities. It would appear to be very difficult to reduce these winds to any well-recognised rule, such as the Trades and Monsoons.

1*a*. Area included between Lat. 30° and 25° N., Long. 50° and 55° E.
Prevailing wind, W.
Frequent wind, N.W. (103.)

In this *sub-area* there is a N.W. wind nearly as prevalent as the W. wind; it does not, however, appear to form part of the stream sweeping the west coast of Hindostan, being separated from it by the N.E. Monsoon.

2*c*. Area included between Lat. 25° and 20° N., Long. 60° and 65° E.
Prevailing wind, N.
Frequent winds, N.E.—W. (102.)

The wind in this *sub-area* appears to be a part of the N.E. Monsoon.

Winds at the Head of the Bay of Bengal :—

4*d*. Area included between Lat. 25° and 20° N., Long. 85° and 90° E.
Prevailing wind, N.
Frequent wind, N.E. (100.)

5*c*. Area included between Lat. 25° and 20° N., Long. 90° and 95° E.
Prevailing wind, N.
Frequent winds, N.N.W.—N.W. (99.)

The prevalent wind in *areas* 4*d* and 5*c* is North, which merges into the Monsoon, while the frequent winds blow along-shore.

CHART DIAGRAM No. II., January, February, March.

The South-East Trade :—

During this quarter of the year the S.E. Trade attains its maximum polar development, but it scarcely reaches 10° S. except on the eastern side of the Indian Ocean, hence we may say it is fully developed over twenty degrees of latitude—viz., from 31° to 11° S. It is found to the northward of 10° S., in *areas* 26, 27, and 28, but

owing to the more general prevalence of a westerly current of air between the Equator and 10° S., it ranks only as a frequent wind.

Region of the N.W. Monsoon :—

Between the Equator and 10° or 11° S. the N.W. Monsoon is in full operation during Jan., Feb., and March;—in *areas* 24 and 25 blowing from the N.W., but in *areas* 26, 27, and 28 having a more westerly direction.

25. Area included between Lat. 0° and 10° S., Long. 60° and 70° E.
Prevailing wind, N.W.
Frequent winds, N.—N.N.W.
Occasional wind, W. (329.)

26. Area included between Lat. 0° and 10° S., Long. 70° and 80° E.
Prevailing wind, W.
Frequent winds, N.—N.N.W.—S.E.—S.W.—N.N.E.—N.W.—W.N.W.—N.E.—W.S.W. (328.)

27. Area included between Lat. 0° and 10° S., Long. 80° and 90° E.
Prevailing wind, W.
Frequent winds, N.W.—S.W.—W.S.W.—S.E.—W.N.W.—E. (327.)

28. Area included between Lat. 0° and 10° S., Long. 90° and 100° E.
Prevailing wind, W.
Frequent winds, N.W.—S.W.—S.E.—W.N.W.—E.—W.S.W. (326.)

Calms are of very frequent occurrence in *areas* 27 and 28.

Region of the N.E. Monsoon :—

The N.E. Monsoon, during January, February, and March, is prevalent over all the northern part of the Indian Ocean.

15. Area included between Lat. 0° and 10° N., Long. 50° and 60° E.
Prevailing wind, N.E.
Frequent winds, N.N.E.—N. (31.)

16. Area included between Lat. 0° and 10° N., Long. 60° and 70° E.
Prevailing wind, N.E.
Frequent winds, N.N.E.—N.—Occasional wind, N.W. (30.)

17. Area included between Lat. 0° and 10° N., Long. 70 and 80° E.
Prevailing wind, N.
Frequent winds, N.E.—N.N.E.—Occasional winds, N.W.—S.W. (29.)

18. Area included between Lat. 0° and 10° N., Long. 80° and 90° E.
Prevailing wind, N.E.
Frequent winds, N.—E.—N.N.E.—E.N.E. (28.)

19. Area included between Lat. 0° and 10° N., Long. 90° and 100° E.
Prevailing wind, N.E.
Frequent winds, N.W.—E.—N.—S.W.—S.E.—W.—E.N.E.—N.N.E.—S. (27.) Calms are very common in this *area :* from the relative size of the lines in the wind-star of the Board of Trade Wind Chart, the wind during the quarter is, more or less, all round the compass.

8. Area included between Lat. 10° and 20° N., Long. 50° and 60° E.
Prevailing wind, N.E.
Frequent winds, E.—E.N.E.—N.N.E.—Occasional wind, S.E. (67.)

9*d*. Area included between Lat. 10° and 15° N., Long. 65° and 70° E.

Prevailing wind, N.
Frequent winds, N.E.—N.W. (66.)

11. Area included between Lat. 10° and 20° N., Long. 80° and 90° E.
Prevailing wind, N.E.
Frequent winds, E.—N.—E.N.E.—N.N.E.
Occasional wind, S.W. (64.)

12*a*. Area included between Lat. 15° and 20° N., Long. 90° and 95° E.
Prevailing wind, W.S.W.
Frequent winds, N.—W.—S.W.—N.W.
Occasional wind, N.E. (63.)

12*c*. Area included between Lat. 10° and 15° N., Long. 90° and 95° E.
Prevailing wind, N.
Frequent winds, N.E.—N.N.E. (63.)

4*d*. Area included between Lat. 20° and 25° N., Long. 85° and 90° E.
Prevailing wind, N.E.
Frequent winds, N.—N.N.E.—W.—S.W.—N.N.W.—S. (100.)

The N. and N.W. Streams of Air on the West of Hindostan :—

10*a*. Area included between Lat. 15° and 20° N., Long. 70° and 75° E.
Prevailing wind, N.
Frequent winds, N.W.—N.N.W. (65.)

10*c*. Area included between Lat. 10° and 15° N., Long. 70° and 75° E.
Prevailing winds, W.—N.N.W.
Frequent winds, N.E.—N.—N.W. (65.) Occasionally a S.E. wind is experienced.

10*d*. Area included between Lat. 10° and 15° N., Long. 75° and 80° E.
Prevailing wind, N.W.
Frequent winds, N.N.W.—N. (65.)

Winds at the Head of the Arabian Sea :—

2*c*. Area included between Lat. 20° and 25° N., Long. 60° and 65° E.
Prevailing wind, S.W.
Frequent winds, W.—W.S.W.—S.S.W.—S.E.
Occasional wind, N.W. (102.) Calms frequent.

2*d*. Area included between Lat. 20° and 25° N., Long. 65° and 70° E.
Prevailing winds, N.W.—W.N.W.
Frequent winds, W.—S.W.—S. (102.)

During the six months, April to September, the *S.E. Trade-wind* reaches the Equator, being known as the *S.E. Monsoon* in its more northern portion, and thence gradually merging into the *S.W. Monsoon*. Calms are less frequent during this period than during the other six months, viz. from September to April.

CHART DIAGRAM No. III., April, May, June.

The South-West Monsoon :—

1*d*. Area included between Lat. 25° and 20° N., Long. 55° and 60° E.
Prevailing wind, S. (103.)

2*a*. Area included between Lat. 25° and 20° N., Long. 60° and 65° E.
Prevailing wind, S.W. (102.)

4*d*. Area included between Lat. 25° and 20° N., Long. 85° and 90° E.
Prevailing wind, S.W.
Frequent wind, S. (100.)

8. Area included between Lat. 20° and 10° N., Long. 50° and 60° E.
Prevailing wind, S.W.
Frequent winds, S.E.—S.—E. (67.) Calms frequent.

11. Area included between Lat. 20° and 10° S., Long. 80° and 90° E.
Prevailing wind, S.W.
Frequent winds, S.—S.S.W. (64.)

12*a*. Area included between Lat. 20° and 15° N., Long. 90° and 95° E.
Prevailing wind, S.W. (63.)

12*c*. Area included between Lat. 15° and 10° N., Long. 90° and 95° E.
Prevailing wind, S.W. (63.)

15. Area included between Lat. 10° N. and Equator, Long. 50° and 60° E.
Prevailing wind, S.W.
Occasional winds from N.E. to N.W. (30.)

16. Area included between Lat. 10° N. and Equator, Long. 60° and 70° E.
Prevailing wind, W.
Frequent winds, W.N.W.—S.W. (30.) Calms frequent.

17. Area included between Lat. 10° N. and Equator, Long. 70° and 80° E.
Prevailing wind, W.
Frequent winds between N.W. and S.W. (29.) The winds in the two *areas* 16 and 17 seem to be connected with the north-westerly stream of air on the west side of the Indian peninsula.

18. Area included between Lat. 10° N. and Equator, Long. 80° and 90° E.
Prevailing wind, S.W.
Frequent winds between W. and S.
Occasional winds between S.E. and N.E. (28.)

19. Area included between Lat. 10° N. and Equator, Long. 90° and 100° E.
Prevailing wind, S.W.
Frequent winds between W. and S.
Occasional wind, S.E. (27.)

The N.W. and W. Winds on the West Side of Hindostan :—

9. Area included between Lat. 20° and 10° N., Long. 60° and 70° E.
Prevailing wind, N.W.
Frequent winds, S.—W.S.W.—S.; occasionally N.E. (66.)

10*a*. Area included between Lat. 20° and 15° N., Long. 70° and 75° E.
Prevailing wind, N.N.W.
Frequent winds, S.W.—N.W. (65.)

10*c*. Area included between Lat. 15° and 10° N., Long. 70° and 75° E.
Prevailing wind, W.
Frequent winds between S.W. and N. (65.)

10*d*. Area included between Lat. 15° and 10° N., Long. 75° and 80° E.
Prevailing wind, N.W.
Frequent winds between S.W. and N. (65.)

CHART DIAGRAM No. IV., July, August, September.

The S.W. Monsoon :—

1*d*. Area included between Lat. 25° and 20° N., Long. 55° and 60° E.
Prevailing wind, N.
Frequent winds, S.E.—S.W. (103.)

2*c*. Area included between Lat. 25° and 20° N., Long. 60° and 65° E.
Prevailing wind, S.W.
Frequent wind, W.S.W. (102.)

2*d*. Area included between Lat. 25° and 20° N., Long. 65° and 70° E.
Prevailing wind, W. (102.)

4*d*. Area included between Lat. 25° and 20° N., Long. 85° and 90° E.
Prevailing wind, S.W. (100.)

8*b*. Area included between Lat. 20° and 15° N., Long. 55° and 60° E.
Prevailing wind, S.W. (67.)

8*c*. Area included between Lat. 15° and 10° N., Long. 50° and 55° E.
Prevailing wind, S.
Frequent winds, between S.W. and S.S.E.
Occasional wind, N.E. (67.)

8*d*. Area included between Lat. 15° and 10° N., Long. 55° and 60° E.
Prevailing wind, S.W. (67.)

9. Area included between Lat. 20° and 10° N., Long. 60° and 70° E.
Prevailing wind, W.
Frequent winds, S.W.—W.N.W. (66.)

10*a*. Area included between Lat. 20° and 15° N., Long. 70° and 75° E.
Prevailing wind, W.
Frequent winds, W.N.W.—W.S.W. (65.)

10*c*. Area included between Lat. 15° and 10° N., Long. 70° and 75° E.
Prevailing wind, N.W.
Frequent winds, W.N.W.—W. (65.)

10*d*. Area included between Lat. 15° and 10° N., Long. 75° and 80° E.
Prevailing wind, N.W.
Frequent winds, S.E.—W.—S. (65.)

11. Area included between Lat. 20° and 10 N., Long. 80° and 90° E.
Prevailing wind, S.W. (64.)

12*a* & *c*. Area included between Lat. 20° and 10° N., Long. 90° and 95° E.
Prevailing wind, S.W. (63.) In the northern part of this area the wind is more westerly; in the southern part more southerly.

15. Area included between Lat. 10° N. and Equat., Long. 50° and 60° E.
Prevailing wind, S.W. (31.)

16. Area included between Lat. 10° N. and Equat., Long. 60° and 70° E.
Prevailing wind, W.
Frequent winds, S.W.—S. (30.)

17. Area included between Lat. 10° N. and Equat., Long. 70° and 80° E.
Prevailing wind, N.W.
Frequent winds, W.N.W.—W.—S.W. (29.)

18. Area included between Lat. 10° N. and Equat., Long. 80° and 90° E.

Prevailing wind, S.W.

Frequent winds, between W. and S. (28.)

19. Area included between Lat. 10° N. and Equat., Long. 90° and 100° E.

Prevailing wind, S.W.

Frequent winds, between W. and S. (27.)

The N.W. stream of air on the West Coast of Hindostan is still present (see *area* 10); but now (July to September) it is not the prevailing wind to the same extent as in the previous quarter.

These remarks (pp. 25–50) sufficiently explain CHART DIAGRAMS Nos. I., II., III., and IV., of the winds of the Indian Ocean.

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28. MAURY on the Monsoons.—With the view of investigating certain monsoon-phenomena—when and where each wind (N.E. or S.W.) begins and terminates, as well as the duration of each—Maury examined his abstract logs, and from 11,697 observations made at sea, between the meridians of 80° and 85° E., and from Calcutta to the Equator, constructed the following table, illustrative of what he aptly terms the *march of the Monsoons*:—

MONTHS.	BANDS OF LATITUDE.										MONTHLY MEAN.	
	22° to 20° N.		20° to 15° N		15° to 10° N.		10° to 5° N.		5° N. to Eq.			
	N.E.	S.W.	N.E.	S.W.	N.E.	S.W.	N.E.	S.W.	N.E.	S.W.	N.E.	S.W.
	Days.	Days.	Days.	Days.	Days.	Days.	Days.	Days.	Days.	Days.	Days.	Days.
October	**9**	6	**12**	6	**8**	**10**	**6**	**16**	4	**14**	**8**	**10**
November	**11**	6	**25**	2	**21**	2	**10**	6	5	**14**	**14**	6
December	**27**	0	**26**	1	**24**	1	**15**	3	**12**	**11**	**21**	3
January	**17**	6	**21**	2	**23**	1	**20**	1	**19**	3	**20**	3
February	**11**	**11**	**13**	6	**19**	3	**22**	1	**16**	2	**16**	5
March	4	**18**	**7**	**15**	**18**	5	**13**	0	**15**	2	**11**	**8**
April	2	**24**	2	**22**	**6**	**21**	**6**	**11**	4	**14**	4	**17**
May	1	**26**	1	**24**	3	**29**	1	**23**	0	**19**	1	**23**
June	0	**28**	1	**27**	0	**12**	1	**25**	0	**24**	0	**27**
July	2	**24**	1	**27**	0	**30**	0	**28**	0	**24**	1	**27**
August	0	**28**	1	**24**	0	**24**	1	**22**	0	**18**	0	**23**
September	**6**	**14**	1	**18**	0	**23**	0	**26**	1	**18**	2	**20**
Mean Days*	**81**	**173**	**104**	**157**	**119**	**149**	**92**	**151**	**62**	**156**	**90**	**155**

And, taking into consideration the causes of these winds, MAURY says that† "the S.W. Monsoons commence at the north, and *back down*, or work their way towards the south. Thus they set in earlier at Calcutta than they do at Ceylon, and earlier at Ceylon than they do at the Equator. The average rate of travel, or *backing down* to the south, as seamen express it, is from 15 to 20 miles a day. It takes the S.W.

* These means for the duration of each wind are obtained as follows: for N.E.=9+11+27+17+11+6=81 days; for S.W.=11+18+24+26+28+24+28+14=173 days.

† "Physical Geography of the Sea," 11th edition, revised, chap. vi. §§ 684-689.

Monsoon six or eight weeks to *back down* from the tropic of Cancer to the Equator." And again—"As the vernal equinox approaches, the heat of the sun begins to play upon the steppes and deserts of Asia with power enough to rarefy the air, and cause an uprising sufficient to produce an indraught thitherward from the surrounding regions. The air that is now about to set off to the south as the N.E. Monsoon is thus arrested, turned back, and drawn into the place of low-barometer as the S.W. Monsoon. These plains become daily more and more heated, the sun more and more powerful, and the ascending columns more and more active; the area of inrushing air, like a circle on the water, is widened, and thus the S.W. Monsoons, *backing down* towards the Equator, drive the N.E. Monsoons from the land, replace them, and gradually extend themselves out to sea."

29. The Table on p. 50 establishes what has already been observed, the greater persistency of the S.W. Monsoon over the N.E., but it is to be regretted that MAURY should have selected the western side of the Bay of Bengal as an illustration of his theory of the *backing down* of the wind, inasmuch as the Monsoons undergo a greater modification from the *lay of the land* on that side than in any other part of the N. Indian Ocean; and again, during the change of the Monsoon the breezes there by night are from S.W. to W., by day from S. to E.; and these have evidently been confounded with the season of the S.W. Monsoon.* That these winds do penetrate far into the land is certain, but that their direction is very considerably modified thereby is also evident from the following observation made at Dum-dum, near Calcutta:—

Months.	Approximate Direction of Wind in the Order of Frequency.	Mean Direction.
October	N.W.; S.W.; N.E.; N.; W.; S.E.; S.; E.	N. 46° W.
November	N.W.; N.; N.E.; W.	N. 19° W.
December	N.W.; N.; N.E.; W.	N. 25° W.
January	N.W.; N.; N.E.; W.; S.W.; E.; S.E.	N. 23° W.
February	N.W.; W.; E.; N.E.; S.W.; N.; S.E.; S.	N. 37° W.
March	S.W.; S.; S.E.; W.; E.; N.E.; N.W.	S. 10° W.
April	S.; S.W.; S.E.; W.	S. 17° W.
May	S.; S.E.; S.W.; E.	S. 12° E.
June	S.W.; E.; S.; S.E.	S. 11° E.
July	S.E.; S.W.; S.; E.; W.	S. 12° E.
August	S.W.; E.; S.E.; S.; W.; N.E.	S. 25° E.
September	S.E.; S.W.; E.; N.E.; S.; W.	S. 31° E.

In the winter months there appears to be a marked predominance of N.W. winds; so that in December the mean direction is N.N.W.: this predominance gradually diminishes, and in March the winds blow more frequently from the south than from the north,—the west winds still retaining their superiority over those from the east: this relation ceases, in its turn, in proportion as the meridian altitude of the sun increases; and at the summer solstice the wind blows from the S.S.E., a direction dia-

* That uncertainty as to the *season* does prevail is evident from the following remarks, extracted from HORSBURGH:—

(Madras). "During the S.W. Monsoon, particularly in the early part of it, after the 1st of February," &c.

(Hoogly). "When the southerly winds begin to have strength, during the latter part of March, or early in April," &c. &c." "North-westers are liable to happen near the entrance and in the river Hoogly about the changes of the Monsoon, particularly in April and May," &c. &c.

metrically opposite to that of the winter. The winds turn to the west when the declination of the sun is more southerly; and in winter they settle, without variation, in the west. It will not fail to be observed that, generally, the winds are far too variable at the head of the Bay of Bengal to indicate when either Monsoon commences,—though the two seasons, in the main, are sufficiently well marked.

The influence of the declination of the sun upon the Monsoons has long been recognised on the west coast of Hindostan; as the sun arrives later at the zenith of places situated more northerly, so the S.W. wind also blows later at these places: at Anjenga, in Lat. 8½° N., it commences as early as the middle of April; at Bombay, in Lat. 19° N., not until the middle of May.* On the coast of Aracan it is not recognised to commence earlier than May. Such being the case, it is difficult to see how this Monsoon can *back* down on the east coast of Hindostan, and yet more difficult to understand the influence of the "steppes and deserts" at the back of the Himalaya range (see p. 51), for these, together with the desert region behind the Hindoo Koosh, should, on MAURY's supposition, be more potential for Bombay than for Calcutta. Nor, if MAURY is correct, could the S.W. Monsoon be any longer regarded as the prolongation of the S.E. wind of the S. tropic into the N. tropic, as the N.W. wind is the prolongation of the N.E. from the N. to the S. tropic. The heated land unquestionably has an influence, but the sun must heat the tropical land bounding the Northern Indian Ocean before its effect can be felt on steppes and deserts in extra-tropical regions. There appears then no reason to alter the opinion already formed (pp. 18, 19) on the production of the Monsoons.

30. As showing the predominance of the S.W. Monsoon over the N.E., as well as the great variableness of the latter, the following Table, deduced from MAURY's charts, and the direction of the wind determined on the formulæ of LAMBERT, will be both useful and interesting to the navigator:—

MONTHS.	NORTH LATITUDE.					S. LATITUDE.	
	25° to 20°	20° to 15°	15° to 10°	10° to 5°	5° to 0°	0° to 5°	5° to 10°
October. . .	E.S.E.	N.E.	S.S.E.	S.W.	W.S.W.	S.	E.S.E.
November .	N.N.W.	N.N.E.	N.E.	N.E.	W.S.W.	W.S.W.	N.N.E.
December .	N.N.E.	N.N.E.	N.E.	E.N.E.	N.N.W.	W.	W.
January . .	N.E.	N.E.	N.E.	N.E.	N.N.E.	W.	S.
February. .	W.N.W.	W.S.W.	N.E.	N.E.	N.N.E.	W.N.W.	S.W.
March . . .	W.S.W.	N.N.E.	N.E.	N.E.	N.E.	W.N.W.	S.W.
April	S.S.W.	S.S.W.	S.	S.S.E.	S.W.	W.N.W.	S.W.
May	S.S.W.	S.S.W.	S.S.W.	S.W.	S.W.	S.W.	S.E.
June	S.S.W.	S.W.	S.W.	S.W.	S.W.	S.S.E.	S.E.
July	S.S.W.	S.W.	W.S.W.	S.W.	S.S.W.	S.S.W.	S.E.
August. . .	S.S.W.	S.W.	S.W.	S.W.	S.W.	S.	S.E.
September .	S.S.W.	S.S.W.	S.W.	S.W.	S.W.	S.E.	E.S.E.

* CAPPER, "On Winds and Monsoons." See also HORSBURGH: "The S.W. Monsoon (on the western side of Hindostan) sets in earlier on the southern part of the coast than at Bombay, the difference in time being frequently fifteen or twenty days between Cape Comorin and that island." * * * "Between Cape Comorin and Anjenga the S.W. Monsoon or stormy weather from the S.W. may be expected to commence between the 20th and 28th of May, between Mount Dilly and Goa early in June, and at Bombay from the 6th to the 15th of June."

LONDON, James Imray & Son.

31. This general review of the winds of the Indian Ocean may be aptly closed with an extensive abstract from Mr. Meldrum's* excellent paper—**"A Meteorological Journal of the Indian Ocean,** for March, 1853, with a Summary of the Results of the Observations." It is based on observations made at Mauritius, and from information derived from the Logbooks of 30 vessels, whose tracks were across the Indian Ocean during that month.

The space over which these vessels were scattered extended, generally, from 20° N. and 39° S. to 90° E. and 15° E., in a belt from 20° to 30° in longitude, stretching obliquely across the ocean, from the southward of the Cape of Good Hope to the Bay of Bengal.

Very few of the observations were made to the westward of 60° and northward of 15° S., or to the eastward of 75° and southward of 15° S.

With so few and imperfect data it is useless to expect to obtain precise and accurate results respecting almost any of the meteorological phenomena that presented themselves in the space within which the observations were taken; while with regard to other parts of the ocean, the Journal affords no data whatever.

But information far short of absolute correctness may be of no small practical utility, as well as of scientific interest. Observations which are not sufficiently numerous or precise for the complete investigation of a phenomenon may, nevertheless, place its existence beyond all doubt, and afford a rough view of the laws which it obeys. A general knowledge of this sort serves to point out the direction to be given to future observations, each fresh accumulation becoming the basis for another step in advance, till truth is at length fully attained.

The Limits of the S.E. Trade-Wind:—

During the first five or six days of the month the S.E. Trade-wind extended much nearer to the Equator on the eastern than on the western side of the ocean.

If the positions of the vessels, and the direction of the winds, on each of those days be projected on a chart, the equatorial limits will be found to have stretched obliquely across the ocean, from the vicinity of Mauritius to 7° or 8° S. and 85° E.

During the next seven days the equatorial limits gradually receded still further to the southward, on both sides of the ocean, but with nearly the same relative distances from the Equator, till the Trade almost entirely disappeared.

On the 13th, 14th, and 15th, calms prevailed over several hundred miles around Mauritius, the Trade setting in far to the southward and westward of that tract, and appearing also to the northward and eastward of it.

From the 14th to the end of the month the Trade seems to have approached as near to the Equator on the western as on the eastern side of the ocean, but to have blown more strongly and steadily on the latter.

The mean equatorial and polar limits for the month were 11° S. and 29° S. respectively, giving a mean breadth, in latitude, of eighteen degrees.

From the 1st to the 13th the western equatorial limits were, on an average, 19° 20′ S., or about eight degrees more to the south than the mean limits for the month. The mean western polar limits were 29° 17′ S.

The mean eastern equatorial limits for the same time were 11° 24′ S., leaving a

* Charles Meldrum, Esq., M.A., Secretary of the Mauritius Meteorological Society. This work was originally published in the colony, and has since been reprinted by the Board of Trade. Both issues are now scarce.

difference, between them and the western limits, of also eight degrees: the mean eastern polar limits, so far as they can be ascertained, were about 25° S.

From the 12th to the 16th, inclusive, the Trade-wind appeared, on the western side, as far south as 38°; that is, nine degrees beyond the mean polar limits.

After the 16th it gradually receded, till, by the 25th, the polar limits were in the vicinity of Mauritius.

But on the 30th it is again found as far south as Lat. 33° 4′ S.

We thus perceive several distinct vibrations of the Trade-wind in the course of the month on its equatorial and polar borders. The western equatorial limits gradually receded from about 16° S. on the 1st and 2nd, to 26° S. on the 12th, and there seems, upon the whole, to have been, at the same time, a similar contraction of the polar limits, till at length the Trade almost entirely disappeared. It is then found to have suddenly extended both north and south over 18° in the one direction and 18° in the other. After the 16th, again, the polar limits began gradually to recede, till they at length reached the vicinity of Mauritius. And then, on the 30th, they are once more found far to the southward, as if about to undergo a similar contraction.

It would seem that the northern limits approached nearest to the Equator between the meridians of 65° and 75°.

Deflection of the S.E. Trade-Wind to North and N.E. on its Equatorial Borders:—

As a general rule the S.E. Trade, on approaching the Equator, is deflected to N. and N.E., forming a S. and then S.W. wind, which lasts from a few hours to several days, according to the longitude. This is observed on almost every day of the month.

From a comparison of the observations, it appears that this deflection of the S.E. Trade to N. and N.E. takes place to the eastward of 58° E. only, and that the space over which the S.W. wind blows is greater on the eastern than on the western side of the ocean, gradually narrowing from about 86° E. to 60° and 58° E.

The extreme eastern limit for the month is 86° 39′ E., and the extreme western 58° 35′ E., the limits in latitude being 6° 1′ N. and 15° 43′ S.

The mean southern limits are 8° 32′ S., and the mean northern limits 2° 4′ S.

The average breadth in latitude is 5° 16′, and in longitude 16° 4′.

Between the meridians of 75° and 85° the average breadth in latitude is about 10°, but it diminishes towards the meridian of Mauritius.

The prevailing direction is W.S.W., and the mean direction about S.W. by W.

The mean daily force is 2·5.

The wind was lightest from the 1st to the 10th, and strongest from the 21st to the 29th, when it again became light.

Seventy-five observations contributed to the above data.

Deflection of the S.E. Trade to S. and S.W. on its Southern Borders:—

One of the most remarkable features presented by the charts is the constant prevalence of a N.E. wind on the south-western limits of the Trade-wind.

There is hardly a day on which this N.E. wind is not found somewhere between the meridians of 14° and 70° E., blowing in strong gales over an extensive tract.

On the 1st of March we find four vessels, situated between Lat. 34° 46′ S., Long. 44° 50′ E., and Lat. 31° 38′ S., Long. 57° 48′ E., experiencing N.E. and E.N.E. winds in moderate and fresh breezes during the whole day, and no other

wind is observed in that space; while to the northward of it, as far as Lat. 16° 49′ S., Long. 56° 21′ E., the S.E. Trade is blowing strongly and steadily, as shown by observations taken at five different places variously remote from one another.

On the 2nd of March this N.E. wind is still seen in the same locality, blowing in fresh breezes; but it now extends as far north as Lat. 24° 35′ S., Long. 49° 27′ E. Between that point and Lat. 35° 1′ S., Long. 49° E., there were six vessels which had it constantly, and no other wind was observed within the same limits. The S.E. Trade was at the same time blowing a little farther to the north.

These N.E. winds are found on every succeeding day down to the 14th, when they disappear. They gradually advanced towards the east and north, to about Lat. 17° S., Long. 70° E. On the 5th, for example, they stretched from Lat. 22° 37′ S., Long. 57° 9′ E., to Lat. 33° 40′ S., Long. 52° 10′ E., as shown by seven vessels; and on the 6th they extended to Lat. 18° 31′ S., Long. 62° 26′ E. From want of observations, their northern limits on some of the following days are not easily ascertained.

On the 14th they are not seen; the space which was occupied by them is now occupied by the S.E. Trade. But on the 15th one vessel, in Lat. 39° 13′ S., Long. 27° 7′ E., is found with a N.E. wind; and on examining the observations for the following days, this second N.E. wind, like the former, gradually progressed to the eastward, till, by the 29th, it reached at least the 67th meridian. On the last two days of the month it is again encountered far to the westward by seven or eight vessels.

Thus, a N.E. wind on three different occasions is found gradually advancing from the south-western extremity of the ocean to the eastward.

Of these three successive winds or currents from the same quarter, the *first* advanced from Lat. 34° 46′ S., Long. 44° 50′ E., on the 1st, to Lat. 24° 24′ S., Long. 74° 9′ E., on the 10th, giving a range in longitude of 29° 19′;—the *second* from Lat. 39° 13′ S., Long. 27° 7′ E., on the 15th, to Lat. 36° 17′ S., Long. 67° 7′ E., on the 29th, giving a range in longitude of 40°;—and the *third*, which extended from Lat. 38° 50′ S., Long. 21° 50′ E., to Lat. 28° 4′ S., Long. 33° 41′ E., on the 30th, extended from Lat. 28° 55′ S., Long. 33° 37′ E., to Lat. 38° 54′ S., Long. 40° 20′ E., on the 31st, which gives an advance to the eastward of about 7°.

The mean eastern limit of the *first* is 63° 24′ E., and the mean western limit 52° E., so that its mean extent in longitude is 11° 24′. Its mean northern limit is 23° 17′ S., and its mean southern limit 32° 45′ S., giving a mean extent in latitude of 9° 28′.

The mean eastern limit of the *second* is 56° 5′ E.; its mean western limit 42° E.; and its mean longitudinal extent 14° 5′ E. Its mean northern and southern limits are 30° 23′ S. and 38° 40′ S. respectively, and its mean extent in latitude 8° 17′.

The mean limits of the *third* for the two days on which it was observed are 38° 52′ S. to 28° 29′ S., and 23° 47′ E. to 42° 58′ E., showing a mean of 10° 23′ in latitude, and 19° 11′ in longitude.

So far, therefore, as can be judged from these observations (136 in number), the mean extent of this N.E. wind, for the month, is 9° 22′ in latitude, and 14° 13′ in longitude, and the wind which is confined to this average space has a mean range in longitude of at least 35°, it being found to advance from the west towards the east.

Its extreme northern and southern limits are about 18° S. and 39° S., and consequently its range from north to south about 21°.

The prevailing direction of the wind is E.N.E. and N.E., and its mean direction between N.E. and N.E. by E.

Its mean daily force is 5·2.

Connexion between the S.E. Trade and the N.E. Wind, on its Polar Limits :—

On comparing the polar limits of the Trade-wind and the northern limits of the N.E. winds to the southward of them, we find that as the former recede towards the eastward and northward, the latter advance in the same direction. From the 1st to the 11th of the month the polar limits of the Trade became more and more northerly, till they reached Mauritius, or were found even beyond it; and during those days the N.E. wind advanced from 34° or 35° S. to 18° or 19° S. in the same meridians. When, again, the S.E. wind appeared far to the southward and westward, after the 12th, the N.E. wind made its appearance still farther to the westward; and as the Trade receded towards the Equator, till it reached Mauritius a second time, on the 25th, the N.E. wind seems to have followed it. And the commencement of another repetition of the same thing probably occurs on the 30th and 31st, for the S.E. Trade is found at 33° 4′ S. and 53° 21′ E., and the N.E. wind to the westward of it.

The two winds are, on the first seven days of the month, seen so near to each other that the immediate impression is that the one is a continuation of the other; and on examining the logs of the vessels, from day to day, the S.E. Trade is in some cases actually found to have veered to E. and N.E.

I have therefore considered the N.E. wind to be merely a deflection and continuation of the S.E. Trade. It is not quite clear, however, that it is so, for many of the vessels, on losing the S.E. Trade, had calms and variables for at least a few hours previously to their getting the N.E. wind, no gradual veering from S.E. to E. and N.E. having been experienced.

It may be, and there are some indications that seem to favour the supposition, that these N.E. winds are the N.W. Monsoon, which, *having overleaped the intervening S.E.* Trade, makes its reappearance on the surface, and is deflected towards the S.W. by the heated land which lies in that direction.

On the S.W. Wind found to the Southward of the S.E. Trade-Wind :—

The N.E. winds beyond the polar limits of the Trade-wind are invariably accompanied by a current of air moving from the opposite direction, which always makes its appearance to the westward of the N.E. current.

This S.W. wind presents itself on every day of the month, except from the 14th to the 21st, and on the 31st, when (the N.E. wind being far to the westward) the journal does not show whether the S.W. wind appeared still farther to the west or not, as no observations taken to the westward of the 13th meridian were extracted from the log-books. But on every other day, when the N.E. wind extended considerably far to the E., a S.W. wind was constantly found to blow beyond its western limits, and to follow the progression of the N.E. wind to the eastward; and it is probable that, if the observations had a greater extent in longitude, the S.W. wind would be seen on the other days also.

The extreme eastern limit observed is 58° 53′ E., on the 11th, and the extreme western 14° E., on the 8th; so that the range in longitude was at least 44°.

The extreme northern limit observed is 19° 43′ S. on the 8th, and the extreme southern 39° 27′ S., on the 26th; which gives a range in latitude of 19° 44′.

The mean eastern and western limits are 42° 15′ E. and 27° 7′ E. respectively giving a mean extent in longitude of 15° 8′.

The mean northern and southern limits are 28° 48′ S. and 35° 30′ S.; and hence the mean extent in latitude is 6° 42′.

From an average of nearly four daily observations, the mean daily force of the wind appears to have been about 4·8.

The prevailing direction of the wind was S.S.W. and S.W., and the mean direction nearly S.W. Comparing the mean force of the S.W. wind with that of the N.E. wind to the east of it, the latter (5·2) appears to be somewhat greater than the former, but the difference may be owing to the fewness or inaccuracy of the observations.

The mean directions of the two winds seem to have been nearly diametrically opposite.

These S.W. winds, like the N.E. winds to the eastward of them, extend obliquely across the part of the ocean where they prevail, namely, from the southern extremities of Africa towards Cape St. Mary and Mauritius, and sometimes blow over an extensive tract. On the 8th, for example, they extended from the Cape of Good Hope up to Mauritius. To the southward of the 30th parallel they seldom appear farther to the east than the meridian of 48°, their eastern limits being found at their northern extremity, about the meridian of 59°. There is, therefore, a strong presumption that they are caused by the high temperature which prevails at that season of the year in the Islands of Mauritius and Bourbon, and in Madagascar and Southern Africa.

It will be seen, on comparing the limits of the S.E. Trade-wind and that of the N.E. and S.W. winds which prevail to the southward of it, that the changes of position which they undergo are closely related. When the S.E. Trade sets in far to the westward, as on the 14th and 15th, it occupies the whole ocean to the eastward and northward of 30° E., the N.E. and S.W. winds not appearing at all. In a short time, however, the N.E. wind, as on the 16th, makes its appearance to the southward of the 30th parallel, near the meridian of 30°, and the Trade is pushed to the eastward and northward. The N.E. wind then continues to advance, and, by and bye, as on the 21st, the S.W. wind sets in to the westward of it, and the northern and eastern limits of the two daily increase, in proportion as the southern and western limits of the Trade decrease.

Ninety-one observations contributed to the above data.

Direction and Force of the S.E. Trade:—

In order to ascertain, approximately, the mean direction and force of the S.E. Trade, the number of hours during which it blew on each day, from E., E.S.E., S.E., S.S.E., and S., respectively, has been determined; and as each of these winds blew in different parts of the ocean, the point which gives the greatest number of hours is regarded as the point of maximum direction.

It is scarcely necessary to observe that in determining the direction of the S.E. Trade, as well as of the other systems of winds, no allowance is made for magnetic variation.

The prevailing direction of the Trade in March 1853 was S.E.

The mean direction was S. 51° E.

The mean daily force was 3·4.

The point from which the wind blew in greatest force was the east, and in least force the south.

With regard to the Trade, the stormiest days of the month were from the 1st to the 9th, inclusive, and the calmest days the 10th and 23rd.

The easterly winds prevailed to the westward of 60° E.

The Trade blew with greatest steadiness to the eastward of 66° E. and southward of 15° S.

Limits, &c., of the N.W. Monsoon :—

The southern limits of the N.W. Monsoon, during the first fourteen days of the month, stretched obliquely across the ocean from about 17° S. and 46° E. to the Equator, in about 80° E., and thence towards the north of Sumatra.

After the 14th, the mean southern limits were 5° 22′ S.; but they still extended farther to the south on the western than on the eastern side of the ocean.

The northern limits appear to have been to the north of the Equator during the whole month, at least on the eastern side, and to have extended, from the 1st to the 16th, obliquely up to 14° N. and 90° E. In fact, a N.W. wind is found, on almost every day, blowing over the southern part of the Bay of Bengal, from Ceylon to the Straits of Malacca; and I suppose it to be the Monsoon—the vessels situated to the southward and westward of that space having the wind from the same quarter.

On this supposition, the mean northern limits on the east side are 9° 27′ N. and 88° 7′ E.

The mean southern limits on the west are 10° 52′ S. and 58° 33′ E.

The mean extent in latitude appears to be about 12°.

The N.W. Monsoon, on approaching the S.E. Trade, is sometimes deflected to S. and S.W., becoming a N. and N.E. wind.

One hundred and eight observations contributed to these data.

The N.E. Trade-Wind :—

The N.E. Trade seldom appears to the eastward of 66° E., south of 10° N.

On some days, as on the 17th and 18th, it seems to take the place of the N.W. Monsoon, to the eastward of Ceylon. On the 17th, four vessels, from Lat. 7° 51′ N., Long. 89° 27′ E., to Lat. 2° 17′ N., Long. 78° 55′ E., had N. and N.E. winds during the whole day; and this is observed also on the 18th. But, with the exception of these and one or two other days, there are few signs of the N.E. Trade in the Bay of Bengal, or to the eastward of the 66th meridian.

The winds in the northern part of the Bay were generally from N.W. and S.W.

From the 25th to the end of the month a strong S.E. wind prevailed from about 6° N. and 84° E. to 14° N. and 87° E., blowing towards the east coast of India.

To the westward of 66° E. the N.E. Trade was generally found on every day on which vessels made their appearance there, prevailing during the month from 1° 40′ N. to at least 18° N.; but that to the eastward of the meridian of 66° E. the prevailing wind on the north side of the Equator was N.W.

The logs seem to indicate that in the line between the N.E. and N.W. winds, and coinciding more or less with the meridian of 66°, the wind was due north.

With regard to the mean force and direction of the N.E. Trade, the observations are too few to enable one to obtain an approximate value. The former, however, appears to have been 3, and the latter to have been N.E., between 55° and 65° E.

Belts of Calms :—

Although the observations show, upon the whole, the existence of a belt of calms to the north of the equatorial borders of the S.E. Trade, and another to the south of its polar borders, yet they are not sufficiently numerous for determining the exact limits of these belts.

Between the N.E. and S.E. Trades lies the region of the N.W. Monsoon, and also, on the eastern side, the region of the S.W. wind or Monsoon, the limits of which have been given at p. 56.

Now, between the S.E. Trade and N.W. Monsoon, to the westward of 60° E., where the S.W. wind is rarely found, most of the vessels met with calms and light variable airs, which lasted from a few hours to a few days.

Also, to the northward of the Monsoon, and between it and the N.E. Trade, similar calms and variables were found; but it often happened that the Trade gradually veered to N. and N.W., without any calms, the N.W. Monsoon appearing to be merely a continuation of the Trade.

Again, between the S.E. Trade and S.W. Monsoon, on the east side of the ocean, calms were sometimes experienced. Generally, however, the Trade seems to have veered to S. and S.W., without any interruption; but to the northward of the S.W. wind, between it and the N.W. Monsoon, calms and variables were much more frequent.

Calms and variables were also experienced on the polar limits of the S.E. Trade, but it more frequently happened that, though the wind became variable, or shifted, it blew in strong breezes and gales.

Hurricanes and Gales :—

The relative mean forces of the different systems of winds above described were apparently as follows :—

N.E. Trade	3
N.W. Monsoon	3·7
S.W. wind towards the Indian Archipelago . . .	2·5
S.E. Trade	3·4
N.E. wind to the southward of the S.E. Trade . .	5·2
S.W. wind	4·8

It seems, therefore, that the two latter winds are the strongest; that the N.W. Monsoon is stronger than the S.E. Trade, and that the S.W. wind, which blows towards Sumatra, &c., is the weakest.

Again, if the N.W. Monsoon be regarded as a continuation of the N.E. Trade, caused by the combined influence due to the sun's elevation and the heated land of the Indian Archipelago, Australia, &c., it may be said to extend over a greater space than the S.E. Trade, and to put a greater mass of air in motion.

Hence, the Monsoon pushes the S.E. Trade back towards the Tropic. The two opposing winds are in conflict, and the weaker gives way to the stronger; it is therefore in the belt of calms and variables which separates them, that storms and hurricanes are most likely to occur.

Now, the position of this belt is constantly changing. It follows the sun. When the land in the southern hemisphere begins to be heated up by the sun's rays, the N.W. Monsoon begins to set in, and it advances more and more to the southward, in proportion as the heat increases, till, in the month of March, it attains its highest limit, after which it gradually recedes, and at length disappears, the S.E. Trade taking

its place. But although the Monsoon from October to March is, upon the whole, advancing towards the south, and the Trade receding, the two winds fluctuate backward and forward within certain limits, according to temporary fluctuations of temperature, both alternately occupying the same space.

If, then, the hurricanes of the Indian Ocean, as here maintained, occur in one space between the N.W. Monsoon and the S.E. Trade, the localities of these hurricanes should vary according to the season—according to the sun's declination—and observation shows that such is the case. The Monsoon begins to blow in the latter part of October, or in the beginning of November; the hurricane season of the South Indian Ocean begins at the same time; and, in the early part of that season, the hurricanes occur far to the eastward and northward of Mauritius, in the vicinity of the Equator. But as the sun's southern declination increases, they gradually attain higher latitudes, and make their appearance in localities farther to the westward, till at length they come down as far as Mauritius, or even beyond it. In November 1851, for example, a very severe hurricane occurred in 6° to 16° S. and 80° to 90° E., and in March of the same year an equally severe one took place in about 25° S. and 60° E. Now, these storms were the two extremes of a series of gales which took place in intermediate localities, and at intermediate times in the course of the season; and a similar series of storms or gales is, in general, observed annually, the first storm occurring in the early part of the season in the neighbourhood of the Equator, and the last, towards the end of the season, in the neighbourhood of the Tropic; while at a still later period storms occur again, nearer to the Equator, as the sun advances to the north.

In the hurricanes of the South Indian Ocean the wind moves in a circular direction, from west to east by the north, and from east to west by the south, or with the hands of a watch. This is termed their law of rotation. They have at the same time a progressive motion in a course of from about E.N.E. to W.S.W., which is termed their law of progression. Now, the explanation of these laws, about which writers on storms have so widely differed, will, I think, be afforded by an examination of the connexion between the ordinary prevailing winds, as influenced and determined by the action of heat.

The N.W. Monsoon, on approaching the belt of equatorial calms, appears to have, as already remarked, a tendency to veer to N. and N.E., becoming first a N. and then a N.E. wind; and the S.E. Trade, to the eastward of 60° E., veers to S. and S.W., forming a wind, first from south, and then from S.W. These veerings, then, would evidently give rise to a wind rotating according to the law which obtains in the southern hemisphere.

This is the explanation which was given of the law of rotation by Dr. Thom, on hypothetical grounds; and the observations given in the journal show that the two opposing winds, especially the Trade-wind, do actually veer in the manner which he supposed.

I am not aware, however, that any satisfactory explanation has been given of the law of progression. Why is it that the hurricanes of the South Indian Ocean generally travel from E.N.E. to W.S.W.?

This question will, I think, be answered in the course of these researches.

It has already been observed that the N.W. Monsoon extended farther to the south on the western than on the eastern side of the ocean. Its southern limits, during the first half of the month, stretched obliquely from about 17° S. and 46° E. up to

the Equator in 80° E. or 85° E.; and the northern limits of the S.E. Trade extended at the same time from 20° S. and 50° E. to 11° S. and 80° or 85° E., where it was deflected towards the N.E., forming a S.W. wind.

Between the two opposite systems of winds is the belt of calms and variables.

Now, if the hurricanes of the South Indian Ocean take place on the borders of the Monsoon and of the S.E. Trade—and it appears certain that they generally do so—it is manifest that a storm originating near the Equator in about 85° E. would, if it progressed at all, move along the belt of calms which separates the two winds. But the position of the belt of calms is determined by the limits of the Trade and Monsoon, which extended during a considerable part of the month from the vicinity of the Equator, in 85° E., down towards Mauritius; and that is exactly the course which hurricanes generally take at that season of the year.

The position of the belt of calms is indicated in CHART DIAGRAM V. On the one side of it is represented the region of the S.E Trade, and on the other that of the N.W. Monsoon. The Trade on nearing the Equator is deflected towards Sumatra, &c., forming a S.W. Monsoon. Now, it often happens that the N.W. Monsoon, in veering to N. and N.E., penetrates into this S.W. wind, while, somewhat farther to the westward, the S.W. wind still pursues its course; and it is easily conceived how a rotatory wind may thus be generated. I have therefore represented the supposed formation of a circular gale in this manner, where the belt of calms crosses the Equator, and it is more than probable that, if such a gale had actually been formed there, it would, if it did not remain stationary, move along the belt of calms.

The journal shows distinctly that the Monsoon and Trade, and consequently the belt of calms between them, had, during a considerable portion of the month, the relative positions assigned to them in the chart, and it is these relative positions that determine the usual tracks of hurricanes.*

Some writers often speak of the hurricanes of the South Indian Ocean as passing down across the Trade, and have recourse to extraordinary causes to account for the supposed phenomenon. But it does not follow, that because hurricanes may originate about 8° or 9° S. and 80° or 85° E., and come down towards Mauritius, they travel through or across the Trade. They do not pass through the Trade, but along its equatorial edge, which, in the hurricane season, often extends considerably further to the southward on the western than on the eastern side of the ocean, as shown by the journal, and represented in CHART DIAGRAM V.

If the usual tracks of hurricanes coincide with the equatorial limits of the Monsoon and Trade, it is plain that the cause or agent which determines the one will also determine the other; that is, that whatever causes the N.W. Monsoon to extend to Mauritius, or beyond it, also determines the hurricane tracks.

What is it, then, that gives rise to the N.W. Monsoon? and why does it extend so far to the southward in the meridians of 50° and 60°?

The answers to these questions are furnished by considering the distribution of the land and the influence of solar heat. The Monsoon is caused by the increase of temperature which takes place in the summer months of the southern hemisphere in Australia, Madagascar, and Southern Africa; its equatorial limits being deter-

* The edges of the calm belt, and of the Trades and Monsoons, are sharper in CHART DIAGRAM V. than they are in nature—where they are irregular, jagged, or waving and indented. The chart gives merely the average limits.

mined by the positions of localities in which the temperature attains its highest elevation in different parts of the ocean, from eastward to westward. In other words, the belt of calms, or of maximum temperature, in the Indian Ocean is drawn to the southward by the influence of the heated land, as well as by the direct action of the sun. If there were no land at all, the maximum isotherm would extend due east and west, in a parallel corresponding to the sun's declination; but the heated land on either side of the ocean causes the zone of maximum temperature to extend farther to the southward, along its whole extent, than it would have done in the absence of that land, and to attain a still higher latitude towards the coast of Africa, where the heat is greatest; and hence the oblique position of the equatorial edges of the Monsoon and Trade, and of the belt of calms, or tracks usually followed by hurricanes.

If it be asked why these hurricanes travel from E.N.E. to W.S.W., and not in the contrary direction, it may be answered, that they travel towards the westward because the temperature is more elevated on the African side of the ocean, and because the N.W. Monsoon, which is, upon the whole, stronger than the S.E. Trade, impinges upon the N.E. quadrant of the storm with a force greater than that with which the Trade impinges upon the S.W. quadrant.

With regard to the continued action of the storm for several days in succession, it may be inferred that, if it is originally set in motion by the Trade and Monsoon, the same forces may keep it in motion; for, in progressing towards the westward, the Trade and Monsoon still continue to act as at first. It is not necessary to suppose that the Monsoon moves down, sideways, from 10° S. and 85° E. to Mauritius, in proportion as the storm advances. The equatorial edge of the Monsoon may have had a slanting direction across the ocean before the storm commenced, and also during the whole time it lasted; the motive power, instead of requiring to be renewed, at each successive step, residing in the Monsoon itself, along the whole extent of its southern limits. But even if it were necessary to suppose that the Monsoon did advance sideways to the southward and westward, according as the hurricane moved in the same direction, this would only show that an elevation of temperature had taken place in the direction of Mauritius and Madagascar, which caused the Monsoon to extend to the southward and westward, pushing the Trade back towards the Tropic, and thus producing a storm or hurricane.

The object of these remarks is simply to direct attention to what the journal indicates, viz., that the localities of the hurricanes of the South Indian Ocean, and their laws of rotation and progression depend upon the observed relative strength, positions, and veerings of the Trade and Monsoon, and upon the known effects of heat. Whether or not they observe in other respects that precision and regularity which have been ascribed to them by writers on the subject is a question the consideration of which must be deferred to another occasion. It is not impossible that further investigation will show that they are not quite so regular in their movements as some suppose, and that several of the views entertained respecting them have been put forward rather prematurely.

Besides the position of the belt of calms, and the regions of the N.W. Monsoon and S.E. Trade, Chart Diagram V. represents the deflection of the Trade towards Sumatra, forming the S.W. Monsoon referred to at p. 56. It also shows the N.E. and S.W. winds which prevailed to the southward of Mauritius and Madagascar, with the supposed formation of a circular gale between them; and, on

the north side of the Equator, the N.E. Trade is seen to the westward of 65° E., while to the eastward of that meridian the prevailing winds, north of the 10th parallel, are N.W. and S.W.

The various systems of winds represented in the chart are explained by the effects of heat. The S.W. wind towards Sumatra is caused by the heat which prevails there at that season of the year; and a similar cause will account for the S.W. Monsoon, which blows up towards the southern coasts of Africa, Madagascar, and Mauritius. This influence of heated adjacent land seems to be exemplified in the case of the N.E. Trade. So far as the observations which were made in that part of the ocean go, it would appear that, while the wind blows from the N.E. towards Africa, it blows towards the coast of India chiefly from N.W., its direction in about 65° E., being north or intermediate.

The chart and journal seem to indicate that the N.W. Monsoon is a continuation of the N.E. Trade, and the S.W. Monsoon, toward Sumatra, a continuation of the S.E. Trade. Is not the S.W. Monsoon of the northern hemisphere, from April to October, also a continuation of the S.E. Trade? If the N.W. Monsoon is not caused by a deflection and prolongation of the N.E. Trade, and the S.W. Monsoon by a similar deflection and prolongation of the S.E. Trade, whence comes the air that feeds them? When the N.W. Monsoon of the southern hemisphere prevails, the N.E. Trade is found blowing to the vicinity of the Equator, and a little beyond it are the northern limits of the Monsoon. Whence, then, is the air which sustains the Monsoon derived, unless from the N.E. Trade which prevails in its immediate vicinity, and has, like itself, a southerly course? Similarly, when the S.W. Monsoon prevails in the northern hemisphere, the S.E. Trade blows down to the Equator, or beyond it, and the southern limits of the Monsoon are in the immediate neighbourhood of the northern limits of the Trade, both winds moving in a northerly direction. The S.W. Monsoon sets in at Ceylon and on the southern shores of India in the early part of April, and it gradually advances to the northward, reaching Bombay about the 15th of May, and places farther to the north at later dates, it being caused by the rarefaction which takes place over the extensive plains and deserts of Asia as the sun's meridian altitude increases. Now, whence does this great rush of air proceed unless from the S.E. Trade? The Trade blows in greater force in the winter of the southern hemisphere, in consequence of the elevated temperature which prevails to the north of the Equator, and after passing over into the northern hemisphere it is deflected to the N.E., and blows like the S.W. Monsoon near Sumatra, towards the localities of maximum heat.

As the Monsoon progresses to the northward the N.E. Trade recedes before it, or rather, the Trade on reaching the line of maximum temperature is rarefied and ascends. Thus, between the two opposite winds there is a zone of calms and variables, analogous to that between the S.E. Trade and N.W. Monsoon in the southern hemisphere; and theory would lead us to infer that this zone, also, is the scene of storms and hurricanes, which in the Bay of Bengal, and in the China Seas, revolve in a direction contrary to that of the hurricanes of the southern hemisphere, and have a progressive motion from E.S.E. to W.N.W.; for the heated land of Asia lying to the west of those seas, the belt of calms and variables in them would extend toward the land in the direction indicated; and the Monsoon being stronger than the Trade, and impinging on the S.E. quadrant of the storm, the latter would be impelled towards

the W.N.W., whither the elevated temperature in that direction would also have a tendency to draw it. In short, the great agent in the production both of the ordinary winds and of their stormy gyrations seems to be *Heat*.

It does not appear that any hurricane was experienced on the south side of the Equator during this month (March 1853), but gales were of frequent occurrence between the Cape of Good Hope and the parallel of Mauritius, as far as 65° or 70° E. These gales generally took place between the S.W. and N.E. currents of air which prevailed in that part of the ocean. On some days, also, the N.W. Monsoon in coming down towards the 20th parallel seems to have veered to N. and N.E.; and the S.E. Trade blowing at the same time to the southward of Mauritius, and the S.W. Monsoon of the Cape blowing towards Madagascar, a circular wind of great extent was occasionally formed.

These two systems of winds which we have been considering are, apparently, caused by the action of heat on the atmosphere of Southern Africa, Madagascar, and the Islands of Bourbon and Mauritius. If, for example, we suppose the zone of maximum temperature to be in or near the southern parts of Madagascar, we should infer that currents of air would flow thither from all sides, viz., a S.W. current from the southward of the Cape of Good Hope, a S.E. current from the Indian Ocean, east of 45° E., a N.E. current from Mauritius, and a N.W. current from the Mozambique Channel. Now, such currents are actually found in those parts, but the zone of maximum heat is constantly varying: it may on one day be several degrees farther to the east or the north, and on another as many degrees farther to the west or south, and hence the confines of the aerial currents flowing towards it are subject to fluctuation.*

At the commencement of the month we find a S.E. wind (the Trade) flowing towards the south end of Madagascar; but a little to the southward of this S.E. wind is found a N.E. wind; and in the same parallels with this N.E. wind, but considerably far to the westward, a S.W. wind prevails. The S.E. wind, however, gradually disappears, being replaced by the N.E. wind, which ultimately extends as far north as Mauritius and as far east as 70° or even 75°, the S.W. wind still appearing in the same parallels to the westward. On the 8th, for example, the N.E. wind is observed extending from 21° 10′ S. and 65° 55′ E. to 33° 21′ S. and 52° 46′ E., a distance of 700 miles, over which it is blowing in strong breezes and gales; and it is probable that it extended still farther south. The S.W. wind, at the same time, extends from 35° 3′ S. and 20° 4′ E. to 19° 43′ S. and 58° 9′ E., a distance of nearly 900 miles.

These two winds (the N.E. and S.W.) seem to have attained their maximum force on the 7th, when a heavy gale was blowing from 19° 44′ S. to 36° 2′ S., and from 44° 3′ E. to 68° 48′ E. And it is remarkable that on that day there was scarcely a breath of air in motion at Mauritius, though a strong gale was raging in its immediate vicinity. Yet, calm though the weather was, there were unmistakeable signs of what was occurring in the neighbourhood. The barometer, at 3½ p.m. of the 6th, stood at 29·615 (the minimum pressure for the year), to which it gradually fell from 29·848 on the 3rd, on which day the gale was felt most at 34° 51′ S. and 48° 45′ E. On the 8th the barometer at the same hour stood at 29·621; the sky during the day was overcast and lowering, the sea sending in breakers on the reefs, and at 2 p.m.

* The N.E. wind, however, appears upon the whole to proceed from warmer to colder latitudes, which may be owing to a disturbance of the atmospheric equilibrium caused on the south-east coasts of Africa by the air being removed thence by the S.W. wind.

there was thunder at north. About 120 miles to the east of the island a gale was blowing from E.S.E., the ship's barometer standing at 29·66; and about 56 miles to the S.W. of it the same gale was blowing from E.N.E.; while in the island itself the atmosphere was perfectly tranquil. On the 6th, however, the wind was E.S.E., in moderate breezes, with a falling barometer.

We here find that though the wind was E.S.E. at Mauritius (on the 6th), and the barometer low and falling, yet there was no hurricane, nor any sign of one, to the northward of the island. The bad weather was in the very opposite direction, to the southward. Yet, how often has it not been announced, with confidence, that because the barometer was falling at Port Louis, with a S.E. or E.S.E. wind, a hurricane was bearing down upon the island from E.N.E.?

As the northern limits of the N.E. wind go on extending, the S.E. Trade seems to run into it. This is exemplified on the 8th, when, in the case above cited, the wind was E.S.E. at 19° 44′ S. and 59° 14′ E., and E.N.E. at 20° 58′ S. and 56° 48′ E., and various other instances might be adduced; I shall, however, give only one other.

When, on the 7th, the wind was E.S.E., with a falling barometer, and other indications of bad weather, Captain Harold, of the *Fanny Fisher*, in 25° S. and 78° E., trusting to what is called the Law of Storms, evidently thought that he was in the "dangerous quadrant" of a hurricane or gale, the centre of which bore N.N.E of the vessel's position.

Now, there is no evidence of there having been bad weather in that direction, but we have, on the other hand, positive proof that a strong gale was prevailing to the westward.

It is recommended by cyclonologists that when a vessel has the wind at any point between E. and S.S.E., with a low barometer and other "premonitory signs," her commander should, if possible, pass in front of the storm which is considered to be bearing down upon him from the north-eastward; that is, that he should steer to the W. or W.N.W. But in the present case it seems certain, that by steering W. the vessel would have run into the very heart of the gale.

On the 9th the wind, after having been at E.S.E. and S.E. for four days, "gradually veered to E.N.E.," the barometer rising from 29·35 at 2 A.M. to 29·60 at 8 A.M.

Here, according to the Law of Storms, we should infer that the centre of the gale or hurricane had passed to the northward of the vessel's position, and that it now bore N.N.W. of her. But of this, also, we have no evidence; while it is certain that a strong gale still prevailed to the westward; and, moreover, the veering of the wind from S.E. and E.S.E. to E.N.E. is precisely what had occurred on the preceding days to vessels situated to the *west* of the vessel in question.

We have no proof whatever, but the very contrary, that the gale was bearing down upon the *Fanny Fisher* from the north-eastward, and yet her intelligent commander was perfectly justified in supposing that it was; for, with the wind and weather which he had, and a falling barometer, a cyclonologist would have assured him that he was in the "dangerous quadrant" of a revolving storm.

These remarks are not made with the view of casting doubt upon the general theory of storms, which I think is, in the main, unassailable, but of pointing out the danger of laying down dogmatic rules for the guidance of vessels in the circumstances in which the *Fanny Fisher* was placed. Commanders who have acted

according to such rules have, in some cases, proclaimed the Law of Storms to be without any foundation, because the very reverse of what was expected has turned out.

The great practical importance of a knowledge of these N.E. and S.W. winds which have now been briefly passed in review, and of the revolving gales which seem to be formed on their borders, is so palpable as to require no notice here. The advantages which the former wind offers to vessels sailing from India, Ceylon, Mauritius, and the East generally, towards the Cape of Good Hope, and the similar advantages afforded by the S.W. wind to vessels steering on an opposite course, are manifest to every one.

Pressure and Temperature of the Air :—

The number of observations made with the barometer in the course of the month is 343, and with the thermometer 267, which gives a daily average of 11 of the former and of 8 to 9 of the latter.

The greatest altitude of the barometer was observed on the days and at the localities subjoined :—

30·20, on the 14th, in 38° 46′ S. & 26° 0′ E.
30·24, on the 19th, in 23° 27′ S. & 54° 25′ E.
30·24, on the 20th, in 25° 56′ S. & 52° 40′ E.
30·25, on the 30th, in 37° 0′ S. & 28° 5′ E.
30·25, on the 31st, in 33° 4′ S. & 53° 31′ E.

It stood lowest at the following localities :—

29·615, at 3½ P.M. of the 6th, at Port Louis.
29·66, on the 7th, in 19° 44′ S. and 59° 14′ E.
29·66, at 9½ A.M. of 7th, at Port Louis.
29·65, at 3½ P.M. of 8th, at Port Louis.
29·60, at 4 P.M. of 8th, in 24° 52′ S. & 77° 17′ E.
29·35, at 2 A.M. of 9th, in 24° 59′ S. & 76° 59′ E.
29·55, on the 9th, in 35° 10′ S. & 21° 4′ E.
29·60, on the 21st, in 33° 57′ S. & 25° 39′ E.
29·64, on the 25th, in 36° 30′ S. & 46° 6′ E.
29·60, on the 29th, in 37° 7′ S. & 48° 12′ E.
29·55, on the 29th, in 39° 3′ S. & 32° 55′ E.
29·60, on the 30th, in 38° 50′ S. & 21° 50′ E.
29·50, on the 31st, in 38° 30′ S. & 25° 45′ E.

The highest temperature was observed on the 1st, in 12° 20′ S. and 75° 5′ E., and on the 15th, in 15° 9′ S. and 88° 56′ E., the thermometer on both occasions standing at 91°.

The lowest temperature was observed on the 26th, in 36° 37′ S. and 10° 52′ E., where the thermometer was at 59°.

In consequence of the fewness of the observations, and of the instruments not having been verified by common standards of comparison, no definite results, with regard to the pressure and temperature of the atmosphere in different parts of the ocean can be obtained. I have, however, after rejecting the observations made with instruments which were evidently too high or too low set, taken the means of the

remaining observations for each square of 10 degrees, and exhibited the results on Chart Diagram V.

It will be seen that, upon the whole, the zone of maximum temperature extends from the Equator in about 90° E. to the north end of Madagascar, and that the barometer stands highest in the vicinity of the Tropic and in the region of the N.E. Trade, and lowest from Mauritius to the north of Madagascar.

That the pressure was so great in the district of the N.E. Trade as is represented may, however, be doubted, for the observations were made by only one vessel, and her barometer, though a subtractive correction of ·015 was made, may have still been too high. The general results, also, are doubtless somewhat different from what they would have been even with the same instruments if the observations had been made in the different squares on the same days, instead of at different periods of the month.

The difference between the temperature of the air south of Cape Colony and in the neighbourhood of Mauritius accounts for the S.W. Monsoon, which blows from the former to the latter locality; but the counter N.E. current of air does not admit of a similar explanation, for it flows from warmer to colder latitudes. The probability is, therefore, that it moves southward, to preserve the equilibrium which would otherwise be disturbed by the constant withdrawal of air from those parts by the S.W. wind. On this supposition the two currents are owing to the influence of heat, the S.W. directly, and the N.E. indirectly.

Most of the observations made south of the 30th parallel show that the barometer is subject there to great fluctuation. But, with regard to this and many other subjects of inquiry, a far greater number of barometric and thermometric observations made with instruments compared with common standards and with one another are required.

The observations show that the swell and heavy sea depend upon the strength and direction of the winds. The sea appears to have been agitated most on the 7th, 11th, 29th, and 30th, and also on the 5th, 6th, 8th, 9th, 21st, 24th, 25th, 26th, 27th, and 28th, when the wind blew in strong gales; and to have been least agitated from the 13th to the 20th, when the African S.W. Monsoon did not appear, and no rotatory gales occurred in that part of the ocean.

The direction of the swell and heavy sea seem to be determined by the direction of the wind, though the directions of the wind and swell are frequently different at the same locality, the swell in that case being caused by a stronger wind in another quarter. This is exemplified in the case of vessels approaching the equatorial limits of the S.E. Trade, where a swell from S.E. is generally experienced, though the wind may be coming from a different direction. Most of the instances of a S.E. swell were owing to this cause, and the other directions of the swell were owing to similar causes. On the 11th, for example, a vessel in 8° 28′ S. and 65° 58′ E. had a swell from S.S.W., the wind being from N.W.; but on that and previous days a S.W. wind extended from the southern coasts of Africa to at least Mauritius; and it is probable that it was the swell caused by this wind which the vessel in question experienced. In circular gales, also, the directions of the wind and swell are often different. On the 23rd, for instance, a vessel in 38° 11′ S. and 27° 54′ E. had a heavy sea from N., while the wind was strong from S.S.W.; but a N.E. gale had recently passed over or near that locality. On the 28th, in 36° 6′ S. and 46° 8′ E., a heavy swell set in from N.W. at midnight, the wind being strong from N.E.

Rain:—

The rainiest days were from the 1st to the 9th inclusive, especially the 1st, 2nd, and 3rd, and also from the 23rd to the end of the month; and these were the days on which gales were prevalent. Very little rain fell from the 10th to the 18th, when the wind was generally light, and calms frequent.

There were, generally speaking, two regions of aqueous precipitation, viz., the equatorial borders of the S.E. Trade, and the region of the N.E. wind to the southward of Mauritius.

The district of the N.W. Monsoon was almost rainless, condensation taking place only on its limits.

The S.W. Monsoon, which blows towards Madagascar and Mauritius, also appears to be a dry wind. In the circular gales which took place between it and the N.E. wind rain fell abundantly on the east side of the gale, where the wind was N.W., N., and N.E., but on the west side, where the S.W. wind prevailed, the weather was generally fine.

It is apparently to the vibration of the northern limits of the S.E. Trade, and of the belt of calms, that the Indian Ocean owes its rainy season, which at Mauritius usually commences in the latter end of December, when the Trade arrives there loaded with moisture. The rainy season of Sumatra, it may be presumed, sets in when its S.W. Monsoon, which is but a continuation of the S.E. Trade, reaches it, depositing moisture on meeting the high lands, as the S.W. Monsoon of India on arriving at the Western Ghauts.

Thunder and Lightning:—

In the course of the month thunder was heard, or lightning seen, on 41 different occasions.

The distribution of these 41 observations, as regards the regions of the different systems of winds, was as follows:—

Region of the N.W. Monsoon	.....	No. of Obs.	14
„ „ N.E. wind to the southward of Mauritius		„ „	12
„ „ S.W. Monsoon towards Sumatra	.....	„ „	3
„ „ S.E. Trade	.....	„ „	3
Calms and variables	.....	„ „	5

The remaining 4 observations were made south of 30° S., the wind being from the N.W. quadrant.

No lightning was observed in the region of the S.W. wind to the southward of Mauritius, or in that of the N.E. Trade.

Frequent electrical discharges occurred in the vicinity of the Equator, about 80° E., from the 3rd to the 8th inclusive, when, as has been seen above, heavy gales prevailed to the southward; and much lightning was observed also on the 20th, 21st, and 22nd, when a second series of gales was commencing near the southern promontory of Africa.

It is very desirable that Mr. Meldrum should, in the interest of navigation, discuss the meteorological phenomena of the Indian Ocean for every month in the year in a manner similar to the foregoing very able paper (pp. 53-68).

CHAPTER IV.

WINDS ALONG THE COAST OF THE INDIAN OCEAN.

32. South Coast of Africa.—Speaking in general terms, S.E. winds prevail from September to May; should these rise to a gale they follow the trend of the coast, blowing S.E. by E. to the eastward of Cape Agulhas, and S.S.E. in False Bay. Such a gale may last for three or four days, after which it is succeeded by calms and light westerly winds, but as regards strength these S.E. gales are only local, for while ships have been driven from their anchors in one port, at another the wind from the same direction has been only moderate.

From May to September the prevalent winds are from the westward, which very frequently rise to gales, especially in June, July, and August, when they are very strong; beginning at W. they veer to N.W. and N., then going back to W. may eventually blow up fine at S.W. Should the wind, when veering, shift to N.E. or N.W., with lightning, hard squalls and general bad weather may be expected. Hard gales frequently commence very suddenly in these regions, and it must always be borne in mind that in the southern hemisphere the barometer stands lower with northerly than with southerly winds.

Westerly winds and gales may occur at any season of the year, but are most prevalent in the months stated above, although they are also *occasionally* experienced with some severity in September, October, and April.

33. Table Bay.—From October to April (summer) the prevalent winds are from S. and E., generally S. by E. to S.S.E.; these frequently rise to a very severe gale, known as the *south-easter*, and may generally be expected in January, February, and March, though one of them may occur in any month of the year, and its sure precursor is the white cloud (table-cloth or cap) on Table Mountain; when there is no cloud on the mountain the south-easter is more moderate.

The *black south-easter*, generally from S.S.W., differs from the preceding by the *nimbus*, or rain tint, of a canopy of cloud on the mountain, and is usually accompanied with light rain.

From May to September (winter) winds from N. to W. are prevalent. With the regular N. and N.N.W. gales of this period, which are very strong and not unfrequently disastrous, a mountainous sea rolls into the bay, requiring the very best ground-tackle; the first indication of a *north-wester* is the appearance of a mass of condensed vapour rolling over the Lion Hill, and enveloping the signal station; there is also a damp chilliness in the air. These N.W. gales may spring up in any month of the year, but seldom blow home from November to May; their duration fluctuates between two days and a week. Strong W. and S.W. winds, with fog, hail, and general cloudy weather, are also frequent during this season. Winds from the N.E. quarter are only occasionally experienced, and rarely last.*

34. False Bay and Simon's Bay.—S.E. winds prevail here from October to April; when they rise to a gale they blow at about S.S.E. ½ E. and fre-

* Sir T. Maclear. Also, for fuller particulars respecting Table Bay, see W. H. Rosser's "South Atlantic," pp. 43–47, published by Messrs. Imray and Son.

quently last from three days to a week; when they moderate they are followed by light variable airs from the land. Muysenberg *capped* with white cloud indicates the approach of these south-easters, which will probably be very violent if the Hottentot Holland range (east of False Bay) is also capped; when the barometer stands at 30·2 to 30·3, and falls suddenly to 30 or 29·95 inches, in nine cases out of ten a strong S.S.E. gale will blow.

From May to September strong N.W. winds are very frequent, but gales from this quarter may occur at any season, although not with such likelihood during the period of the south-easters. Winds from the N.E. are rare. The *kloof*, or S.W. wind, is cold and rainy.

35. Mossel Bay.—The heaviest gales during the year are from the W.N.W.—*i.e.*, off the shore, hence vessels ride in security. Winter gales, May to August, commence from the N.N.W. with heavy gusts, unsteady both in direction and force, then veering to W.N.W. or W. they blow very hard and continuously, with a low barometer (29·6 inches), finally shifting rather suddenly to the S.W., when they subside with steady breezes and occasional showers. At this latter period a swell sometimes sets round the bay, but nothing to cause apprehension for the safety of vessels, nor to interfere with landing.

In the summer months, September to April, strong breezes from the S.E. recur at intervals, bringing into the bay a heavy break of sea; these, however, seldom continue thirty hours, and vessels with good ground-tackle have nothing to fear. Moderate S.W. winds at this season of the year are also very common.

36. Algoa Bay.—The wind and weather here is the same as appertains to the South African coast in general; the S.E. and easterly gales, common to the summer, are the only winds to be apprehended in this bay, and of them due notice is generally given by the aspect of the sky and by the barometer.

37. Port Natal.—Winds between S. and E. are more or less prevalent throughout the year; more rain falls from October to February than at any other time of the year; when the weather is very fine N.E. winds are not uncommon; W., S.S.W., and N.W. winds are also prevalent during the dry weather.

At a short distance inland (at Ekukanyeni and Maritzburg) the following observations have been made on the winds in 1858 and 1859:—

April to September, at 9 A.M.:—N. 17½ days; N.E. 14; E. 26½; S.E. 20; S. 20; S.W. 25; W. 25½; N.W. 29; calm 5½ days.

At 3 P.M.:—N. 10 days; N.E. 11½; E. 70½; S.E. 59½; S. 10; S.W. 3½; W. 4; N.W. 13½; calm ½ day.

September to April, at 9 A.M.:—N. 16 days; N.E. 17; E. 40; S.E. 29½; S. 26; S.W. 15; W. 12; N.W. 25½; calm 1 day.

At 3 P.M.:—N. 6 days; N.E. 9½; E. 63; S.E. 70½; S. 12½; S.W. 4½; W. 2; N.W. 14 days; calm 0.

Dr. Mann also makes the following observations on the same subject:—

"During the ninety days of the summer season the wind was blowing from the E. or from the S.E. forty times at nine in the morning, sixty-seven times at three in the afternoon, and forty-nine times at nine in the evening. The sky very fre-

quently bears the precise aspect of the Trade-wind sky during this season. During the summer the S.E. Trade-wind, in all probability, affects in a measure the South African region, becoming at the same time partially a Monsoon, on account of the N.E. and S.W. trending of the coast of the vast continent, and being also frequently broken for short intervals by disturbing influences dependent on the irregular heating of the land. The capricious and wet season which accompanies the advent of the summer bears very much the appearance of holding some connexion with the calm-belt of Capricorn, which serves as an outskirt to the region of the Trades, and which sweeps backwards and forwards over the earth's surface, with this region, as it follows the southing or northing of the sun. There is no doubt that the calm-belt of Capricorn extends further south than the parallel of Natal, in both the Atlantic and Indian Oceans, during the summer of the southern hemisphere, and that it is encountered to the north of that parallel in the winter of the same hemisphere."

38. Delagoa Bay.—The rainy season lasts from September to March, but it is quite as often fine as wet; after a strong E.N.E. sea breeze, alternating with light land winds at night, the rain sets in with S. and S.W. winds. At this season a gale of thirty or forty hours' duration is not uncommon, which ceases with fine weather, and the wind at S.E.

Winds from W. to S. always bring bad weather, which clears up as soon as it hauls to eastward.

39. African Coast from Cape Corrientes to the Equator, with the Mozambique Channel.—The seasons here are very uncertain: the so-called N.E. Monsoon, variable between N.E. and N.W., is the ordinary wind from November to April; this is the rainy season. From May to October, during the fine season, the prevailing winds are from S.S.E. to S.S.W. The regular land and sea breezes are very persistent. In the vicinity of the Comoro islands the N.E. winds (as determined by numerous observations) set in about the middle or end of December, a fortnight later than at Zanzibar. The southerly Monsoon blows at S.S.E. between Europa island and Mozambique. In the area comprised between Mozambique, Cape Delgado and the Comoro islands, this Monsoon is variable between S.S.E. and S.W., but blows more from the S. as it approaches Zanzibar.

At the southern entrance to the Mozambique Channel southerly winds from beyond the Tropics often produce a strong wind and heavy sea; and when this amounts to a gale it will very commonly penetrate far to the northward into the region of the northerly Monsoon, which it displaces for a time.

The Mozambique Channel is subjected at times to very hard gales and severe weather, though it generally escapes the hurricanes of the Southern Indian Ocean. (See also pp. 25, 26.)

40. Zanzibar.—From the middle of December to the middle of March the wind blows from the north-eastward, and for the first two months with considerable force—varying, however, from E.N.E. to E.S.E. towards the end of the season. When the Monsoon changes, towards the end of March, heavy squalls from S.W. and W. are very frequent, with a copious rainfall; during the remainder of the year (eight months) the prevalent winds are from S. and E. The heaviest rains fall in March, April, and May; the second rainy reason is in September and

October. The temperature does not vary much, but it is rarely oppressive, owing to the general prevalence of fresh breezes from seaward. January, February, and March are the hottest months; July, August, and September, the coolest. The climate is not so unhealthy as has been often reported; but under all circumstances avoid sleeping in the open air, and near the jungle.

41. Equator to Cape Guardafui (Ras Asir).—The S.W. Monsoon—variable between W.N.W. and S.W.—from March to October. The N.E. Monsoon from October to March, but it is rarely strong near the coast.

From October to January the winds are very variable, not unfrequently veering all round the compass; the prevailing N. wind brings rain, at times in great quantities. From January to May the wind is commonly fresh from N.E. to N.N.E., with fine weather; but after March it varies to S.W., bringing bad weather in the vicinity of Cape Guardafui.

From May to October southerly winds are prevalent; occasional calms are, however, to be expected near the coast during July, August, and September, although it may be blowing strong at sea.

In the immediate vicinity of Cape Guardafui, owing to its peculiar prominent position, general bad weather and heavy squalls are of common occurrence during July, August, and September, although at the distance of thirty leagues there may be fine weather and a smooth sea.

Land and sea breezes are prevalent and fresh along this part of Africa during February and March, and again in October; these months separate the Monsoon seasons.

42. East Coast of Madagascar.—Respecting Madagascar, a memoir was read to the Royal Geographical Society in 1849, from J. A. Lloyd, Esq., F.R.S., F.R.G.S., Surveyor-General of Mauritius. From this report it appears that "there are two distinct seasons on the eastern coast of the island: the first, called by Europeans the *fine* season, begins in May, and terminates towards the middle of October. The heat is moderate; strong breezes from the S. and S.E. blow during the day, and from the S. to S.W. after sunset, which renew the air and dissipate the effluvia of the stagnant waters. The appearance of the country during this period of the year is delightful to an extreme, and the provinces of the interior especially are most healthy and salubrious.

"The second, or *bad* season, begins towards the end of October, and continues until April. The hottest and most unhealthy weather happens in January, February, and March. Storms of thunder and floods of rain inundate the country during this period. The wind is calm, or blows lightly from the N.E. during the day, and from the N. to N.W. during the night. It is in this season that the influence of the intense heat upon the animal and vegetable substances washed down by the floods breeds infectious and deadly vapours.

"*On the N.W. coast* the N.E. Trade-wind blows without intermission from October to April. During the remaining part of the year it varies from S. to W. from noon to night; it then shifts by S. to E., and remains in the latter quarter the next forenoon.

"The temperature of the interior is much cooler than that of the sea-shore, the

thermometer in summer (October to May) rising to 85° Fahr., and in winter falling as low as 40° Fahr."*

Respecting that part of the east coast of Madagascar south of Lat. 18° S., it has been observed,† that the N.E. Monsoon, variable to N.N.E., prevails from November to April; the S.E. Monsoon, variable to S. and S.S.W., and which brings the fine or dry season, occupies the remainder of the year. But north of the parallel of 18° S. —comprising Fong Island, Tamatave, Foul Point, Mahambo, Fenerive, St. Mary Island, and Tintingue—S. and S.S.W. winds, generally fresh, are prevalent from March to the beginning of September. During September the winds haul to N.E. and N., alternating at times with southerly breezes; when the former succeed the latter they frequently blow strong for two or three days, after which they subside and gradually veer again to S. This succession of winds continues until the N.E. Monsoon is fully established. Land and sea breezes begin in September; the land breeze, always very light, sets in at 10 or 11 P.M., lasting till 9 or 10 A.M.; after a calm of an hour or two the sea breeze begins and lasts the remainder of the day; the land breeze does not extend seaward to a greater distance than 9 or 10 miles.

From the middle of April to the middle of June the E. and E.S.E. winds seldom or never bring rain; in November, and while the winds are veering to the northward, stormy weather may be expected,—sometimes, however, not beginning before December; then, towards 3 P.M., the sky is generally overcast, and an evening seldom passes without rain; this lasts till April—it is also the hottest period of the year. A second rainy season occurs from the middle of June to the middle of July or August. The winds are generally fresh during the rainy season, and produce at times a heavy sea. The cyclones of the Indian Ocean occasionally reach the coast of Madagascar.

The insalubrity of the coast has been somewhat exaggerated according to recent French accounts. *Marsh* fevers may be expected during the rainy reason, and excess of every description must be avoided here as much as on the African coast.

43. Reunion.—This island is entirely within the limits of the S.E. Trade-wind, which, however, undergoes some modification, arising from the altitude of the interior, and its proximity to the region of the N.W. Monsoon.

All the roadsteads of the island on the windward side, between St. Pierre and St. Denis, feel the full effects of the S.E. Trade, which is generally strong, but during the day its inclination is more *from seaward*, according to the position of the place; towards evening the strength of the wind gradually diminishes, and during the night its direction is more *along the land*. These slight modifications are all that constitute the difference between the land and sea breezes on that part of the island;—for example, at St. Denis the wind is generally fresh from S.E. to S.E. by E. by day, but during the night it changes to S.S.E., and is usually not so strong.

On the leeward side of the island the influence of the land is well established.

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* "Jour. R. Geog. Soc.," 1850, p. 54, "Memoir on Madagascar."
† "Annales Hydrographiques," 1864, tome xxv. p. 318.

From 6 P.M. to 6 A.M. the S.E. Trade-wind pursues its course directly across the high land, but towards morning its force diminishes, and a calm may possibly follow; after which, towards mid-day, the sea breeze sets in from S.W. by W. or S.W., veering gradually as the day advances, and dying out as it gets to W.N.W.

During the fine season, from April to December, the wind blows continually from the S.E., varying to S.S.E. and E.S.E. The breeze generally freshens at 9 A.M., and decreases at 4 P.M. The nights are generally calm, and if otherwise, you may be almost sure that it will blow strongly the following day. If during the day the breeze is moderate, and fails early, there will be a light land breeze during the night.

The winds are generally fresh during June, July, and August. The usual S.E. winds continue during winter, or from December to April (a period improperly called the N.W. Monsoon), but they are generally more moderate, and interrupted by calms and winds from W. and N.W. It is in this season that heavy gusts, and even hurricanes, occur. After these gusts there is often a profound calm, or a W. wind, which is always of short duration, and is soon followed by winds, generally from S.E. Hurricanes are most dreaded by the regular traders about the days of full and change of the moon, but for this there is no sufficient reason.

The distribution of the winds, as above indicated, is further modified between the months of November and April. At that season of the year the N.W. Monsoon is well established to the southward of the Equator, on the African side of the Indian Ocean, and its influence is felt at Réunion in the variable (chiefly westerly) winds prevalent there during that period. This Monsoon rarely blows either with great strength or regularity, but during its prevalence the weather is fitful and squally.

44. Mauritius.—Most of the remarks on the winds given above (*see* REUNION) apply with equal force to Mauritius; and there is a marked difference in the climate of the island in different situations: the windward (or S.E.) side enjoying a lower temperature by several degrees than the leeward (or N.W.), owing to the cooling and refreshing influence of the S.E. Trade which prevails during the greater part of the year.

The principal rainy season is from the end of December to the beginning of April, but showers occur in all months.

The prevailing direction of the wind at St. Louis is as follows:—*January*, *February*, and *March*, E.S.E. to N.E. and N.W.; *April*, E.S.E. to E.N.E.; *May*, S.E. to E.S.E.; *June*, S.S.E. to S.E.; *July* and *August*, S.S.E. to S.; *September*, S.E. to E.S.E.; *October*, S.E. to E.; *November*, S.E. to E.N.E.; *December*, S.E. to E. and N.W.; Mean of the year, E.S.E. to E.

See also the Chapter on "HURRICANES and CYCLONES."

45. Rodrigues.—The Trade-wind blows here more persistently than at Mauritius and Réunion, prevailing between E. and S.E. nearly all the year round: occasionally the influence of the N.W. Monsoon of the northern part of the Southern Indian Ocean extends as far as this island, when a hurricane may be the consequence, after which there will be a succession of calms and light airs. Rodrigues is of too small an extent to feel the influence of land and sea breezes, but the steady Trade for eight or nine months in the year keeps the temperature cool and equable.

46. The Gulf of Aden.—The N.E. Monsoon commences early in November, increasing in strength at full and change of the moon. During November and December the weather is unsettled and cloudy, frequently blowing a moderate gale, with heavy rain. In January, February, and March, the wind varies from E. to E.N.E., increasing in strength towards the Strait of Bab-el-Mandeb; the weather is now fine and the sky generally clear, the temperature ranging from 68° to 80° Fahr.

During April and May the wind is often light and variable, between E.N.E. and S.E., near the coast; and though the weather is generally fine, the sky is frequently cloudy and the horizon obscured by fog: close in-shore land and sea breezes are now prevalent, the land breeze lasting from 4 A.M. to 8 A.M. During April it rains occasionally, and at night a heavy dew falls.

The weather is generally unsettled and dull during June; with a calm or light air in the morning, a fresh breeze from the S. will set in, freshening towards noon, and producing a long swell on the Arabian coast. Towards the middle of the month, and during July and August, between Burnt Island and the Strait of Bab-el-Mandeb, strong westerly winds are prevalent, which facilitate the passage from the Red Sea to the Indian Ocean. These winds will probably fail before a vessel reaches Rás Rehmat, but afterwards she will get the Monsoon from the southward, from which direction it blows with great strength through the channel separating Socótra from the main land of Africa. The weather is generally dull, with a thick fog at times. A southerly wind—very fresh by day and light at night—may always be expected on the Arabian coast at this time of the year; not unfrequently, however, severe land-squalls come off at night, which, by raising a cloud of dust, give ample warning to the seaman.

In September the westerly winds cease, and the land and sea breezes are tolerably regular. The nights are often calm, and always more or less sultry.

At Aden the temperature during May is generally intolerably hot, ranging from 84° to 95° Fahr.; so also in September, owing to the cessation of westerly winds. In November and December the range is between 76° and 84° Fahr., the weather being cooler as the N.E. Monsoon increases; the same average temperature may be expected in January and February: during March and April it becomes warmer, ranging from 80° to 86° during the latter month.

On the African coast the heat is intense (sometimes 110° Fahr.) during the prevalence of the S.W. Monsoon; as a consequence, the natives sometimes leave the coast for the uplands, and trade ceases.

What is termed the S.W. Monsoon in the Indian Ocean generally blows out of the Red Sea in a southerly direction, varying with the line of mountains on the Arabian coast: outside the Straits of Bab-el-Mandeb it takes a westerly direction, but seldom extends far beyond Aden. At Cape Guardafui it blows with great violence along the coast from N.N.E., and thence across the Gulf of Aden to Rás Rehmat; and on this line, after experiencing variable, light airs or a calm for a few hours, a vessel proceeding eastward generally enters the Monsoon.

That part of the Arabian Sea included between a line drawn from Cape Guardafui (Africa) to Rás Rehmat (Arabia) on the one hand, and Rás Kosaïr (Arabia) on the other, is a region of calms and light, variable winds during the period of the S.W. Monsoon; and it serves to separate the wind region of the Gulf of Aden from that of the Arabian Sea.

47. Red Sea.—Commander T. Elwon, I.N., gives the following general notes on the winds and weather of the Red Sea :—

"The N.E. Monsoon entering the Red Sea, becomes a S.E. wind, and, being repelled by the high land of Africa into a narrow strait, blows with considerable force, and rather inclining towards the Arabian coast; for it is probable that they are stronger there than on the Abyssinian side, even in the lowest part of the sea. These winds generally begin to decrease in force after passing the Harnish and Zoogur islands in Lat. 14°; and as they approach the wider part of the sea, they are gradually lost in light winds along the outer reefs on the Arabian side, or turn to the westward amongst the banks and islands on the African side, and gradually unite with the prevailing northerly winds in that part.

"The southerly winds commence in October, and subside in the latter part of May, or beginning of June. They blow with most force from October to the end of January, and in some months extend as far as Suez, but most commonly do not reach Jiddah; they are frequently succeeded by light, variable, or northerly winds in the 18th degree of latitude. From February to the end of May they do not always blow so strong as in the preceding months, and are frequently succeeded by northerly winds for several days, particularly in the month of February, at which time the native boatmen avail themselves of the opportunity to quit, and reach the southern parts of the sea.

"From October to January, in the lower part of the sea, the weather is generally thick and hazy, obscuring objects until pretty near; and along the outer reefs squalls and rain are frequently experienced in November and December. From February to May the weather is unsettled—in April and May particularly. Below the 15th degree of latitude we experienced fresh squalls from the eastward, with heavy clouds of sand, and sometimes rain.

"In the beginning of June the southerly Monsoon is succeeded by north-westerly winds, which, in the lower part of the sea, seldom blow with great force. They continue pretty regular during June and July, and in August and September are frequently light and variable; in the latter month there are sometimes light southerly winds or calms. During this time the weather is frequently very thick and hazy, particularly on the Arabian side; and the Abyssinian shore is consequently much the most pleasant, and is considered the most healthy.

"In October the pilot drew our attention to the Pleiades, which the Arabs call 'Tryer,' and which were then seen low down in the East; he informed us that, on their first being seen in that quarter in the evening, it indicated the commencement of the southerly winds. The latter part of April, in the evening, the Pleiades set, when he said there would be light, variable winds for forty days, after which they will be again seen in the East in the morning, when the N.W. winds commence, and continue until they again set in the morning in the beginning of September, when there will be light, variable winds for forty days, after which the southerly winds commence again, when they are seen in October early in the evening.

"In the *inner channel* on the Abyssinian side of the Red Sea, northerly winds, inclining to land and sea breezes, seem the most prevalent of all the year round, but most probably are, as in all other parts to the south, light and variable in August and September, when there are also frequent calms, and southerly winds are by no means common. From the month of August to October is generally fine weather,

but from November to the end of March appears to be the rainy Monsoon upon that coast. In April the weather was cloudy, and fine in May, June, and July; but between 19° and 20° of lat. in these months we experienced several hot winds and fresh land squalls; and by Mr. Salt's journal, it appears that the *Panther* was driven from her anchorage, in Lat. 15° 30′ N., at Massowah, June 20th, 1805, by a partial *Simoon*, or land squall.

"There are similar winds and weather on the Arabian side; and though we had land and sea winds more frequently in March and April, the land squalls in the lower part of the sea occurred in April and May. From May to July, when we experienced them on the Nubian coast, there was at that time thick, hazy weather; and heavy dews on the Arabian side opposite."

Commander T. E. Rogers, I.N., from observations made over a lengthened period, also furnishes the following memorandum on the winds of the Red Sea throughout the whole year:—

"From the beginning of October to the end of April, which may be called the winter months, from the Straits of Bab-el-Mandeb to Jibbel Teer, in Lat. 15° 31½′ N., the wind may be said to blow constantly from the southward, with the exception of an occasional day or two of northerly winds on the full and change of the moon; but two months frequently pass without any change. The current generally takes the direction of the wind 15 or 20 miles per day, particularly that from the northward, from the southerly winds having, as it were, heaped the waters in the upper part of the sea; from this cause also I imagine it is, that a set is at times found against the southerly winds, on the decreasing of a strong breeze from that quarter.

"The effect of the southerly wind in raising the water, and the northerly wind in decreasing it, very plainly appears in Jiddah roads; with the former a small boat can go straight from the anchorage to the shore, whereas with the latter, in the same direction, a succession of dry banks appears, having only a circuitous and shallow channel.

"From Jibbel Teer to Lat. 19° or 20° the winds at the same season are variable, blowing nearly as much from the N. as the S., that particular wind predominating as you approach the north or the south of the above limits. The currents here, in general, set with the wind, but at times are found to run across the sea as much as 20 miles in twenty-four hours; occasionally, but not often, a set to windward is experienced of 12 or 15 miles in the same time. The winds here do not, in general, blow so strong as the prevailing ones above and below these limits.

"From Lat. 21° to 27° at the same season, the northerly is the prevailing wind, but half a moon seldom passes without having the wind one or two days from the southward, more particularly from the end of November to the beginning of March. The currents here are much the same as between Jibbel Teer and Jiddah; the southerly wind is less frequent as you approach the north extreme of these limits; strong northerly winds, of two or three days' continuance, are often experienced here in these months.

"From Lat. 27° to Suez the wind is almost constantly from the northward, and, unless during the months of December, January, and February, seldom interrupted by that from the southward. The currents run with the wind, but are not so strong as those experienced more to the southward. The north-western seldom blows with violence here for more than twelve or fifteen hours at a time, and, from what I have

experienced, I should say it does not blow so strong in the summer as in the winter.

"In June, July, August, and September, the northerly winds prevail, with more or less strength, throughout the sea from Suez to Bab-el-Mandeb, with little interruption; occasional slants from the land are met with, particularly in August and September; and a vessel that sails fairly will average 35 miles a day in working from Mocha to Suez in these months.

"Leaving Mocha in the end of July, the *Euphrates* worked to Suez in thirty-six days; leaving Mocha in the end of August, she completed the same voyage in thirty-two days. On both these occasions, from leaving Mocha until she passed the Straits of Jubal, she never had a second reef in the topsails. The water was in general smooth; the current generally against, sometimes with her, the difference giving an average of 3½ and 4 miles daily against her during the voyage.

"In opposition to HORSBURGH,* who says the wind in the Sea of Suez generally blows strongest during the day, I have found in working up on three occasions, once in June, another in July, and again in August, the contrary to be the case, never, on any occasion, having found a second reef in the topsails necessary during the day, whereas at night I have been generally obliged to double-reef the topsails, and at times take in the mainsail.

"Throughout the Sea of Suez a hazy horizon is generally a sign of a breeze; but it is not always its precursor. The same remark applies to a light, fleecy cloud hanging above the tops of the Tor or Sinai mountains, as seen from the southern entrance of the Straits of Jubal.

"During the winter months, throughout the sea, the northerly wind is generally accompanied by a dry atmosphere, and the southerly wind by one that is damp. A change of wind is thus often indicated some hours before it takes place, or before any other sign is visible.

"During the summer months the atmosphere is generally damp throughout the sea; but the sky overhead is so clear that a planet can often be seen at noonday.

"In working up the sea to the Straits of Jubal, I think the Arabian coast is the best to keep on; and in this opinion I am strengthened by the practice of Turkish ships, which, in their way from Jiddah to Cosire, sight the island of Tirahn before they venture to cross over, so much do they dread making the Egyptian coast below Cosire. This is 60 miles further to the northward than I think a fair sailing ship need go, and the practice is sometimes attended with provoking consequences, as I have known one Turk reach Cosire before another who left Jiddah thirteen days earlier, in consequence of the former getting a southerly wind below Cosire, which to the other was a foul wind, from his being so far to the northward.

"The wind in the Red Sea seldom blows in squalls, but its gradual rise is often very rapid in the northern part.

"In the months of December, January, and February, a ship sometimes will carry a fair wind from Mocha to Cosire, and make the passage in six or seven days. I never heard of this being done from Cosire to Mocha unless in the summer months."

CAPTAIN MORESBY says:—"The winds from Suez to Jiddah, during the whole of the year, are mostly northerly, blowing with great violence at times, but generally moderate with the changes of the moon. During the winter months, from December

* Observations by CAPTAIN KYDD, E.I.C. service.

to April, southerly winds at times prevail for a few days, occasionally blowing fresh; more especially in the Sea of Suez, where they freshen at times to a moderate gale. In these months, in the Sea of Suez, westerly gales are not unfrequent; they are called by the natives the Egyptian winds, and from their violence are much dreaded. On the Arabian coast, near Jiddah, both to the southward and northward of it, northerly, north-east, and easterly winds at times blow with great violence during the winter months, bringing off clouds of dust from the land."

Some navigators, d'Après de Mannevillette, Malham, &c., say that southerly winds prevail in the southern part of the Red Sea during two-thirds of the year, from October to May or June, after which, northerly winds take their place for the remaining four months.

The following remarks on the same region are by Lieut. R. Wellsted, I.N:*—

"During the warm season, from May to October, in the northern part of the sea, the reefs are observed to have about two feet less water on them than in the remaining months of the year. This effect is produced by the influence of northerly winds at this season, which, prevailing throughout the whole extent of the sea, cause a continued current to set through the Straits into the Gulf of Aden. When the southerly winds, which at the lower part of the sea prevail from October to May, set in, these currents are observed to change their direction, and to flow back with rapidity; the whole body of water having no means of escape, then collects towards the northern part of the sea, and becomes considerably elevated. The partial influence of a southerly breeze during the former months was observed to produce for a short time a similar effect, the water subsiding to its former level on the return of the northerly breezes."

Climate.—Though the sea-coast of Hejás is pronounced unhealthy, yet, afloat, we do not find it so. The temperature, compared with that of the Persian Gulf, is moderate; near the sea-coast, where the winds are light with intervals of calm, it is usually much warmer than in the middle of the sea, where there is rarely any intermission of the prevailing breezes.

The north-westers are cool and refreshing; but the southerly winds are damp, sultry, and unwholesome. During the period at which the latter prevail, in September and October, the dampness of the air is very great in the warmest days; and the heavy dews at night, when all are obliged to sleep in the open air, renders them particularly disagreeable. The sudden and grateful change which a return of the north-westerly breezes produces in the atmosphere renders them particularly desirable at this season.

In the cold weather the sky is, for the most part, clear and cloudless; generally speaking, there is no want of rain, which falls in heavy showers during the months of November, December, and January. In this respect the climate of this coast differs widely from that of Egypt, where (though the distance between the two countries is only about 160 miles, the width of the Red Sea), it is well known, rain is of rare occurrence. A season of drought, it is calculated, occurs here about once in four years; the floods during the rainy season pour down from the hills with great violence. Almost every part of the coast bears traces of torrents formed during this season. Fogs are not uncommon at Jiddah and in its neighbourhood, but rarely prevail to the northward of that port.

* "Jour. Roy. Geog. Soc.," 1836. "Observations on the Coast of Arabia between Rás Mohammed and Jiddah."

48. The S.E. Coast of Arabia, from the Gulf of Aden to Ras-al-Hed.—On this part of the coast the N.E. Monsoon sets in about the middle of November, and lasts until the middle of March—the direction of the wind being greatly modified by the trend of the coast-line; at some distance off shore the direction varies between N.E. and E. by S. The weather is generally fine and the sky clear, with neither squalls nor rain, except between Rás Seger and the island of Masírah, and the vicinity of the bay of Kuriyán Muriyán, where the winds and weather are more boisterous and variable than on any other part of the coast.

The following remarks respecting the extensive bay of Kuriyán Muriyán are by Capt. S. B. Haines, I.N.:*—

"The sudden changes of the winds, and the great violence with which they blew, frequently rendered the position of the surveying-vessel which I commanded dangerous; nor could she have been extricated but for the activity of the officers and crew, and her good supply of ground-tackle. It is also necessary to observe that these changes give no warning, owing to which I was compelled, for the safety of the vessel, to secure her 30 miles from the islands, while I surveyed them in my boats; and it was not an uncommon occurrence for boats to be manned and ready when, from a clear, serene sky, a light arched cloud would appear over the table cliffs surrounding the bay, and in five minutes (just time enough to run the boats up) we could not see ten yards from us, and it blew a perfect gale from the northward. These winds, termed by the Arabs *Belát*, are much dreaded; but what surprised me more than these land winds were the frequent and heavy gales from S.S.W. during February and March, blowing for six days together. In one of these, after the close of the survey of the islands, I was overtaken when surveying round the bay on a dead lee-shore, having parted two bowers. A *Belát* lasted for twenty-one days on a recent occasion, during the time the Red Sea and Indian Telegraph Company occupied Hullániyáh, the largest of the Kuriyán Muriyán group.

"These northerly gales do not extend far southwards, but appear to be confined to the limits above mentioned; when clear of Kuriyán Muriyán Bay, and past Rás Nús, they blow along the line of coast, being influenced by the high range of the Subhán mountains towards Morbát, in which anchorage the water is smooth from the wind's blowing off shore; but through the deep valley of Dhofár it again blows off shore with great violence.

"The southerly breezes appear also confined to that part of the Arabian coast, as to the southward they are seldom felt, and the S.W. Monsoon does not reach Socótra before the 1st or 10th of May. For three years successively it reached Socótra the 4th of May, with heavy rain on the 6th and 9th; so that navigators coming from the Gulf towards the Red Sea must not take the S.S.W. winds they may fall in with in February or March for the S.W. Monsoon, as has been the case; and in consequence of such a mistake a fast-sailing vessel, to my knowledge, bore up for Bombay. From the 15th of March till April the winds are light and variable along the whole line of coast, and the weather warm; land and sea breezes then enable the crowd of boats from Súr and Masírah to run back with their cargoes of shark-fins, the produce of some months' toil, to the southward. The sky is then generally cloudless, and the atmosphere light and pure, with heavy night-dews.

"May is a doubtful month, for if the Monsoon is early it may blow hard from the S.W. At times, however, moderate weather is experienced.

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* "Jour. Roy. Geographical Soc.," 1845, p. 147.

"During June, July, and August, the S.W. Monsoon is in its full strength, and at times blows very hard along the whole line of coast, particularly in July. In the early part of June large boats run from the Red Sea to the Persian Gulf; and this voyage, which is accomplished after the first blast of the Monsoon, is termed the '*tadhbír*.'* They also set sail at the latter end of August, and run up during the '*degmáni*,'† or after the strength of the Monsoon is over.

"During the month of September the winds are moderate from the W. and S., and the weather is warm.

"In October light uncertain breezes and calms are common; land and sometimes sea breezes when in-shore; and at night cloudy, with passing showers of rain.

"The experience of several years along the coast has taught me not to place implicit confidence on the regularity of the seasons, as I have frequently during the same month, in different years, experienced exactly opposite winds. In March, 1835, I was twenty days in passing from the Kuriyán Muriyán Islands to Makallah, with southerly and westerly winds, and adverse currents; and in March, 1836, I was only three days working the same passage, having the N.E. Monsoon with me. Further, I have observed that at all seasons, and on all parts of the coasts of Arabia, particularly when the land is low, the wind is influenced more or less by the sun's position and the changes in the state of the atmosphere towards the sea; and even in strong breezes the same influence prevails to a certain degree."

The following is a SYNOPTICAL TABLE of the weather experienced off the Kuriyán Muriyán Islands in 1835 and 1836:—

Date.	Winds.	Date.	Winds.
Dec.		Feb.	
14	Light E.N.E. to E.S.E.	1	E. and moderate.
15	Light S.E.	2	E.N.E. and light.
16	Light S.E. and S.	3–5	Fresh gale, N. to N.W.
17, 18	Hard gale from N. to N.W.	6	Moderate E.N.E breezes.
19	Fresh W.N.W. *Reliance* whaler wrecked.	7	N.E. to E.S.E. moderate.
		8, 9	Fresh gale, N. to N.W.
20	Fresh gale, N.W. to N.	10	Moderate N.N.E. to E.N.E.
21, 22	Moderate A.M., light P.M., N.	11	Fresh southerly gale to S.E. by S.
23, 24	Light E.N.E.	12–14	S. to S.W. by S.; fresh gale.
25–27	Light airs and calms.	15	Calm light airs, clear sky.
28	A.M. N., P.M. S.E.	16–18	Hard gale, N. to N.W.
29, 30	Light E.N.E. and S.E.	19, 20	S.S.E. to S.W. fresh.
31	Calm.	21	Moderate gale at S.S.W.
Jan.		22, 23	N.; moderate gale.
1–5	Hard gale, N. to N.W.	24	Gale at S.S.W.; squalls and rain.
6	Fresh A.M., P.M. light airs.	25, 26	Hard gale, S.S.W. Vessel parted two bowers.
7–11	Light land and sea breezes.	27	Moderate S.S.W.
12–17	Moderate from N.E. to E.S.E.	28	S. by E. to S.S.W. moderating.
18–23	A furious *belát* from N. to W.N.W.	29	Moderate.
24	Moderate gale, P.M. light airs.		
25–27	Blowing a gale from N. to W.N.W.	March.	
28	Moderate N.E.	1	S.E. by E. to S.; moderate.
29	N.E. to N. moderate.	2	E.S.E. to S.S.E.
30	N.N.E. light.	3	Fresh S.
31	N.E. moderate.	4	Light airs from N.N.E. to E.

* *Tadhbír* signifies a certificate; it is here probably used technically for the first indication of the Monsoon.

† Probably *dekmáni*, "the season of mischief;" if so, *ba'd ed dekmáni* would be, after the violence of the Monsoon is past.

The observations of Commander J. P. Saunders on this coast are to the following effect:*—

"I was much hindered on my first arrival (December) on the coast by the strong *Belát* winds which prevail on it, one breeze succeeding another at intervals of eight or ten days, always blowing very strong, sometimes a perfect gale, and constantly varying in gusts from N.N.E. to N.N.W., rendering it quite unsafe to send a boat away from the vessel. These *Beláts* never last less than three, but sometimes seven, or even ten days.

"The *Belát* is also dangerous to ships near the shore. Occasionally at night the breeze would die away to a perfect calm, and remain so for an hour or two; heavy gusts would then blow down from the mountains at intervals of a few minutes (without any warning except the noise on the water) sufficiently strong to split the sails or carry away the masts of any ship under sail not prepared for it: these gusts would succeed each other for five or six hours.

"The Arabs consider that the N.E. Monsoon lasts only three months to the N.E. of Rás Farták—viz., part of November, December, January, and part of February. The S.W. Monsoon is considered over at the middle or end of August, and they begin to trade at the beginning of September. Between the 1st of September and the setting in of the N.E. Monsoon is about six weeks, and is a season of light, variable winds called *Damauro*.

"In March the southerly winds to the E.N.E. of Rás Farták blow sometimes very fresh, particularly in Kuriyán Muriyán Bay. April and May is considered another season, which is called *Bayn el Autem* by the Arab navigators. The winds are variable, though generally inclining to the south. Vessels pass up and down, and, as the current sets up to the east, they make rapid passages to Muskat and the Persian Gulf. Nearly all the trading-boats which pass down in the commencement of the N.E. Monsoon return again in these months, bringing back rafters, grain, and slaves, from the different ports to which they have been.

"The winds to the south-westward of Farták towards the end of March generally blow to the S. of E., sometimes S.E., and even S.S.E. and S.; occasionally the current also changes and sets to E.N.E. along the shore. The wind generally dies away at night, rendering progress to the west very difficult. The trading-boats from the Persian Gulf and Muskat begin to return in this month for Zanzibar and the Red Sea, and continue to do so until near the end of May. An occasional turn in the current to the westward may take place, and a shift of wind from the N.E., even as late as the 25th of May, but it does not often occur.

"To the E.N.E. of Cape Bogashua, after the beginning of May, a high long swell gradually sets in from the southward, rising much higher in the day and falling towards sunset. A long swell rolls on to the coast during the whole of the Monsoon; but the fishermen, when they have a small nook to shelter their boats in launching, go out to fish in it at times.

"In the *Palinurus* I experienced this swell during the whole month of May, which, when the wind died away, caused her to roll very heavily. It would affect a steamer, of course, in the same way in passing, as generally it would be four or five points on her bow.

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* "Jour. R. Geog. Soc.," 1846, p. 169. "Memoir of the Proceedings of the Hon. Co.'s Surveying-brig *Palinurus*, between Rás Morbat and Rás Seger, and between Rás Farták and the Ruins of Misenát."

"From the best information I could procure from many of the natives on the part of the coast I was surveying, fishermen and others, it would appear that the S.W. Monsoon, to the south-westward of Morbat, close to the shore, blows fresh only occasionally—a breeze lasting from three to four days, and is then succeeded by light breezes and calms from three to ten days; the swell, however, remains. The sea is not so great as that experienced on approaching India. A large steamer passing down from Morbat would be obliged to keep near the shore, where she would experience lighter winds; and it would of course be necessary to keep a good look-out, and the lead constantly going; though, in some parts, even that would be no guide for the distance off shore. She might, if necessary, pass along at one mile's distance in the day, and a few miles off it at night; occasionally she might probably set her try-sails; but a strong current, from a half to a mile and a half per hour, would be constantly experienced running against her to E.N.E.-ward.

"From Morbat to Rás Isolette the coast bends a good deal to the westward, forming two bays, with the Kuriyán Muriyán Islands projecting from it at a distance of upwards of thirty miles. Along these bays, and nearly as far as Masírah Island, the natives that I have spoken to all agree that the Monsoon blows stronger and the swell is much higher than on any other part of the coast; this part is much dreaded by them. They also stated that the Monsoon sets in there with a gale of wind, dark gloomy weather, thunder, lightning, and rain. Many boats that have been caught in it have been lost; after the first burst the weather is the same as in the open ocean."

49. Gulf of 'Omman.—During the N.E. Monsoon winds known as *nashïs* and *shemáls* prevail; during the summer, calms and light winds from S.E. are common, rendering the navigation tedious. The S.W. Monsoon is not felt inside Rás-al-Hed. But neither here nor in the Persian Gulf are the winds regular or of long continuance; those from N.W. and S.E. are the most prevalent; the former being more or less persistent throughout the year, the latter appertaining more especially to November, December, and January; but there is great diversity of opinion respecting the winds in these regions.

50. Persian Gulf.—Here the navigation of a ship requires great attention; the winds, as in most inland seas, are very uncertain, and blow occasionally with great force down the gulf; and in winter, also in the opposite direction: they set in without much warning.

The following remarks are chiefly by Capt. C. G. Constable and Lieut. A. W. Stiffe, of the Indian Navy:—

The prevailing wind in the gulf is undoubtedly the north-wester, called by the natives *Shemál;* this wind blows down the gulf, changing its direction with the trend of the coast. Thus, on the Arab coast, from Koweït to Bahreïn its average direction is N. by W. to N.N.W.; on the Gutr coast N. to N.N.W.; and on the west coast of 'Omman W.N.W.

On the Persian coast it blows N.W. by N. down as far as the angle at Jabel Dreng, veering to N.W. and W.N.W. between that and Sheïkh Sho'aïb. Off Kaïs the direction is about W. by N.; and from Bostáneh, eastward, it blows from W. to S.W. by W. at the entrance of the gulf.

In the Gulf of 'Omman its general direction is N.W. The *Shemál* blows about

nine months in the year in the northern half of the Persian Gulf; it blows almost incessantly during June and part of July (called the *Great Shemál*), seldom exceeding a moderate gale in force, and at times quite light; its general duration is three days, but it may last seven days; the worst *Shemáls* often only last one day.

During a *Shemál*, if after rain, the air may be clear and sky cloudless, but generally the air is so loaded with dust from the Mesopotamian deserts that a dense mist is the result. This makes the navigation very dangerous, as the land cannot be seen; the white surf on the beach is often first seen, while the land is still hidden. In the Shat-al-'Aráb this is sometimes so much the case that neither bank of the river can be seen. Out of sight of land a vessel's decks and rigging get covered with fine dust. The air during the *Shemál* is generally very dry and sky cloudless, but in the winter they are sometimes attended at the commencement by rain squalls (often with thunder and lightning), which generally clear off during the breeze; it veers during the twenty-four hours a few points, blowing more off the Persian coast, or from the northward, at night; and off the sea, or more from the westward, in the day, which a vessel should take advantage of when working against one: it sets in at any hour of the day or night, and generally suddenly.

The barometer cannot be said, as a rule, to give any warning of the approach of a *Shemál;* if it was low before, it will begin to rise as soon as the *Shemál* sets in, but generally not before, and continue high during the whole duration of the gale. It sometimes falls before a bad winter *Shemál*, but rises again after the first burst of the gale; the barometer in the surveying-ship was not at all affected by one of the heaviest *Shemáls*, either before, during, or after it. This breeze is sometimes preceded by the drying up of the dew by night, or the dampness of the air ceasing, which is a pretty sure sign.

A heavy swell from the N.W., especially in the southern part of the gulf, is often the precursor of a *Shemál*, although such a swell sometimes occurs without any wind following it.

Some of the heaviest winter *Shemáls* set in in fine weather, with no warning except a heavy bank to the N.W. an hour or two previously, which rolls down and gradually obscures all objects, and yet this occurs sometimes without any wind following. Such a warning should, however, never be disregarded.

Ships should be prepared in winter, during a S.E. gale, for a sudden shift to the N.W., especially at night, as the *Shemál* often blows then very strong.*

The worst of the *Shemál* is always at the beginning: frequently it does not extend over the whole gulf, and often lulls for a short time about daylight. In the summer *Shemáls* the wind rarely exceeds the force of a moderate gale, but in the winter they are often fresh gales, or at times hard gales; it is generally advisable to seek shelter, if possible, during the strength of a *Shemál*, as little or no way will be made against it. The Persian coast and islands offer many suitable places of shelter.

During the winter months south-easters, called by the natives *Shurgi* or *Koss*, alternate with the north-westers, and, like the *Shemáls*, follow to a certain extent the

* On 17th March, 1820, E.I.C. brig of war *Ariel*, from the river, bound to Bú-shehr, beating against a south-easter, under double-reefed topsails. At 1 A.M., 18th, sail was further reduced, as a squall was expected from the N.W. This was scarcely accomplished when the squall burst upon them, and taking her right aft, she ran through the opposing head-sea, buried herself in it, and sank about twenty miles W. by N. of Kháreg Island. There were about ninety souls on board; of these only the surgeon, boatswain, and three of the crew were saved, on a canoe which floated off the booms.

direction of the coast; they only blow strong from December to April. The *Koss* is generally accompanied by thick, gloomy weather, with hard squalls, and often much rain, sometimes thunder and lightning. The atmosphere is moist, and the barometer generally low. With a falling barometer and cloudy, threatening weather, a *Koss* may be expected in the above months, but timely warning is not always to be expected, although the barometer always falls during the gale, if not before. It seldom blows more than three days; its strength is generally a moderate gale, but at times it blows a fresh gale; the strongest only last one day. When the wind begins to veer to the southward the *Koss* is over, and is often succeeded by a *Shemál* almost immediately; or it may blow hard for a short time at S. or S.W. and so die away, no *Shemál* occurring for several days. The wind sometimes, however, after blowing hard at S.W., chops round suddenly to N.W., when a strong *Shemál* will follow; the notion that a *Koss* is always followed by a *Shemál* is not correct.

If a vessel has anchored for the *Koss* in an anchorage open to the *Shemál*, she should weigh immediately the *Koss* is found to be over, as she may otherwise have to ride out a N.W. gale on a lee-shore; easterly winds are of most frequent occurrence in the southern part of the gulf.

In the winter, particularly in the southern part of the gulf, strong breezes are experienced from N.E., called *Nashí;* they are attended by dark, cloudy weather, and generally rain; the natives make a distinction between these breezes and the *Koss*. The barometer is not affected by this breeze, being generally high, and if so, it will fall a little when the *Nashí* is over; there is sometimes a dense haze before a *Nashí*, caused by the dust blown off the land. This breeze often blows three or five days, but frequently only one day; after the first day the air becomes clearer, possibly owing to rain on the land. The *Nashí* blows in gusts with frequent lulls, and if a three days' gale is strongest on the third day; it blows very strong in the Gulf of 'Omman, and is much dreaded by native craft, as the Bátneh coast is a lee-shore, and there is no shelter.

The south-wester, called by the natives *Saheïlí*, is much feared by them, as it blows into nearly all the sheltered anchorages on the Persian coast; it lasts generally only a few hours, and often follows the *Koss*, but sometimes occurs after fine weather; it is accompanied by rain, and is preceded by masses of clouds rising from the S., with lightning; it is not of frequent occurrence, and only happens in the winter months; it blows all over the gulf, and also in the Gulf of 'Omman, especially off Rás al Kúh.

The land and sea breezes are uncertain, but in fine weather land winds are experienced near the coast. On the Arabian coast strong land winds—often in hot gusts—are not uncommon in the morning. At Koweit sea breezes are regular during fine weather. At Bu-shehr sea breezes are regular in summer when there is no *Shemál;* they set in about 9 A.M.; there is scarcely any land wind. At Basiduh the sea breezes are regular, and the land winds are strong, lasting till 10 A.M.

When the season changes—between Oct. 15th and Nov. 5th—very severe squalls (called *Leheymah*) may be expected; their direction is uncertain. During this period an unusual amount of electrical action is present, and St. Elmo's fire has been observed on board ship; the air is also wonderfully clear. No native vessels put to sea at this time. Should no such squalls occur before the 5th of November it is generally supposed that the season will be free from them until the bad weather of winter sets in.

In Basídúh roadstead very violent squalls have been experienced from the N. in May; the E.I.C. schooner *Tigris* drove with two anchors ahead until she struck off the hospital. Heavy squalls from the S.E., with lightning and rain, are occasionally experienced in July. In the winter tremendous gusts blow out of the valley in the mountains (Devil's Gap) below Muskat.

At the north end of the gulf very heavy squalls blow at times from the northward.

A succession of squalls from opposite quarters, each lasting only a few minutes and alternating several times, is no uncommon occurrence in any part of the gulf and at any season. During winter, also, the winds are very local—a *shemál* blowing at one end of the gulf, while in the centre or at the other end it may be calm, or perhaps a wind from the opposite direction, and moderate.

At Bú-shehr gales of wind with rain occur in January and February; the wind is often from an opposite quarter to that at Shat-al-'Arab.

The hottest weather occurs in the Persian Gulf during June, July, August, and September, when, on board ship, the thermometer may range from 90° to 98° Fahr. at 4 P.M.; on shore the thermometer has risen to 124° in the shade, and 150° in the sun. With a southerly wind the heat is almost insupportable, from the increase of moisture in the air. December is fine and cool, while January and February are cold and often boisterous; thermometer from 67° to 72° Fahr. The heavy dew in the summer months will wet the sails so that they appear as if a shower of rain had fallen; dense fogs also occur at times near the coast in the morning, wetting everything as with rain. Calms, lasting for days together, are common in the Persian Gulf and Gulf of 'Omman; a continuous steady breeze is rare: water-spouts, and sand-spouts on shore, are frequently observed. Rain is variable, less probably on the Arabian than on the Persian coast, and it generally falls in winter; the barometer is not reckoned a safe guide against bad weather in the gulf.

51. Bombay and the Coast to the Westward.—During November and December the winds are fresh from N.E. and N.—stronger at sea than near the coast,—but the weather is fine. In January and February the winds are more moderate, but sudden squalls from the southward and westward are occasionally experienced. During March and April the N.E. Monsoon is dying out, and fresh N.W. winds alternating with calms are frequent. Off Bombay and Kurrachi, and thence seaward, during March, April, and May, the winds are variable between N.W. and S.W., after which the S.W. Monsoon sets in.

52. West Coast of Hindoostan.—During October and the beginning of November the navigation of this coast presents many difficulties, arising from the inconstancy and variability of the winds; subsequently, from November to March, the N.E. Monsoon is well established, and brings with it remarkably fine weather. This is also the *season of land and sea breezes*, which to the south of Calicut extend some distance seaward; but the land breeze is tolerably fresh in December and January along the whole coast. The sea breeze commences about 11 A.M., or near mid-day, varying between W.S.W. and N.W., and is moderately strong; at some period between 6 P.M. and 9 P.M. a calm ensues, after which the land breeze sets in from N.E. to E.S.E. These alternating winds are prevalent between Cape Comorin and Surat, and cease in March, after being rather uncertain in February.

In April the winds are variable, between W.N.W. and N.N.W., and sometimes N.N.E., indicating the termination of the N.E. and approach of the S.W. Monsoon; at this time a calm is not unfrequent during the morning, after which light airs from N.E. to N. are not uncommon.

During May the weather is very uncertain, being squally, with rain, and the wind from S. to S.W., passing to N.W., after which it is fine. If near the land in May and June very strong squalls may be anticipated during the night.

The S.W. Monsoon sets in with dark, cloudy weather, and generally a strong gale from S.E. to S.W., lasting several days. The Monsoon is in its strength during June and July, with the mean direction of the wind W.S.W., and W. by S. in August; no vessels should at this season unnecessarily approach too near the coast. In August the squalls are frequently from W.N.W. and N.W.; in September the weather is finer, but the prevalent winds are still from W. and W.N.W., with heavy squalls occasionally between S.W. and W.N.W., and when these occur there are brief *intervals of calm between the gusts.*

In the *middle* of the SOUTHERN PART OF THE ARABIAN SEA, westward of the Laccadivh Islands, in a rude oval area included between Lat. 5° and 12° N., Long. 59° and 71° E., the sky is generally cloudless, the wind light, the water smooth, and squalls seldom happen, notwithstanding that the S.W. Monsoon may be blowing in full force on the Arabian and Indian coasts. This region, as well as the band of strongest Monsoon and apparent course of the rain-clouds from Africa, is shown on CHART DIAGRAMS III. and IV.

Towards the middle of October the force of the S.W. Monsoon has decreased, and shows signs of terminating; at this period land and sea breezes commence near the coast.

53. Laccadivh Islands. — Hereabouts, and thence to Cape Comorin, the S.W. Monsoon is very fresh, and varies from W.S.W. to S.S.W., rarely passing to S. From the end of September to the beginning of November the weather is often squally, with rain. To the westward of these islands and in their vicinity, from November to the end of February, the N.E. Monsoon is regular between N. and N.E., hauling to E. during night. In March and April the wind varies between N. and N.N.W. In May westerly winds may be expected, and as soon as the S.W. Monsoon sets in there is generally a long rolling swell near the Laccadivh and Maldivh Islands; but the weather is never so bad as that near the coast of India; the squalls are not as strong, nor is the rain so copious. In September the S.W. Monsoon is dying out; calms are common; and the wind is generally from the N.W.-ward.

54. Maldivh Islands. — Among and in the vicinity of the Maldivh Islands the winds vary from N.W. to W.N.W. during February, March, and April, after which the *rainy* season sets in with the S.W. Monsoon. The *dry* (or fine) season extends from October to April, although it rains occasionally during the former month. This is the period of the N.E. Monsoon; the prevalent winds are, however, easterly—but inconstant both as regards direction and strength.

55. Ceylon.—The position of this island is such that the weather and seasons of its N.E. side approximate to the meteorological character of the Coromandel coast,

while its S.W. side has more affinity with the Malabar coast. The N.E. Monsoon prevails from November to February, and the S.W. Monsoon from April to September, the intervening months being periods of variable winds and calms. The N.E. Monsoon is the fine season of the west coast of the island, and the S.W. Monsoon the wet and stormy season.

Point de Galle.—During the N.E. Monsoon, from December to March (inclusive), the harbour of Galle is always accessible, for a sea breeze, varying from S.S.E. to W., generally prevails during a part of each day, and early in the morning the wind is from the northward, off the land. During the S.W. Monsoon, from April to November (inclusive), a heavy swell rolls into the mouth of the harbour from the southward, even though the wind frequently veers to the northward of W. The annual range of the thermometer is from 70° to 87° Fahr.

Colombo.—A gale of wind may occur about the changes of the Monsoon, in the months of May, June, November, and even as late as December; though a gale in the latter month is very rare, and several years sometimes pass away without any beyond a stiff Monsoon breeze. These gales are seldom violent, and communication between the shore and shipping is seldom interrupted, although there are occasional spells of squally weather and a high sea during the S.W. Monsoon, making the passage over the bar difficult. The annual range of the thermometer is from 76° to 87° Fahr.

In the Gulf of Manaar the N.E. Monsoon often blows with great strength even as far south as Cape Comorin, bringing with it the bad weather common at that season on the Coromandel coast.

On the south coast of the island, and as far as the Basses, westerly winds are prevalent, more or less, throughout the year; for even during the period of the N.E. Monsoon, when the land and sea breezes are tolerably regular, the E. and N.E. winds of the morning change to W. and S.W. after mid-day.

On the east coast of the island the N.E. Monsoon is prevalent at the same period as on the Coromandel coast. In November the wind is from N.N.E. to E.N.E., and the weather generally squally and rainy. Heavy rain falls on the north part of the island during October, November, and December. Towards the middle of December to the end of January, although the Monsoon is occasionally strong, yet it is generally moderate from N. to N.N.E., and during the remainder of the season it is at times very hazy. Gales may, however, be expected any time during November, December, and January, rendering it dangerous to approach the east coast, for they blow for the most part dead on shore. At Trincomalee the annual range of the thermometer is from 74° to 91° Fahr.

In the Bay of Palk the S.S.W. winds are often very fresh and squally during May, June, and July.

At the change of the Monsoon land and sea breezes are prevalent.

In general, the eastern part of Ceylon, which is open to the N.E. Monsoon, partakes of the hot and dry climate of the coast of Coromandel. The western division, which is open to the S.W. Monsoon, has a climate like that of the Malabar coast, which is temperate and humid. The N.E. winds, although accompanied with rain, are drier than those from the S.W., and the country over which they blow has an arid appearance as contrasted with the luxuriant verdure of the southern and western districts, which continues during the greater part of the year. The driest seasons

are those which occur between the range of the two Monsoons, partaking slightly of the influence of both.

The climate and seasons of the northern and southern districts may be thus strikingly contrasted. On one side of the island, and even on one side of a mountain, the rain may fall in torrents, while on the other the earth is parched and the herbage withered. The inhabitants in one place may be securing themselves from inundations, while in another they are carefully distributing the little water of former seasons, which is retained in their wells and tanks.

56. Bay of Bengal.—In the middle of the Bay of Bengal, during the N.E. Monsoon, the winds vary from N.N.E. to E.N.E.; during the S.W. Monsoon their direction is generally from the southward, and more persistent at sea than near the coast.

In March variable winds from S.W. to S., veering even to E. and N.E., are prevalent; frequently when the wind is from S. near the coast, it may vary from N.E. to S.E. at sea.

In April and May S.S.W. and S.W. winds are prevalent, varying to W.S.W. in May; when the breeze is light and variable, in April, it is occasionally interrupted by calms; and should it veer to N.E. and E., it may blow fresh, if not strong.

In June, July, and August, the S.W. Monsoon is at its height, variable between S.W. and W.; towards the end of July, and during August, it may veer to W.N.W. or N.W.

In September and October the prevalent winds are W. and S.S.W.; these, from the middle of August to the commencement of October, are accompanied by heavy rain; after the middle of September the Monsoon begins to die away, and winds, variable between N.E. and N.N.W., are not uncommon.

In November variable winds from N.N.E. to E.N.E. are prevalent, and in December and January the N.E. Monsoon is fully established in the bay. In October and November the weather is squally, and a gale or two may be expected; at such times there is a copious rainfall. From the middle of December to the end of January the weather is more moderate.

February is generally a fine month, and the wind fresh from N.N.E. to N.E.; towards the end of the month the Monsoon is gradually disappearing, when southerly winds are as frequent as those from the N.

In January, February, and March, the alternations of the wind are from N.E. to S.E., rarely to S.W.

Between the Equator and Lat. 8° or 10° N., in October and November, the winds are often very fresh or strong from the westward, and continue so for several days in succession; near the Equator they will blow from N.W. to N.N.W. On the parallel of Ceylon and Acheen Head (especially in the vicinity of the Nicobars) they vary from W.S.W. to W.N.W., while more to the north they may be from S.W. and S.S.W.

57. Weather on the Coromandel Coast.—The following statement of the weather during each month of the year is from an extensive series of meteorological observations made at the Madras Observatory:—

During January the wind blows uniformly and steadily from the N.E., with occa-

sionally an inclination towards the E. about the middle of the day, in the shape of sea breeze. In the mornings, for the most part, heavy dew is deposited, and occasionally fog, which reaches only to two or three feet above the surface of the ground. The weather is mostly very serene, presenting about twenty days of uninterrupted clearness, and five of mist, the remaining days being clouded, with perhaps a single shower of rain; lightning is almost unknown in this month. The hottest time of the day is about 1 P.M., the coldest at 4.20 A.M.

In February the N.E. Monsoon continues, with occasional exceptions, till the middle of the month, after which calms and S.E. winds as frequently prevail. In the early part of the forenoon it is usually calm until 11 A.M., when the sea breeze sets in, and blows till 10 or 12 P.M. During the whole of this month the weather is, without exception, always beautifully clear and placid, and it is generally considered to be the most healthy period of the year. There are no more than one day of haze, and one of clouds. Rain or lightning does not occur once in seven years. The hottest time of the day is at 0.40 P.M., the coldest at 5 A.M.

Throughout March the S. (or alongshore) wind prevails with very unequal force. It is accompanied with a profuse dampness and sultriness, which render its effects highly prejudicial to health and comfort. On this account the sea breeze, which sets in at noon and blows till 10 P.M., is less courted than at other seasons. The sky is, however, beautifully clear for about twenty-seven days, the remaining four being cloudy. Dew less frequently occurs and is less in quantity than last month; rain and lightning are little known. The hottest time of the day is at 0.20 P.M., the coldest at 5 A.M.

The remarks of last month relative to the winds are equally applicable to April. The S. wind, varying from S.E. to S.W., still continues, at times blowing very fresh, but occasionally calms ensue, which are exceedingly oppressive. The weather is clear for about twenty-four days, with four days of flying clouds, or haze, and two of clouds, on one of which rain falls; lightning occurs for two days. Dew is very little in quantity, and of unfrequent occurrence. The hottest time of the day is about noon, the coldest at 4.50 A.M.

The S. wind, which is mentioned as peculiar to the two last months, continues till the middle of May, relieved sometimes by a land wind from the W. or S.W. In this interval gales of wind of extreme violence have occasionally been experienced, commencing generally at the N.W., and veering to every point of the compass. About the 16th the regular land or hot winds set in, which are moderated in their effect towards the end of the month by occasional showers. The sea breeze sets in about noon, and blows till 9 or 10 P.M. There are about nineteen days of clear weather, eight of flying clouds and haze, and four cloudy days, on two or three of which there is rain.* The dew is almost imperceptible; and lightning, with thunder, occurs about four times. The hottest time of the day is 11.20 A.M., the coldest at 4.20 A.M.

The land wind has arrived at its maximum of effect about the beginning of June, being afterwards much moderated by clouds and rain. The sea breeze, which is extremely uncertain, sets in about 1 P.M., and blows till about 9 or 10 P.M., but sometimes altogether fails. The weather is clear for about eight days, there being eleven

* In this statement the rain which fell during three gales of wind has been omitted; on the 2nd May, 1811, during the gale which then blew, there fell 5·5 inches; on the 8th, 9th, and 10th May, 1820, 16·54 inches; and on the 7th, 8th, and 9th May, 1827, 23·30 inches.

days of flying clouds and haze, and the same number of cloudy days. Of these there are six days in which rain occurs, and three or four of lightning and thunder. Dew is almost imperceptible. The hottest time of the day is about 2 P.M., the coldest at 4.20 A.M.

With July, the rains of the S.W. Monsoon being generally in heavy but partial showers, the weather may be reckoned among the most cloudy of the year, there being only six clear days; the remaining days consist of thirteen cloudy and twelve of flying clouds and haze. Of these there are eight days on which rain falls, and about three of thunder and lightning. The sea breeze is very uncertain as to the time it commences or ceases, and not unfrequently fails for several days together. The hottest time of the day is at 2.20 P.M., the coldest at 4 A.M.

The regular westerly winds, which terminate about the middle of August, are succeeded by winds of a light and variable nature, mostly from the W. and S. Calms, haze, and rain, occur in about the same proportions as last month, leaving about eight days of clear weather. Lightning, unattended by thunder, is very frequent, but thus accompanied it occurs only once or twice. The sea breeze assumes much the same character as that experienced last month, commencing at 2 or 3 P.M., and continuing till 8 or 10 P.M. Dew is sometimes discovered, but more frequently fails. The hottest time of the day is at 2 P.M., the coldest at 3 A.M.

Throughout September light and variable winds, with occasional calms, continue; and with the exception that the weather is not quite so much clouded, the remarks of last month apply with equal propriety to this. Lightning occurs almost every evening, but accompanied by thunder three times only. The sea breeze sets in about 2 or 3 P.M., and blows till 8 or 10 A.M., but occasionally fails for two or three days together. Dew is common, but small in quantity. The hottest time of the day is at 2 P.M., the coldest at 4.20 A.M.

In October the clouds begin to assume a more dense appearance than heretofore. Calms, lightning, and rain, are very frequent, till the 9th, when the N.E. Monsoon, or rainy season, sets in. From this time till the end of the month the atmosphere assumes a very disturbed appearance. Extremely heavy rain, with storms of wind, thunder, and lightning, invariably occur, and gales of wind, of a similar nature to those which occur in the earlier part of the year (*see* May), are sometimes experienced. On these occasions a depression of the barometer of four or five-tenths of an inch is observed. The sea breeze, or rather a slight modification of the N.E. wind, is perceived towards the middle of the day. The hottest time of the day is at 1 P.M., the coldest at 4.50 A.M.

In November the N.E. Monsoon continues with unabated force, and the state of the weather generally is much the same as that experienced towards the end of October, save that an increased dampness of the air, and the less frequent occurrence of lightning, render a distinction necessary. The number of clear and cloudy days in this, as well as last month, is liable to great uncertainty. The remarks relative to the sea breeze of last month apply equally to this. The hottest time of the day is at 0.20 P.M., the coldest at 5.40 A.M.

The heavy rains and violent gusts of wind are much moderated at the beginning of December, and arrive at their close about the 15th. From this time the sky assumes an appearance of tranquillity and clearness, which forms a strong contrast

with the disturbed state of the preceding month. The N.E. wind, however, continues throughout the month without interruption; there are about thirteen clear days, eleven cloudy, and seven days of flying clouds and haze. Of these there are six days on which rain falls. The mornings exhibit a copious deposition of dew, and sometimes a ground fog, which does not reach more than two or three feet above the surface. The sea breeze sets in at 10 A.M., and blows till 4 P.M. The hottest time of the day is at 0.50 P.M., the coldest at 2.50 A.M.

58. At the **head of the Bay of Bengal** the Monsoons are very irregular, and the direction of the wind far from persistent; similar remarks apply to the period of change. To the northward of the parallel of 17° N. the N.E. Monsoon rarely blows with any strength, and is variable between N.N.E. and N.N.W. During this season calms, alternating with light airs, are very frequent.

Between MASULIPATAM AND THE MOUTH OF THE HOOGLY, in October and November, the N.E. Monsoon is variable; during November and December the weather is very uncertain, and heavy squalls, if not gales, may be expected. Towards January the N.E. Monsoon decreases in strength, and the rainy season terminates, after which land breezes from W.N.W. to S.W., and sea breezes from E.N.E. set in; these continue throughout February and March, although the Monsoon may at times blow strong for a few hours. In March the winds are frequently from S.E. to E.S.E. during the day, and from S.S.W. to S.W. during the night. In the vicinity of Balasore and the Sunderbunds the wind, during March and the beginning of April, is frequently from N.W., in gusts.

In April southerly and south-easterly winds prevail—at times strong—bringing cloudy weather and fog. In Balasore roads, during May, the wind varies from S.S.E. to S.W. and W.S.W. These south-westerly winds are often very strong, especially so in May, when the weather is overcast and heavy squalls and gusts may be expected, if not a gale or two; this continues till June and July; the squalls are always accompanied by rain. The S.W. Monsoon is in its strength on this coast during June, July, and August.

The Monsoon in Balasore roads blows from W.N.W. to W.S.W., generally strong; in August the weather is very uncertain and squally, and the wind variable—from S.S.E. to S.S.W. and W.N.W. Heavy rain may also be expected at this time; in the same roadstead, during April and May, the wind usually blows from S. to S.E.; but should it pass from S.S.E. to S.W., it comes in strong gusts, with heavy rain, while it may be fine along the coast to the southward. During the change of either Monsoon, Balasore should be avoided.

At the *mouth of the* HOOGLY the weather is always very changeable between the Monsoons; and when N.W. winds occur at that time, they usually come in squalls and gusts,—with thick, cloudy weather, and lightning.

The rainy season terminates in October on the coast of ARACAN. Southerly winds are prevalent, yet strong N.E. and E. winds are not unusual. Thus it may be said, they are variable between N.E. and S.W. February is the finest month of the year; the wind is from N. and E., while on the opposite side of the Bay of Bengal fresh W.N.W. and S.W. winds are prevalent. Land and sea breezes occur at this period.

59. Gales in the Bay of Bengal.*—In that part of the Bay of Bengal BETWEEN THE COROMANDEL COAST AND THE ANDAMAN ISLANDS the October and November storms come from W.S.W., varying to W.N.W. and N.W., and blow with great force. Sometimes they come from S.E., and more frequently still from N.E. When a N.E. gale occurs in January its strength is generally not so great as in the previous months.

Storms, during April to June, generally begin from N.N.W. to N.N.E., veering to N.E. and E., but moderating and dying out when they change to the southward of E.; they blow hardest from N.E. to E.; but should they continue in any strength from the southward and eastward, which is rarely the case, they will not moderate until they have blown hard from S.W., after which they cease. The approach of these gales towards the coast is indicated by a heavy swell, eight to twelve hours before their arrival.

On the COROMANDEL COAST the storms of April and May begin at N.W., changing in succession to N., N.E., E., or E. by S., after which they abate, having blown hardest at N.E. and E.; when the wind veers to S.E. or S., and thence to S.W., their force is very great, and they send a heavy swell towards the coast. An ugly, threatening appearance of the sky is the precursor of these storms, but the same aspect at this period may merely betoken heavy rain, with little wind. From the beginning of October to that of December is also a stormy season; when the wind blows hard from N.E., and after a lull veers to S.E., S., and S.W., it always blows hard. The coast should be avoided at the latter end of October and during November, unless bound to a port there, because general bad and squally weather begins, attended by heavy rain, thunder, and lightning. The squalls and gales, when they shift to the south of E., generally die out; a strong breeze in September off the land seldom lasts long.

At the HEAD OF THE BAY OF BENGAL, since the Monsoons are uncertain and irregular, storms are equally so; in April, May, and June, they are indicated by a partial lull in the S.W. Monsoon and a smooth sea, when the wind becomes variable —all round the compass—with calms; the horizon is clearer than usual, there is a hollow moaning through the rigging, and light gossamer threads are wafted through the air. In the storm which succeeds these signs the wind is strong from W.S.W., but passing quickly through W. to W.N.W. and N.W., it blows very hard and steadily from that quarter for some time—the gale generally lasting from ten to twelve hours, and with greater force on the western than on the eastern side of the bay. Off Cape Palmyras, though ordinary gales veer as above, yet they sometimes change from N.W. to N. and N.N.E., or N.E., when, after a brief calm, they blow from S.W. with equal fury for an hour or so; then follows a breeze from E.S.E. to N.E., when it may again change to S.W. Heavy rain is a constant concomitant of these gales.

The gales of October and November are heavier than those of any other season. After a slight shower, with a moderate wind from E.S.E., the breeze freshens at E., veering to E.N.E., N.E. and N., where it gradually lulls. Sometimes the changes proceed to N.N.W. and N.W., with heavy rain throughout. These Easterly and Northerly gales may last a day or two, and when a brief calm ensues, the

* KERHALLET:—"Considérations Générales sur L'Océan Indien," 3me ed. p. 29, et seq.

wind is very likely to change rapidly to S.S.W., lasting with great fury for half an hour or more.

The hurricanes of the Northern Indian Ocean are described in Chap. VI.

60. Coasts of Martaban and Tenasserim: Islands of Andaman and Nicobar.—Along the coast the S.W. Monsoon commences towards the end of May, its direction being W. and W.S.W. until the middle of July; it attains its greatest strength in August and September, after which it becomes variable, alternating with calms and light airs. During October, when the S.W. Monsoon is about to close, land and sea breezes set in, but they are neither so strong nor so persistent as the similar breezes at the end of the N.E. Monsoon. In October and November the weather is squally, and the wind, commencing at E.S.E., will frequently pass through E. and E.N.E. to N.N.E. and N., accompanied with heavy rain.

The N.E. Monsoon is regular during December and January, decreasing in strength towards the middle of February, when the Monsoon alternates with land and sea breezes; this continues until April, the alternation being frequently from E. to N.W., though more commonly from the southward than from the northward. Calms of short duration may be expected occasionally during February, March, and April, after which the change to the S.W. Monsoon becomes sensible.

Among the islands forming the Mergui Archipelago, and thence both north and south, the wind is generally light during July and August—variable between N. and W. The strong winds so common in the Bay of Bengal at that period of the year lose much of their strength before reaching the archipelago. The foregoing remarks apply equally to the coast east of Cape Negrais and to the Gulf of Martaban.

While the N.E. Monsoon, variable between N.E. by E. and E.N.E., is prevalent off the Tenasserim coast, northerly winds are frequently experienced off the islands of **Andaman** and **Nicobar.** Similarly with regard to the S.W. Monsoon, it is very irregular in the narrow sea between those islands and the coast; the winds, though generally variable between W. and N., are sometimes from S.E. or S.W., and in respect to strength are equally uncertain, heavy squalls and rain alternating with light airs or calms, while the sky is generally cloudy. The change of each Monsoon is always characterized by heavy squalls and cyclonic gales of short duration. The N.E. Monsoon (more northerly than easterly) commences among the Nicobars in November, and is the fine season; land and sea breezes are prevalent during that period, for the Monsoon wind is rarely strong, except in December and January; towards the end of April sudden squalls from the W. may occur. The S.W. Monsoon begins in May, and in the vicinity of the Andaman and Nicobars generally blows fresh or strong from the S.

61. Straits of Malacca.—The Monsoons are very irregular in the Straits of Malacca, and the winds variable; that of the N.E. (the fine season) lasts from November to April, the S.W. from May to October. During the S.W. Monsoon the sky is cloudy, and the weather squally, with rain.

In October and November the winds are from N.W. to W.; however, the N.E. Monsoon—from N.E. to E.N.E.—has generally set in towards the middle of November, and it blows with force in December and January, moderating in March: N. and N.W. winds are not uncommon during the season; and westerly winds at

times last for a day or two. The Monsoon may be expected to draw to the N. any time between the latter end of February and beginning of April, in which case it becomes light and variable; at this time fresh land and sea breezes prevail, with calms towards mid-day. These calms are more frequent along the Sumatra coast than along that of the peninsula of Malacca.

The S.W. Monsoon is at its height in June and July; and for four months, between May and September, it is variable, from S.W. to S., but never very strong, except at the northern entrance to the strait. Calms are now more prevalent along the Malacca than the Sumatra shore, but they are of short duration, generally occurring near mid-day; but the breeze is tolerably fresh during the night and at sunrise. The rainy season is from the end of August to the beginning of December, when in some parts, as at the N.W. entrance of the strait, the fall is very great, with the wind from N.W. and W., and squally weather.

During the S.W. Monsoon the winds on the N.E. COAST OF SUMATRA frequently hang to S.S.E. and S.E.; but during the night, when in the vicinity of the high land between Cape Pedir and the Carimon Isles, during June, July, and August, heavy and dangerous gusts from S.W. to S.—called *Sumatras*—are often experienced between midnight and 2 or 3 A.M. In some places they commence at 6 P.M. and last till 8 P.M., alternately squally and calm, strong and moderate. In the roadstead of Malacca they commence at 7 P.M. and last till midnight, and are dangerous if no precautions are taken against their approach.

Heavy squalls from the N.W. may also be expected at times off the north coast of Sumatra, as well as in the vicinity of the Carimon Isles and the Straits of Singapore; their approach is indicated by the rapid rising of a black and arched cloud, scarcely leaving time to take in sail; the first gust is the strongest, and, as is the case with the *Sumatras*, they are attended with rain, thunder, and lightning.

The Monsoons are more regular near Singapore.

62. West Coast of Sumatra.—This island, owing to its intersection by the Equator, is very difficult to deal with, as regards wind and weather; for there appears to be a strange blending and modification of the different Monsoons, at least along the central part of the coast, if not towards the north and south parts, where the seasons are better contrasted.

At Acheen and its vicinity the S.W. Monsoon is prevalent from April to November; this is the hot season, as well as that of rain, which falls in April, and again in August. Near the coast the winds are S. and S.S.W.; at sea, W.S.W. to S.W. Along the equatorial part of the island S. winds prevail, varied at times by those from N.W. and S.E., the former very strong. During the same months, or perhaps beginning in May and terminating in October, the S.E. Monsoon (or dry season), with the wind from S.S.E. to S.S.W., occurs, and is at its height in June, July, and August, when there are no land breezes; at the beginning and end of the season S. and S.W. winds (sea breezes) are prevalent during the day, and land breezes from N. and N.W. during the night. Strong *north-westers* are not uncommon at this season, though more prevalent north than south of the Equator.

The N.E. Monsoon, on the northern part of the island, is comparatively weak, and land and sea breezes prevail as far south as Bencoolen during December and January; this is the fine season. The N.W. Monsoon, south of the Equator, com-

mences at the end of November and terminates in March, bringing with it rain and bad weather. The general winds are now from N.W. to W.N.W., occasionally interrupted by a breeze from S. and S.S.E.; strong squalls, especially during the night, may always be expected at this season, and they are invariably accompanied by rain; the sea breeze often veers to W.S.W. in March and April.

As is usual in most parts of the Indian Ocean, the land and sea breezes are most conspicuous when the Monsoons become light and are dying out; and it must be remembered that the fine season at the south extreme of the island takes place during the wet season of the northern part, and *vice versâ;* so also with regard to general bad weather off the coast.

Off the coast, on the Equator, calms are very frequent, and squalls and bad weather comparatively rare; but sudden gusts of short duration come off the mountains during the night, as near Priamen. At Padang the regular Monsoon is marked by the land and sea breezes, which blow with great constancy every day at right-angles to the coast; hence the land breeze is from E.N.E., and the sea breeze from W.S.W. The great quantity of rain and the frequency of thunderstorms in the months of March and April, and again from October to December, alone serve to mark the change of the Monsoon.

63. Sunda Strait.—From April to October the Easterly Monsoon is prevalent—variable between S.S.E. and E.S.E. The Westerly Monsoon, variable between W.N.W. and N.W., prevails from November to May, and is generally accompanied with bad weather.

64. From the **Strait of Sunda to Timor Island** the Easterly Monsoon, variable between E. and S.S.E., commences in May, and is at its height in June and July. The Westerly Monsoon commences in November, and is at its height in January; bad and squally weather sets in with this Monsoon, and gales are not uncommon from November to the middle of February; this is also the rainy season, especially December and January. In March the Monsoon is dying out; April is tolerably fine, and the wind variable. The ordinary strength of the E. Monsoon is fresher than that from the W.

65. South Coast of Java—Sumbawa, &c.—In April the winds are variable, after which (in May) the E. Monsoon begins, bringing with it fine weather, and being at its height from June to August. In October this Monsoon is about to terminate, and after variable winds the N.W. Monsoon commences, lasting till the middle of February.

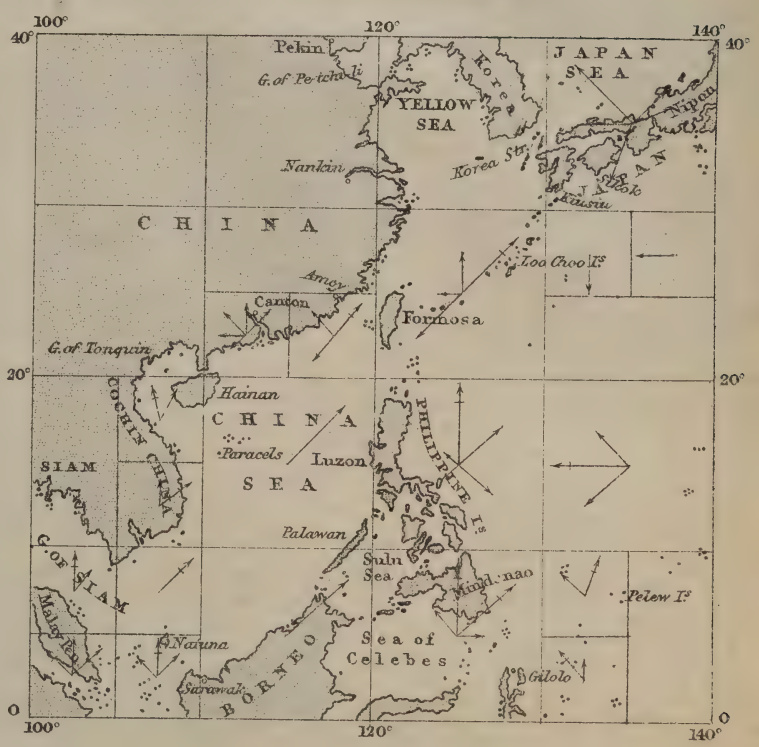
During February and March, and also in October—months when the Monsoons change—land and sea breezes are prevalent, stronger in October than at the former period. In February, March, and even in April, the land breeze often sets in with a strong gust, or in a squall, speedily moderating. The weather is also apt to be squally and puffy with the sea breeze in April and May, but only when it first springs up. During May and November the rain is very abundant on this coast.

In the Straits of Baly the wind often blows with great strength from the N. In the other straits to the east of Java a breeze from the S. very often blows during the morning and forenoon, when, after a calm, towards 2 P.M., it changes to N.

WINDS in the CHINA SEA

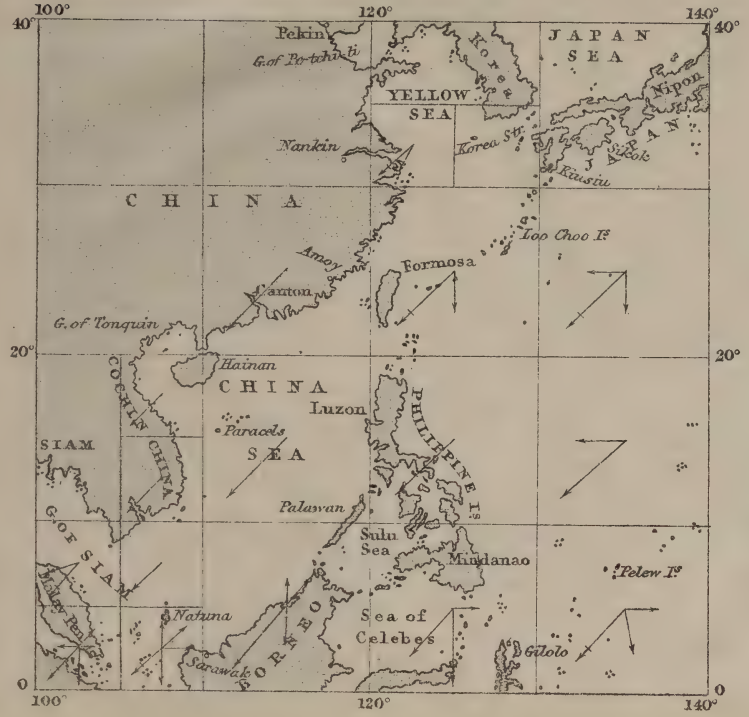
[APRIL, MAY, JUNE]

[JULY, AUGUST, SEPTEMBER]

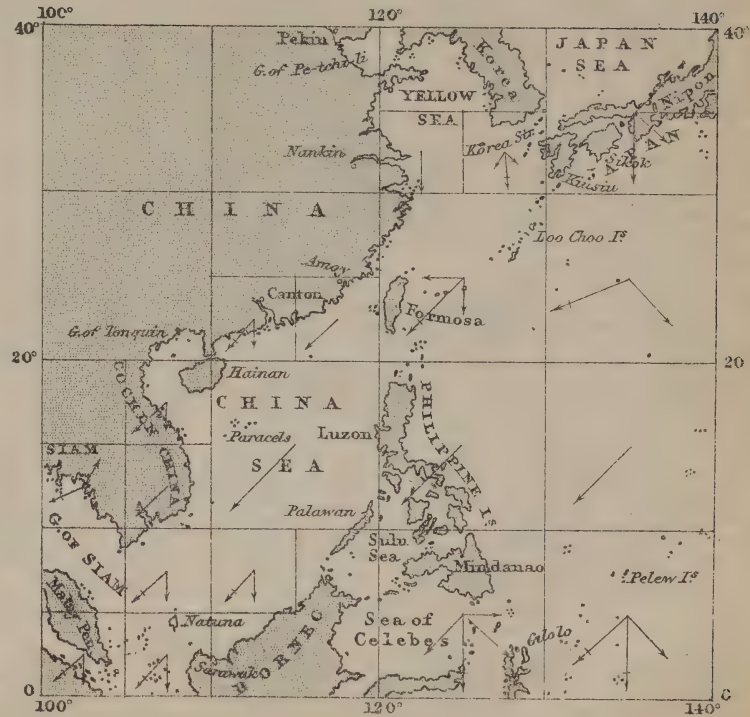


WINDS in the CHINA SEA

[OCTOBER, NOVEMBER, DECEMBER]



[JANUARY, FEBRUARY, MARCH]



On the N.W. side of the island of **Timor,** from October to February, the N.W. Monsoon, variable between N. and W., is fully established, but is at its height only in December and January, when the rains fall, which, however, last till February; this is a season of overcast, squally weather, and the wind is often very strong, from W. to N.N.E. Towards the end of April the easterly Monsoon, variable between E. and S.S.E., brings fine weather, and is stronger than on the south side of the island. On both coasts land and sea breezes set in with the fine season, the land breeze on the south coast being from N.E. to N., the sea breeze from S.S.E. to S.S.W.

Gales may be expected on the south coast in October, on the north coast not before December.

66. In that part of the **Ocean between the Indian Archipelago and the North Coast of Australia** calms are very frequent at all seasons of the year, and Monsoon-like weather is always more or less prevalent. The westerly Monsoon, variable between S.W. and N.W., begins in October and ends in April, blowing with considerable strength and in squalls during December, January, and February. The E. and S.E. Monsoon, from May to September, is the fine season. These remarks apply also to the Ocean as far west as the meridian of Christmas Island.

67. The Java Sea.—The following observations are by CAPTAIN JANSEN, of the Dutch Royal Navy:*—"In the Java Sea, during the month of February, the W. Monsoon blows strong almost continually; in March it blows intermittingly, and with hard squalls; but in April the squalls become less frequent and less severe. Now the changing commences; all at once gusts begin to spring up from the E.; they are often followed by calms. The clouds which crowd themselves on the clear sky give warning of the combat in the upper air which the currents there are about to wage with each other. The electricity, driven thereby out of its natural channels, in which, unobserved, it has been performing silently, but with the full consciousness of its power, the mysterious task appointed to it, now displays itself with dazzling majesty; its sheen and its voice fill with astonishment and deep reverence the mind of the sailor—so susceptible, in the presence of storm and darkness, to impressions that inspire feelings both of dread and anxiety, which by pretended occupations he strives in vain to conceal.† Day and night we now have thunderstorms. The clouds are in continual movement, and the darkened air, laden with vapour, flies in all directions through the skies. The combat which the clouds seem to court and to dread appears to make them more thirsty than ever. They resort to extraordinary means to refresh themselves; in tunnel form, when time and opportunity fail to allow them to quench their thirst from the surrounding atmosphere in the usual manner, they descend near the surface of the sea, and appear to lap the water directly up with their black mouths. Water-spouts thus created are often seen in the changing season, especially among small groups of islands, which appear to facilitate their formation.‡ The water-spouts are not always accom-

* Bijdrage Natuurkündige Beschrijving der zeën, vertaald door M. H. JANSEN, Luitenant ter zee.

† No phenomena in nature make a deeper impression upon the sailor than a dark thunderstorm in a calm at sea.—JANSEN.

‡ I never saw more water-spouts than in the Archipelago of Bioun Singen during the changing. Almost daily we saw one or more.—JANSEN.

panied by strong winds; frequently more than one is seen at a time, whereupon the clouds whence they proceed disperse in various directions, and the ends of the water-spouts bending over, finally cause them to break in the middle, although the water which is now seen forming around their base has suffered little or no movement laterally."

Water-spouts.—"Yet often the wind prevents the formation of water-spouts. In their stead the wind-spout shoots up like an arrow, and the sea seems to try in vain to keep it back. The sea, lashed into fury, marks with foam the path along which the conflict rages, and roars with the noise of its water-spouts; and woe to the rash mariner who ventures therein!* The height of the spouts is usually somewhat less than 600 feet, and their diameter not more than 20 feet, yet they are often taller and thicker; when the opportunity of correctly measuring them has been favourable, however, as it generally was when they passed between the islands, so that the distance of their bases could be accurately determined, I have never found them higher than 2100 feet, nor thicker than 150 feet. In October, in the Archipelago of Rio, they travel from N.W. to S.E. They seldom last longer than five minutes; generally they are dissipated in less time. As they are going away, the bulbous tube, which is as palpable as that of a thermometer, becomes broader at the base, and little clouds, like steam from the pipe of a locomotive, are continually thrown off from the circumference of the spout, and gradually the water is released, and the cloud whence the spout came again closes its mouth."

The East Monsoon in the Java Sea.—"During the changing of the Monsoons it is mostly calm or cool, with gentle breezes, varied with rain-storms and light gales from all points of the compass. They are harassing to the crew, who, with burning faces under the clouded skies,† impatiently trim the sails to the changing winds. However, the atmosphere generally becomes clear, and, contrary to expectation, the N.E. wind comes from a clear sky; about the coming of the Monsoon it is northerly. Now the clouds are again packed together; the wind dies away, but it will soon be waked up to come again from another point. Finally, the regular land and sea breezes gradually replace rain, and tempests, calms, and gentle gales. The rain holds up during the day, and in the Java Sea we have the E. Monsoon. It is then May. Farther to the south than the Java Sea the E. Monsoon commences in April.‡ This Monsoon prevails till September or October, when it turns to become the W. Monsoon. It has seemed to me that the E. Monsoon does not blow the same in every month, that its direction becomes more southerly, and its power greater after it has prevailed for some time.§

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* The air-spouts near the Equator always appear to me to be more dangerous than the water-spouts. I have once had one of the latter to pass a ship's length ahead of me, but I perceived little else than a waterfall in which I thought to come, yet no wind. Yet the water-spouts there also are not to be trusted. I have seen such spouts go up out of the water upon the shore, where they overthrew strong isolated frame-houses. I have, however, never been in a situation to observe in what direction they revolved.—JANSEN.

† At sea the face and hands burn (change the skin) much quicker under a clouded than under a clear sky.—JANSEN.

‡ In the north-east part of the Archipelago, the E. Monsoon is the rainy Monsoon. The phenomena in the north-east part are thus wholly different from those in the Java Sea.—JANSEN.

§ As is well known, the Strait of Sourabaya forms an elbow whose easterly outlet opens to the E., while the westerly outlet opens to the N. In the beginning of the E. Monsoon the sea wind (E. Monsoon) blows through the westerly entrance as far as Mt. Gievie (in the elbow); in the latter part of this Monsoon the sea wind blows, on the contrary, through the easterly entrance as far as Sambilangan (the narrow passage where the westerly outlet opens into the sea).—JANSEN.

"As the sea makes the coming of the southern summer known to the inhabitants of the Java coast,* the turning of the E. Monsoon into the W. Monsoon commences. After the sun has finished his yearly task in the northern hemisphere, and brings his powerful influence to operate in the southern hemisphere, a change is at once perceived in the constant fine weather of the E. Monsoon of the Java Sea. As soon as he is at his height upon the Java Sea (Lat. 6° S.), then the true turning of the Monsoon begins, and is accomplished much more rapidly than the spring turning. The calms then are not so continuous. The combat in the upper atmosphere appears to be less violent; the S.E. Trade, which has blown as the E. Monsoon, does not seem to have sufficient strength to resist the aggressors, which with wild storms from the N.W. and W., make their superiority known. Upon and in the neighbourhood of the land thunderstorms occur, but at sea they are less frequent.

"The atmosphere, alternately clear and cloudy, moves more definitely over from the N.W., so that it appears as if no combat was there waged, and the S.E. gives place without a contest. The land breezes become less frequent, and the phenomena by day and night become, in a certain sense, more accordant with each other. Storms of wind and rain beneath a clouded sky alternate with severe gales and steady winds. In the last of November the W. Monsoon is permanent.

"Such are the shiftings. But what have they to do with the general system of the circulation of the atmosphere? Whenever we read attentively the beautiful meditations of the founder of the Meteorology of the Sea, and follow him in the development of his hypothesis, which lays open to view the wheels whereby the atmosphere performs its varied and comprehensive task with order and regularity, then it will not be necessary to furnish proof that these turnings are nothing else than the passing of a belt of calms which separates the Monsoons from each other, and which, as we know, goes annually with the sun from the S. to the N., and back over the torrid zone to and fro.

"So also the calms, which precede the land and sea winds, are turned back. If, at the coming of the land wind in the hills, we go with it to the coast, to the sea, we shall perceive that it shoves away the calms which preceded it from the hills to the coast, and so far upon the sea as the land wind extends. Here, upon the limits of the permanent Monsoon, the place for the calms remain for the night, to be turned back to the land and to the hills the following day by the sea wind. In every place where these calms go the land and sea winds turn back. If various observers placed between the hills and the sea, and between the coast and the farthest limit of the land wind, noted the moment when they perceived the calms, and that when they perceived the land wind, then by this means they would learn how broad the belt of calms has been, and with what rapidity they are pushed over the sea and over the land. And even if the results of one day should be found not to agree very well with those of another, they would at least obtain an average thereof which would be of value. So, on a larger scale, the belt of calms which separates the Monsoons from each other presses in the spring from the S. to the N., and in the fall from the N. to the S., and changes the Monsoons in every place where it presses."

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* In the Archipelago we have generally high water but once a day, and with the Equinoxes the tides also turn. The places which have high water by day in one Monsoon get it at night in the other.—JANSEN.

68. Banka—Gaspar and Carimata Straits.—Observations made at PALEMBANG (Lat. 6° 52′ S., Long. 105° 16′ E.), on the east side of Sumatra, during 1850–1856, show that from November to March the prevailing winds blow from W. and N.W.; this is also the rainy season—usually attendant on the W. Monsoon. In April the Monsoon changes, and, during the month, storms accompanied with thunder are very frequent. From May to September the prevalent winds are from E. to S.E., and the change occurs in September and October; during the year the veering of the wind is regular through ⇝ S., W., N., E., to S. ⇝.

In STANTON Channel the wind in the N.W. Monsoon blows off the Banka coast, and throughout the year land breezes generally occur during the night. A strong land breeze from the N.E. has been experienced in Stanton Channel during the S.E. Monsoon, when the wind was blowing directly through the Lucipara from the S.W.

In RHIO Straits the southerly Monsoon is generally strong in September, with rain and heavy squalls at the Equinox. In October calms alternate with light southerly airs, during which the atmosphere is damp and close; Sumatra squalls, or south-westers, also occur at night, with thunder and lightning. In November the northerly Monsoon sets in with heavy gusts.

In SINCAPORE Strait the winds during the S.W. Monsoon prevail from W. to S.E. In December, January, and February, the N.E. Monsoon is in full force, and generally very strong.

In GASPAR Strait and the CARIMATA Passage N.W. winds are generally prevalent when N.E. and N. winds are found north of the Equator.

69. Borneo, cut by the Equator, and extending through $11\frac{1}{2}°$ of lat.—from 7° N. to $4\frac{1}{2}°$ S.—exhibits a great diversity of seasons and of climate; in fact, the northern part of the island is characterized by the N.E. and S.W. Monsoons of the Indian Ocean and China Sea, while the southern part experiences the S.E. and N.W., or E. and W. Monsoons of the Java Sea. From May to October the S.W. Monsoon is prevalent on the N.W. coast, while the S.E. Monsoon extends over the west and south parts of the island. Similarly, from October to May, the N.E. Monsoon blows on the N.W. coast, while the N.W. Monsoon is the prevalent wind on the west and south coasts.

"The climate is damp and sultry, the thermometer at the level of the sea seldom falling below 80°, or rising above 90°. . . . . The whole island is one huge primeval forest; but it has not been charged with peculiar insalubrity, although to the European constitution it must be both uncomfortable and debilitating.

"The coast of Borneo would be a dangerous one to navigation from the absence of the shelter of harbours, of which it can hardly be said to have any, if it did not lie in the latitudes exempt from the storms and typhoons which prevail in the northern part of the China Sea, and which, although they extend to the Filippine group, never reach it. Heavy squalls are experienced at the changes of the Monsoons, and this is all."*

Respecting the SOUTHERN PART OF BORNEO, the remarks already made on the Java Sea appertain to this coast and the neighbouring waters. From October to April, with the W. Monsoon, it rains continuously, and often brings heavy and stormy

* "Jour. Roy. Geog. Soc.," vol. xxiii. p. 71. "A Sketch of the Geography of Borneo, by JOHN CRAUFURD, Esq., F.R.S."

weather. During the E. Monsoon the weather is still very damp and misty, though there is less rain. In Borneo it probably rains during ten months of the year.

Krecke* observes that at Banjermassig, on the south coast of Borneo, a S.W. Monsoon blows from December to March, and a S.E. Monsoon from April to October. The remaining months are periods of change. The rainfall is most copious from July to October, while storms, with thunder, are most frequent in November, December, and May, though in this respect there is considerable difference, for while eighteen such storms occurred in 1851, no less than eighty-three took place in 1857. The following is the prevalent direction of the wind for the different months:—In December, S.W. to W.S.W.; in January, W.S.W. to W.; in March, variable; in April the wind changes to S.E., and augments in strength till August and September; in October it hauls more to the S.; in November, during the morning it is southerly, but changes to S.S.W. and S.W. in the afternoon; when in December, the S.W. wind is again fully established.

The N.W. coast from Lat. 2° N., Long. 109° E., to Lat. 7° N., Long. 117° E., a distance of 600 miles, was visited by Captain C. D. Bethune, R.N.,† who says:—"The N.E. Monsoon prevails on the coast from November to April, and the S.W. Monsoon for the other six months. The months of November, December, and January, may perhaps be called the rainy season, but considerable quantities of rain usually occur about the change of each Monsoon; the finest weather is during the S.W. Monsoon. I am, however, inclined to think there is no decidedly dry season. Land and sea breezes alternate near the shore; the nights are always cool. The temperature assimilates to that of Sincapore, which for India is considered a temperate climate; a shower of rain often makes a difference of 10° at each place."

70. Celebes.—The position of the Island of Celebes approximates to that of Sumatra and Borneo in being cut by the Equator; but with respect to Celebes, the larger part of the island is to the *southward* of that line, and to this we shall refer at present. The S.E. Monsoon is the fine season, and lasts from May to September. The N.W. Monsoon, from October to April, is often very strong, with heavy rain at all times. In March, and again in September, when the sun is near the Equator, the winds are northerly, with rain.

71. Straits of Macassar and Molucca Passage.—In the northern part of Macassar Strait, from May to October, the easterly Monsoon is prevalent on the east coast of Borneo: the same Monsoon occurs also in the Molucca Passage. From November to April is the period of the westerly Monsoon.

In the middle and southern part of Macassar Strait the wind is N.E. during April, May, and June, after which it becomes more variable and light from E.N.E. to E.S.E. Fresh breezes from W.S.W. to W.N.W. prevail in October, November, and December, sometimes during January also.

As regards the wind near the land, it would appear that from May to October the wind is tolerably steady from the southward on the east side of Borneo, while at the same time there are regular land and sea breezes off the west side of Celebes.

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* "Meteorologische Waarnemingen in Nederland en zijne Bezittingen."
† "Jour. Roy. Geog. Soc.," vol. xvi. p. 302.

Off the west coast of Celebes the fresh S.W. Monsoon generally veers to W.N.W. and N.W. on approaching the opposite shore of Borneo.

During the S.E. Monsoon there is no strong land breeze on the low shores of Borneo, while on the coast of Celebes, owing to the interior being more elevated, a very fresh breeze comes from the land during the night, followed by the regular sea breeze: these winds are very beneficial in December. During August and September the wind is always light, with calms, at times alternating with a squall or two, which may rise to a storm.

72. Seas of Celebes and Sulu, or Mindoro.—The easterly Monsoon begins in October, but is not fully established before November, and terminates in April: this is the fine season. The westerly Monsoon, beginning in May, is in full strength in June, and ends in September; the weather is now gloomy and overcast, with rain; it is also very squally during this season, and in some of the heavy showers the wind veers round to E., especially in July and August; heavy gales are not uncommon, and occasionally a hurricane; between the islands of Celebes and Mindanao very strong squalls, in gusts, from the N.W. are prevalent. On the coast of Mindanao a heavy mist is not uncommon in September, and westerly winds have been known to last till November.

The N.E. or E. wind in the fine season, and especially in the Sulu Sea, is rarely fresh—more generally variable with calms; such, at least, is the case in December and January.

Similar seasons and winds prevail as far north as Manilla.

73. On the WEST COAST of **New Guinea** the S.E. Monsoon lasts from April to October, and the rainy season is from June to September, when dark, gloomy weather may be expected, with frequent fogs. The N.W. Monsoon begins early in November (sometimes in October), and terminates in April, which is the fine season; during January the winds are variable between N.N.W. and N.E.; in March, April, and May, heavy squalls occur at times, with an occasional gale.

74. The Molucca Islands AND NEIGHBOURING SEAS.—Northward of the islands of Boero and Ceram the S.E. Monsoon from April to October varies from S.S.E. to S.S.W., at Amboina from E. to S.E. The N.W. Monsoon, from November to March, is variable between W.S.W. and N.W., and occasionally a heavy storm occurs near the islands just mentioned. Generally, in the vicinity of the Moluccas, the easterly Monsoon brings bad weather and heavy rain, with hard gales at times; but it cannot be said that either Monsoon is very regular, and for two months at least, between the establishment of each, the wind and weather are more variable and uncertain than at any other time of the year.

75. Arafura Sea.*—In the Arafura and Timor seas the E. or S.E. Monsoon blows with the greatest regularity; at its height, from May to August, it is fresh from E.S.E. to S.E.; earlier and later it hangs more to E., and often veers to E.N.E.; at full and change of the moon calms and variable squally weather may be expected, as is also the case on the east coast of Australia.

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* CAPTAIN M'KENZIE, "Naut. Mag.," 1847, pp. 114, 115.

In Torres Strait E. winds are most prevalent. The W. Monsoon is never very steady, but is often checked by easterly winds, when light and variable airs continue for several days, until it comes up again with fresh strength. In that portion of the sea between New Guinea and Australia, during January and the commencement of the W. Monsoon, winds from N.E. and N. are greatly prevalent, backing to W. at times. In the inner passage, winds from N.E. to W.N.W. may be expected as far as Lat. 14° S., beyond which they haul to E. and S.E.

Between the Monsoons there are often long calms, and the sea at that time abounds with water-snakes: the period when the S.E. changes to the N.W. Monsoon is most liable to these calms. At the approach of the Monsoon, W. winds often blow for five or six days, and then dying away are succeeded for a week or so by light, variable airs: at full or change the true Monsoon sets in, with thick, rainy, and squally weather; this lasts a few days, after which it clears up and the breeze is moderate, bringing finer weather than the E. Monsoon, and certainly the land is more distinctly visible. At the limit of this Monsoon, in 15° S., I have always found rainy and squally weather. The mean direction of the wind is from W.N.W. to W.S.W., hauling to N.W. and S.W.

76. General Remarks on the Malay Archipelago.—The following additional remarks on the Archipelago, from a paper recently read at the Royal Geographical Society, are at once interesting and instructive, and convey an excellent general summary of the seasons of this region:*—

"The contrasts of vegetation and of climate in the Archipelago may be best considered together, the one being to some extent dependent on the other.

"Placed immediately upon the Equator, and surrounded by extensive oceans, it is not surprising that the various islands of the Archipelago should be almost always clothed with a forest vegetation from the level of the sea to the summits of the loftiest mountains. This is the general rule. Sumatra, New Guinea, Borneo, the Filippines, and the Moluccas, and the uncultivated parts of Java and Celebes, are all forest countries, except a few small and unimportant tracts, due perhaps, in some cases, to ancient cultivation or accidental fires. To this, however, there is one important exception in the Island of Timor and all the smaller islands opposite, in which there is absolutely no forest such as exists in the other islands, and this character extends in a lesser degree to Flores, Sumbawa, Lombock, and Bali.

"In Timor the most common trees are *Eucalypti* of several species, so characteristic of Australia, with sandalwood, acacia, and other sorts in less abundance. These are scattered over the country more or less thickly, but never so as to deserve the name of a forest. Coarse and scanty grasses grow beneath them on the more barren hills, and a luxuriant herbage in the moister localities. In the islands between Timor and Java there is often a more thickly-wooded country, but thorny and prickly trees abound. They seldom reach any great height, and during the force of the dry season they almost completely lose their leaves, allowing the ground to be parched beneath them, and contrasting strongly with the damp, gloomy, ever-verdant forests of the other islands. This peculiar character, which extends in a less degree to the southern peninsula of Celebes and the east end of Java, is most pro-

* "Jour. Roy. Geog. Soc.," vol. xxxiii., p. 224. "Wallace on the Physical Geography of the Malay Archipelago."

bably owing to the proximity of Australia. The S.E. Monsoon, which lasts for about two-thirds of the year (from March to November), blowing over the northern parts of that country, produces a degree of heat and dryness which assimilates the vegetation and physical aspect of the adjacent islands to its own. A little further eastward in Timorlaut and the Ke islands a moister climate prevails, the S.E. winds blowing from the Pacific through Torres Straits, and, as a consequence, every rocky islet is clothed with verdure to its very summit. Further west again, as the same winds blow over a wider and wider extent of ocean, they have time to absorb fresh moisture, and we accordingly find the Island of Java possessing a less and less arid climate in the dry season, till, in the extreme west, near Batavia, rain occurs more or less all the year round, and the mountains are everywhere clothed with forests of unexampled luxuriance.

"The changes of the Monsoons and of the wet and dry seasons in some parts of the Archipelago are very puzzling; and an accurate series of observations in numerous localities is required to elucidate them.

"Speaking generally," says Mr. Wallace, "the whole south-western part of the Archipelago, including the whole range of islands from Sumatra to Timor, with the larger half of Borneo and the southern peninsula of Celebes, has a dry season from April to November, with the S.E. Monsoon. This same wind, however, bends round Borneo, becoming the S.W. Monsoon in the China Sea, and bringing the rainy season to northern Borneo and the Filippines.

"In the Moluccas and New Guinea the seasons are most uncertain. In the S.E. Monsoon, from April to November, it is often stormy at sea, while on the islands it is very fine weather. There is generally not more than two or three months of dry, hot weather, about August and September. This is the case in the northern extremity of Celebes and in Boero, whereas in Amboina July and August are the worst months in the year. In Ternate, where I resided at intervals for three years, I never could find out which was the wet and which the dry season. The same is the case at Banda, and a similar uncertainty prevails in Menado, showing probably that the proximity of active volcanoes has a great disturbing meteorological influence. In New Guinea a great amount of rain falls, more or less, all the year round. On the whole, the only general statement we can make seems to be that the countries within about 3° on each side of the Equator have much rain and not very strongly contrasted seasons; while those with more south or north latitudes, have daily rains during about four months in the year, while for five or six months there is almost always a cloudless sky and a continual drought."

77. Winds in the China Sea.—In the China Sea the Monsoon periods have not the same regularity as in the Indian Ocean; they have already been sketched at p. 22, and are indicated graphically on Chart Diagrams VI., VII., VIII., and IX., where, as before, *the direction of the arrows shows the point of the horizon towards which the stream of air is moving.*

The greater persistency of the N.E. over the S.W. Monsoon is clearly shown by these Diagrams, as well as the variability of the latter.

The following Table is from Maury's "Nautical Monographs, No. I.;" it gives the *average winds and calms in the* China *Sea, the total number of observations in each band of latitude, the mean direction of the wind from each quarter, and the average annual duration of each wind in days:*—

Bands in Latitude.	Mean Direction of the Winds.				No. of Days of Calm.	No. of Obs.
Lat. 30° to 25° N.	N. 28° E.	S. 44° E.	S. 34° W.	N. 36° W.		
No. of days . . .	189	43	72	60	1	318
Lat. 25° to 20° N.	N. 47° E.	S. 47° E.	S. 39° W.	N. 32° W.		
No. of days . . .	199	80	56	26	4	2564
Lat. 20° to 15° N.	N. 47° E.	S. 47° E.	S. 32° W.	S. 33° W.		
No. of days . . .	175	84	73	29	4	4298
Lat. 15° to 10° N.	N. 46° E.	S. 45° E.	S. 51° W.	S. 49° W.		
No. of days . . .	135	68	116	42	4	5358
Lat. 10° to 5° N. .	N. 43° E.	S. 42° E.	S. 42° W.	S. 51° W.		
No. of days . . .	125	54	134	45	7	4672
Lat. 5° N. to Eq. .	N. 38° E.	S. 37° E.	S. 34° W.	S. 46° W.		
No. of days . . .	106	85	113	48	13	3834

In the NORTH-WESTERN PART OF THE CHINA SEA the N.E. Monsoon commences about the middle of October; in the SOUTHERN part it rarely appears before November. It generally sets in with a sudden storm, in which the wind increases in force very rapidly, and produces a great swell; consequently, exposed anchorages should be avoided. This outburst lasts a week or more; occasionally, however, the Monsoon sets in without any storm. It is at its height in December and January. The whole period is one of dark, cloudy weather, and heavy rain; and usually a high, turbulent sea is experienced when the wind has been strong for a few days, especially near PULO-SAPATA, and thence to the STRAITS OF SINCAPORE. Off the COAST OF LUZON, although the winds are generally from N. and N.E. during the N.E. Monsoon, still they often veer to N.W. and W., blowing strong, with cloudy weather and a copious rainfall. During February the wind in the China Sea moderates and blows steadily, bringing fine weather. On the LUZON coast, land and sea breezes are not uncommon during this month, and during March and April become more or less prevalent over the whole China Sea. (CHART DIAGRAMS VI. and VII.)

Towards the end of April the S.W. Monsoon sets in; but notwithstanding this, the winds are still light and variable at sea during May, with land and sea breezes near the coast. The Monsoon is at its height during June, July, and August, when the weather is cloudy and rainy; but the wind, though generally fresh, is rarely stormy, except near the entrance to the Gulf of Siam, whence hard squalls sometimes descend very suddenly. In September, winds from N. and E. are occasionally encountered in any part of the China Sea, but they are especially to be expected near Formosa in July, August, and September, though the prevailing wind is S.W. Wind and weather are very unsettled in October; from S.W. and W. to N.W. the wind shifts to N. and E.N.E., puffy and strong, after which the Monsoon sets in. (CHART DIAGRAMS VIII. and IX.)

During the period of the S.W. Monsoon the winds are never as strong, nor the weather so gloomy as during the prevalence of the N.E. Monsoon; it is difficult to beat against the latter, but it is very common to make good progress against the former, especially by taking advantage of the breezes near the coast.

SEVERE GALES, commencing at N.N.W. or N.W., and accompanied by gloomy weather and a deluge of rain, occur in some seasons during May, June, July, and

August; veering to W. and S.W., they still blow with great violence, and finally abate at S. During the same time strong S.W. or S. gales prevail in the middle of the China Sea.

Strong N.E. gales have occurred in the China Sea during the S.W. Monsoon; but this is rare.

On the south coast of China steady gales from N.E. or E.N.E., lasting several days, may be expected in September or October; at the same time, on the west coast of Luzon, they commence at N. or N.W., veering by W. to S.W. and S., with heavy rain and a heavy cross sea.

78. Malacca.—On the east coast of Malacca heavy, continuous rain falls during the N.E. Monsoon. During the change to the S.W. Monsoon strong gales may be expected, after which the wind is moderate or light for some time.

With the S.W. Monsoon, from April to October, the weather is fine on the east coast, but squally and generally bad on the west coast of the peninsula.

On the east coast in June the wind is from S.E. during the day, veering to westward towards evening, whence it blows until 10 or 11 A.M.

79. Between Pulo-Timoan and Pulo-Condore the N.E. Monsoon has set in towards the middle or end of October; at Pulo-Timoan the winds are exceedingly variable from September, and the change of the Monsoon brings at times very bad weather.

The N.E. Monsoon is the fine season, and is generally established by November; nevertheless, during this month, storms with rain do occur, and perhaps a hurricane. The S.W. Monsoon brings the rainy season, and frequently lasts seven months; at Pulo-Condore it rains for a month after the N.E. Monsoon has set in.

80. Gulf of Siam.—From the position of the Gulf of Siam the Monsoon winds are irregular, and the seasons vary.

At sea the S.W. Monsoon begins in April with rain, which lasts during May and June. From June to September the winds are more westerly, but still with rain.

On the coast southerly winds prevail from March to May, but from June to September they are from S.W.—generally very strong near Pulo-Oby. During September they are variable.

In October the Monsoon changes, and the weather is squally; in November, December, and January, the wind is N. and the weather fine. During February variable winds between S. and E. are prevalent; and now, as well as in March, land and sea breezes are tolerably regular.

On the west coast of the Gulf of Siam, during May, and thence to July, when the S.W. Monsoon is at its height, a land wind sometimes prevails, lasting from three to ten days.

81. Cambodia.—On the coast of Cambodia the Monsoons are irregular, and land and sea breezes are more or less constant, those during the N.E. Monsoon being generally much fresher than at the period of the S.W. Monsoon, and lasting longer. In June, July, and August, heavy rain falls, and the wind is strong from the S.W.

82. On that part of the **Coast between the Gulf of Siam and Cape Padaran** the N.E. Monsoon begins with October, and ends during April. When the S.W. Monsoon sets in it blows parallel with the coast; ships approaching the land at night frequently experience a light land breeze, which dying away terminates in a brief calm, after which the Monsoon is fresh during the day.

83. Cochin-China.—Near the coast the Monsoons are never strong, and the winds are more or less variable throughout the year. Heavy rain falls in September, October, and November, with the N.E. Monsoon; and from December to February there is a kind of winter, with northerly winds and occasional rain.

During the N.E. Monsoon the wind is often easterly between the coast and the Paracels, and thence to Cape Vœrela; calms are often prevalent in the vicinity of the Paracels, while to seaward the Monsoon is fresh.

During the S.W. Monsoon land and sea breezes are prevalent along the coast; the land breeze is irregular in the time of setting in, although it is sure to come at some hour during the night: after a calm or gentle, light air till mid-day, a fresh S.E. wind springs up.

84. Gulf of Tong-Quin.—With the S.W. Monsoon comes the rainy and hot season, which, beginning in April, lasts till August; in September and October the weather is moderately fine. In November, when the N.E. Monsoon sets in, fresh northerly winds may be expected, veering to E. and E.S.E. towards the end of the month; in December N.N.E. to E. winds bring foggy weather; in January and February fresh N.E. and N.N.E. breezes are prevalent, with cold weather. In March the Monsoon has died out, and warmer weather is approaching. Typhoons occasionally enter the gulf.

85. Hainan and the South Coast of China.—The N.E. Monsoon from E.N.E. very generally blows along the land; at times, however, it hauls to S.E.

During the S.W. Monsoon S. and S.E. winds are very prevalent; in June, July, and August, heavy rain falls, and the weather is usually overcast and gloomy.

86. From the entrance of the **Canton River to the Chusan Islands*** the N.E. Monsoon usually blows from the beginning of October to the end of April. It sets in strongest in the months of November, December, and January, its medium force being a double-reefed-topsail breeze for a frigate when close-hauled; but frequently, owing to the heavy sea running, a press of sail cannot be carried, and it is therefore necessary at all times to keep as close in-shore as possible, where, owing to the conformation of the land, the rapidity of the tide, and other local circumstances, smoother water will always be found.

During the period of this Monsoon severe gales, lasting for two or three consecutive days, occur at times; it is then supposed that a Typhoon is blowing not far distant, and when the gale breaks the wind usually becomes light and to the southward of E. for a few days. It will again freshen up for a week or ten days together to a steady breeze, for treble-reefed topsails and reefed courses, with a high, short, cross sea, particularly at the entrance of the Formosa Channel.

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* Capt. G. R. Mundy, R.N., in "Naut. Mag.," 1846, p. 621.

In October, November, and December, the atmosphere is moderately clear, rain and thick weather seldom lasting without a break for twenty-four hours. In January, February, and March, hazy weather with thick mist is not unfrequent. In April the Monsoon begins to slacken, light southerly winds for a day or two occasionally blow, and foggy, dirty weather, with returning heavy squalls and rain from N.E. will again set in and continue till the middle of May.

These remarks only apply to that part of the China Sea to the northward of the Canton River.

The S.W. Monsoon, variable between S.S.W. and S., begins in June and ends in October: this is the season when squally weather prevails, and when Typhoons occur.

87. In the **Formosa Channel** bad weather may be experienced at any season of the year. During the S.W. Monsoon heavy squalls with rain are common.

88. Off the **Bashees** the N.E. Monsoon, from N.E. to E.N.E., blows strong and raises a high sea.

89. Among the **Filippines** the N.E. Monsoon commences in October; fine weather may then be expected until April, with winds variable between N. and N.E.; if they veer to N.W. they generally blow hard.

The S.W. Monsoon may be expected at the end of May, but is not regularly established until June. During this season the weather is dark and gloomy, exceedingly wet and foggy. In September the rain abates, but fogs still prevail, lasting till mid-day. The worst Typhoons occur in July and August.

90. Palawan.—On the coast of Palawan the winds are variable during October, November, and December, offering no obstruction to vessels proceeding either to the N.E. or S.W.; but the weather is often cloudy and rainy. Near the southern part of the island, however, strong S.W. winds, with overcast sky, may be expected in September and during the early part of October.

The Monsoons are, however, so subject to interruption from local causes that it is difficult to say at what period either fairly sets in. The following is the experience of the late Commander W. T. Bate, R.N., when employed surveying the coast in the *Royalist*:—

"In November and December the weather is variable; N.E. and easterly winds, changing at times to S.E., more frequently prevail. In the former month a south-westerly blow, with dark, cloudy weather and rain, is not unusual, and one of the heaviest gales experienced shifted to N.W. just before the change of moon, and lasted till the end of the quarter.

"In January, when the N.E. Monsoon is blowing steadily, and sometimes with great violence, in the China Sea, moderate N.E. and easterly winds prevail on the coast of Palawan, and on the coast of Luzon land and sea breezes have been experienced with considerable regularity.

"In April, when light N.E. and frequently S.E. winds prevail in the China Sea, N.E. and easterly winds usually blow steadily on the coast of Palawan, freshening considerably after daylight, and dying away towards sunset.

"May and the early part of June, appear to be the finest period of the year on

the coast of Palawan, when land and sea breezes prevail with tolerable regularity, the former coming fresh from the S. and S.E. in the morning, and the latter from the N. and N.W. in the afternoon.

"Towards the end of June, and throughout July, unsettled weather, generally commencing about the change of moon, may be expected. A slight depression of the mercury, after a succession of fine weather, frequently indicates the approach of strong W.S.W.-ly squalls, which are usually accompanied by dark, cloudy weather and much rain, lasting for a week or ten days. These are generally succeeded by a period of fine weather, with N.W. and S.W. winds, which draw to the southward and eastward in the mornings. If June or July has been unsettled, it may be expected that August generally will be fine, with moderate S.W., but more frequently westerly winds, particularly in the afternoon.

"If, on the contrary, June or July has been tolerably fine, very unsettled weather may be expected in August. In either of these months, when strong S.W. squalls have succeeded a period of fine weather, vessels will not unfrequently, in the S.W. part of the passage, experience a weatherly set of the current.

"In September and October the wind generally blows strong from the W.S.W., with dark, cloudy weather; and off the S.W. end of Palawan, squalls, which veer to W.N.W. and N.W., sometimes blowing with great violence, succeed each other rapidly, and are accompanied by rain. Between the squalls the wind very often shifts to S.E.

"The barometer is of little use in prognosticating the changes; the difference in the column of mercury for the whole year, except in cases where the condition of the atmosphere has been disturbed by some physical cause, such as the approach of one of those violent cyclones known in the China Sea by the name of Typhoon, seldom exceeding $\frac{2}{10}$ths of an inch. In general the mercury rises to N.E. and easterly winds, and falls to S.W. and westerly; but in some instances we have known the reverse of this to occur, doubtless from some such disturbing cause as above-mentioned, when the barometer by falling or rising indicates as usual the approach and recession of the vortex."

91. During the expedition of the American squadron to **Japan** the following observations were gathered:—

"The S.W. Monsoon sweeps over the Loo-Choo group, and reaches the southern shores of Japan and the Bonin Islands.

"At Napha, Loo-Choo, we found it prevailing steadily in May and June, and veering to the southward and eastward in July. In August the wind was very changeable, and blew at times quite strong, with squally, rainy weather.

"The N.E. Monsoon set in about the 1st of September, and continued until the departure of the squadron on the 7th of February, being, however, interrupted during the winter months by fresh gales from the northward and westward, which were generally accompanied by heavy rain.

"The climate of Loo-Choo is as free from the severity of winter's cold or summer's heat as any in the world; and the island is nearly, if not quite, as healthy as any on the bosom of the sea. 'Droughts' are spoken of in an official Loo-Choo document, and we know that the country is in the direct range of Typhoons or hurricanes. These drawbacks are not frequent.

"At the Bonin Islands, in April, the wind was variable; in June it was from the southward and westward, and in October from the northward and eastward. The passage from Loo-Choo, in October, was found to be exceedingly boisterous by the United States ship *Plymouth*.

"On the coast of Japan northerly winds were most prevalent in February, March, and April; and during this period we had occasionally strong gales, which most frequently commenced at S.W., hauling to the northward and westward, and were accompanied with heavy rain. In May and July we had south-westerly winds, and in June they were variable.

"During our stay in Japan, from February to June, the weather was generally pleasant. In the Bay of Yedo the mean temperature for February was 44° Fahr., and the apricot and camelia japonica were in full bloom.

"*Typhoons.*—The whole region from Formosa to the Bonins is within the track of these storms, though we believe they seldom reach the coast of Japan. The season during which they may be expected is from May to November, inclusive; but in the neighbourhood of the Bonins they seem to occur more frequently in October.

"*Fogs.*—We had but few fogs on the coast of Japan. They commenced at Hakodadi about the 1st of June, but did not extend as far south as Simoda."

92. The winds that generally prevail on the **east coast of Japan** are:—January to May, W. and N.W.; May, variable; June to August, E. to E.N.E., and sometimes S.E.; September to December, W. and N.W. October is a bad month for navigation, and from the middle of August to the middle of October is the worst season for cyclones, which blow with great fury, and give but little warning. From December to June the climate is delightful—clear, cool, and bracing. The mean range of the barometer throughout the year is from 29·70 to 30·06 inches. The range of the thermometer, mean 26° to 70°, extreme 14° to 74°.

93. In the months of August and September, 1858—the period H.M.S. *Furious* remained in **Yedo** Bay—heavy gales from the E.N.E., shifting round to the S.W., and increasing in force, were frequent. Winds from W., round northerly to E.N.E., generally brought fine weather, and rain when between S.E. and S.W.

During H.M.S. *Saracen's* survey of the **Strait of Tsugar**—May, June, July, and August, 1855—the prevailing winds were from the S., with much fine, clear weather. The wind was less frequent from the N.W. than any other quarter. Dense fogs prevailed in May and June; after that period they were comparatively rare. The wind, in shifting, usually followed the course of the sun. After a few days of light southerly wind and fine weather it freshened, and veered to the westward, accompanied by fine, clear, and cold weather. At N.W. it usually died away, or flew round suddenly to the eastward; in the latter case it was always followed by a dense fog or a gale, the weather getting fine again as the wind veered to the southward.

94. The Ladrones, or Mariana Islands.—The N.E. and S.W. Monsoons of the China Sea extend to these islands, notwithstanding their distance from the Asiatic continent. The strongest winds blow in August, September, October, and November, from N.W. to S.W., sometimes from S. to S.E.; in December, January, and February, wind and weather are variable; during March, April, May, and June, when the wind is from N.E. and E., the season is extremely fine. Storms, with rain

and thunder, as well as general bad weather, may be expected from July to November. Typhoons are not unknown, but they occur at intervals of a few years.

AUSTRALIA AND TASMANIA.

95. West Coast of Australia.—The prevalent winds are from S.S.W. and S.S.E., especially from October to April, the summer season; from April to October, the winter, the regularity of the southerly winds is interrupted by strong breezes from the north-westward, accompanied by cloudy weather, and rain or mist. Land and sea breezes are experienced near the coast; the former, from S.E. and E., gradually die out towards noon, and after a calm the sea breeze from W. to S.S.W. gradually draws round to S. towards sunset. The westerly Monsoon of the N.W. coast, generally prevalent from N.W. to S.W., blows from W. and W.N.W. in November and December, but it is scarcely more than a sea breeze. N.W. gales are not frequent, but hurricane squalls from E.S.E. to N.E., lasting about two hours during the night, are very terrific; they give ample warning by a bank of clouds and much lightning in the quarter whence they come.

The prevailing winds at **Swan River** are as follows:—In December, January, and February, S. and S.S.W. winds during the day, and S.S.E. to S.E. winds at night; these are occasionally interrupted by strong and oppressive gusts from the E. In March and April the sea breeze is moderate, and the land breeze more perceptible; calms are frequent, as well as light airs from the northward; when the sea breeze is strong the land breeze is light, and *vice versâ*. May brings winter and rain; the wind beginning at N.N.E., veers to the westward with increasing strength; but the rain is not continuous, for there are intervals of fine weather, when the climate is beautiful, and when the land and sea breezes are as regular as during the summer. The N.W. gales of winter are very violent, and the weather is then gloomy and rainy; the west coast is then a lee-shore, for commencing at N.N.E., and shifting to the westward, it blows hardest between W.N.W. and W.S.W. Sudden squalls of a hurricane character, shifting round the compass, may be occasionally expected, but they are of short duration. The barometer generally foretells all these gales a day or so before they commence.

96. South Coast of Australia.—In the vicinity of Cape Leeuwin the winds are generally from the westward throughout the year: frequently during the summer from N.W. in the night, and from S.W. in the latter part of the day, but with no regularity.

Between the Archipelago of the Recherche and Cape Northumberland the prevalent winds from the middle of January to the middle of April are between S.E. and E.N.E., moderate, and generally fine; they partake of the nature of land and sea breezes; W. and S.W. gales, should they occur at this season, seldom blow home on the coast.

Along the whole southern coast of Australia, and as far as Bass Strait, the strongest and most durable winds are from the south-westward, frequently rising to heavy gales varying between S. by W. and N. by E.; they produce at all times a long, rolling swell, which, however, is almost incessant from April to November. Captain Flinders remarks,* "that the progress of the gales is usually this: the barometer falls

* "A Voyage to Terra Australis," by Matthew Flinders, Commander of the *Investigator*, 1814. Vol. i. p. 241, et seq.

to 29½ inches, or lower, and the wind rises from the north-westward, with thick weather, commonly with rain; it then veers gradually to the westward, increasing in strength, and generally clearing up as soon as it obtains any southing. At S.W. the gale blows hardest, and the barometer rises; and by the time it reaches S. or S.S.E., it becomes moderate, with fine weather, and the barometer above 30 inches. Sometimes the wind may back round to W. or something to the northward, with a fall in the mercury, and with diminishing strength, or perhaps die away; but the gale is not over, although a cessation of a day or two may take place. In some cases the wind flies round suddenly from N.W. to S.W.; and the rainy, thick weather then continues a longer time.

"Such is the usual course of the gales along the south coast and in Bass Strait; but on the east side of the strait the winds partake of the nature of those on the east coast, where the gale often blows hardest between S. and S.E., and is accompanied with thick weather, and frequently with heavy rain."

These observations are further corroborated by Commander Henry L. Con, R.N., from an experience of four years on the coast of Victoria; and he adds, that "gales sometimes commence from N.E., thence round by N. to N.W., and continue as above described; they are experienced at all seasons of the year, and their usual duration is from three to four days, causing a furious sea on the coast. July, August, and September, are usually the wettest months; but this is uncertain, the largest floods recorded being in December."

97. Bass Strait.—The prevailing winds are S.W. for nine months in the year. During January, February, and March, N.E. winds, with clear weather, are not unfrequent, but they do not last for many days in succession.

Squalls from S.W. and S.E. may be expected on the east side of the strait, as well as on the coast of Tasmania; the latter are very strong, and when blowing from the coast between Cape Howe and Wilson Promontory should be avoided.

98. Tasmania.—From April to October W.N.W. and N.W. winds prevail; these are interrupted at times by S.E. winds from October to March. Moderate breezes from N.E. are not uncommon on the east coast. Approaching Tasmania from the southward and westward, carefully avoid falling in with its rocky and dangerous coast at night, for you may be out in your reckoning, or may be caught in a S.W. gale. During February, March, and the beginning of April, winds from S.E. to S. are very common off the South Cape.

99. East Coast of Australia.—Northward of the Tropic the S.E. Trade-wind is regular from the end of April until September; this is the fine season. From October to April N.W. winds are prevalent, with rain and general bad weather.

In the vicinity of the Tropic, and thence to Sydney, there is considerable variation; here the S.E. Trade only blows home during summer, but may be interrupted by N.W. breezes at any time; gales from the S.E. may be expected in December, January, February, and March, especially during the two latter months. From May to September, the winter, westerly winds bring fine weather; gales at this period come from N.E. and S., always bringing rain.

At Sandy Cape the S.E. Trade prevails at least nine months in the year.

South and south-easterly breezes are generally prevalent at PORT STEPHENS during the summer, as well as land and sea breezes; the sea breeze sets in at S.E., and veers to N.E. as the day advances; during the winter strong westerly winds are very common.

On the N.E. COAST the hot N.W. wind of summer is almost always followed by sudden squalls varying from S.E. to S.S.W.

Northward of Sandy Cape, at the **entrance to Torres Straits,** and in the **Coral Sea,** the winds, though generally from N.W., are not persistent during the period of the N.W. Monsoon—from November to March—and are interrupted by calms and rain, as well as by occasional heavy gales—with rain, thunder, and lightning. These Westerly winds are steadier and stronger 200 to 400 miles to seaward than nearer the coast, but beyond that they become light, and finally give place to the S.E. Trade.

From April to September the S.E. Trade is the prevalent wind along the N.E. coast, with land and sea breezes near the shore; the weather is generally fine, though squalls and gales may be expected at the commencement of the season—during March and May. CAPTAIN DENHAM, while surveying the CORAL SEA, found the S.E. Trade frequently interrupted by variable wind and calms, and by occasional heavy gales.

100. Sydney.—Land and sea breezes are regular at Sydney from October to April, the former lasting only from midnight to 8 A.M.; these are occasionally interrupted by hot winds from N.W., which last from twelve hours to three days, and are always followed by heavy breezes from the southward, which come on without much warning. From April to October winds from N.W. to S.W. rule, with fine weather; occasionally there may be gales from the N. or S., with gloomy weather and rain. At the spring equinox the wind generally freshens to a gale from S.E. to E., with rain and a high barometer; as the wind veers to S. and S.W. the strength of the gale declines; they last from one to three days.

The following is a general synoptical table of the wind and weather, and of the range of meteorological instruments, for the different months:—

January—Light Easterly winds and calms; stormy if the wind shifts to S.W.

February—Winds between N.E. to S.E. prevail; at times from N.W. to S.W. by the W., and then bringing heavy rain.

March—S.E. and S. winds; the latter bring rain.

April and May—Winds between N.W. and S.W. are predominant, and they often blow strong.

June, July, and August—Westerly winds prevail, variable between N.N.W. and S.S.W.; in general moderate, and with fine weather. Winds from S. and E. in August are accompanied with cloudy weather and rain.

September—The prevalent winds are from W.N.W. to W.S.W, but occasionally from the eastward.

October—Easterly winds, variable between N.E. and S.E.

November—The prevailing winds are S.S.E., veering to S. and S.S.W. occasionally.

December—E.N.E. to S.S.E. are the usual winds, which, however, at times veer to S. and S.S.W.

Months.	Barometer 62 Feet above the Sea.			Thermometer.			Winds.	Weather.			
	Max.	Min.	Mean.	Max.	Min.	Mean.		Days Fine.	Days Rain.	Stormy.	Cloudy.
January . .	30·300	29·430	29·865	91	60	75½	S.S.E.	15	4	12	—
February . .	30·300	29·680	29·990	90	58	74	E.S.E.	20	4	5	—
March . . .	30·490	29·580	30·035	83	60	71½	E.	19	10	2	—
April	30·458	27·772	29·115	83	57	70	W.	21	6	—	3
May	30·442	29·602	30·022	73	50	61½	W.	23	3	—	5
June	30·350	29·290	29·820	62	42	52	S.W.	20	1	—	9
July	30·315	29·840	30·077	60	48	54	S.W.	17	8	5	1
August. . .	30·248	29·488	29·868	66	44	55	S.W.	14	9	7	1
September .	30·380	29·520	29·950	67	42	49½	N.E.	20	—	8	2
October . . .	30·200	29·300	29·750	82	57	69½	N.E.	21	3	5	2
November .	30·220	29·860	30·040	91	57	74	E. & W.	31	—	—	—
December .	30·110	29·530	29·820	87	63	75	N.E.	20	—	10	1

NEW ZEALAND.

101. The following paper, by Captain Byron Drury, R.N., is the result of observations continued over four years, and made on board H.M.S. *Pandora*, combined with valuable contemporaneous observations on shore :—

"It is a matter of interest to trace the extent of the almost rotatory storm, the N.E. wind, which commences at E., and frequently, after suddenly changing from N.E. to N.W. and S.W., ends within a few points of where it commenced. This is more ob-

servable at sea than in the vicinity of the land; where it is an expanded rotary gale, and therefore has not the dire effects of a hurricane. Its prognostics are so certain, and commence so gradually, that the anticipated changes can be made subservient to effecting a passage.

"This N.E. gale appears to be common to the southern regions from Bass Strait eastward to Tierra del Fuego. Descriptions of it at the latter place do not materially differ from what is observed here, except that here they are more decided in the spring and summer than in the winter.

"Before discussing the local winds of these islands, we may describe the ordinary winds off the coast, extending to Australia and Tasmania, beyond those latitudes where periodical Monsoons exist.

"The barometer is a certain indicator of changes in these latitudes; no vessel should be without it; but it requires study, for the greater height presages N.E. gales, and its changes require special notice in reference to the weather. In the latitude of Auckland we have known it to range from 30·66 to 28·80 during the revolution of a gale, which began at N.E.

"The ordinary wind of these seas is Westerly nearly the whole year round.

"It may be generally assumed that the barometer falls to N. and N.W. winds; that these are the rainy quarters; and that although the wind becomes stronger at first as it draws to S.W., the weather will clear up.

"The steadiest wind is about W.S.W. The changes are almost invariably with the sun, or contrary to the movements of the hands of a watch.* South winds bring cold clear weather, and raise the barometer high. S.E. winds are uncommon, but when they do set in, usually in April, May, and June, they last several days; with cold, raw weather, and the barometer about 30 inches. The N.E. wind occurs about once a month in spring and summer, but less regularly in winter; it is preceded by cloudless serenity and calms; the barometer from 30·30 to 30·60. A light breeze from the eastward, drawing to N.E., is gradually accompanied by a dull sky; the barometer begins to fall and the breeze freshens briskly. The sky becomes overcast, and usually in twelve hours it begins to rain. From that time to thirty-six or forty-eight hours the wind continually increases: in a heavy squall it will suddenly shift to the N.W., from which quarter it blows still stronger for from six to eighteen hours, latterly accompanied by heavy rain or hail: lightning is frequently seen in the S.E. quarter. The barometer is at its lowest a little before there is another (sometimes) sudden change to the S.W., from which quarter it begins to clear, while the glass rises rapidly, although the squalls are at first very violent. The wind sometimes remains in this quarter, sometimes veers round as far as S.S.E.; but if it should remain at W.S.W., fresh steady breezes and fine weather will last for several days. We have traced the diameter of one of these rotary gales to 960 miles.† They seldom last more than three days, before the weather becomes fine.

"We now come to the subject more specifically connected with New Zealand, having thus stated a few generalities, and we find it necessary to divide the group into eight portions to distinguish all the local winds.

"The formation of these islands, their comparative breadth at the parallel of the

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* Contrary to those of the northern hemisphere, though still with the sun, which here culminates in the N.

† The N.E. gale is a progressive cyclone, not a merely local wind.

East Cape, with the narrow strip of land to the northward; the Strait, the high snow-capped mountains, and extensive plains and forest tracts, must produce varieties of currents of air; and we find frequent changes, though of short duration. But placed as these islands are, apart from any deserts or icy regions, the ordinary Westerly current, unless blowing with unusual force, becomes neutralized by the varied configurations of the country's surface; and for this reason we purpose to divide the islands into eight atmospheric districts, namely—

"1st.—From the North Cape to Mercury Bay on the east coast, and to Kawhia on the west.

"2nd.—From Mercury Bay to the East Cape.

"3rd.—From the East Cape to Cook Strait.

"4th.—From Kawhia to Cape Farewell.

"5th.—Cook Strait.

"6th.—From Cape Campbell to Cape Saunders.

"7th.—From Cape Saunders to Foveaux Strait.

"8th.—The West Coast of the Middle Island.

"It has been frequently stated that New Zealand is a moist climate as compared to England, bnt if meteorological data during a number of years be taken as the basis of comparison, it will be found such is not the case. Persons residing in New Zealand during 1851-52 might conclude there was an excess of moisture; but had a person lived in the country in 1853-54 alone he would come to an opposite conclusion, for the drought then was a source of considerable uneasiness.

"Farmers do not complain there of excessive moisture. Indeed, at Auckland no more falls than is required to produce its prolific vegetation, although perhaps too frequent to bring grapes and some other fruits to perfection which thrive in other parts of the colony.

"We believe that more rain falls in the West of England and on the west coast of Scotland and Ireland than in any part of New Zealand.

"The comparative absence of great intensity of electricity may modify the falls of rain. It is seldom such floods are heard of as accompany the thunderstorms of other regions. The greatest quantity of rain known to fall in twenty-four hours at Auckland within the three last years was less than at Sydney Heads. We have not been able to trace any accident occurring from lightning.

"Fogs are rare, except in the extreme South. In the Bay of Islands and Hokianga there is a morning fog occasionally in September, October, and November, which generally clears up at 10 A.M., and is followed by a fine day. In the Bay of Plenty we experienced a fog of three days' duration in the month of October, but it was considered quite extraordinary, and they have been experienced in the months of June and July in Hauraki Gulf, but seldom throughout the day.

"From the North Coast of New Zealand to Mercury Bay on the East Coast, and Kafia (or Kawhia) on the West.—In this division the ordinary wind throughout the year is from N.W. to S.W. on the west coast, and from W.S.W. it lasts longest. In summer the N.W. and S.W. are both fine. In winter the N.W. wind is prevalent, accompanied by rain. When the wind veers S. of W.S.W., it blows from the westward off the shore on the east coast, otherwise the wind takes a direction down the coast. There is a sea breeze into Auckland and other harbours on the east coast in summer weather.

"N.N.W. winds are accompanied by rain. The N.E. wind, already described, generally ends in a severe gale. S.E. wind is rare, but when it comes lasts several days, with cold, raw weather, sometimes showery.* In winter there are sometimes very sudden changes on the east coast after short intervals of calm. Cloudless serenity in winter is usually followed by a wet day; and a lunar halo is a sure prognostic of rain. The narrow interval between the seas on the west and east coasts and the extensive forests of Manukau conduce to moisture prevailing in Auckland to a greater extent than at the Bay of Islands. It is also for this reason Auckland is milder in winter, frost being uncommon; whereas at the Bay, though a lower latitude, ice may be found an inch thick occasionally.

"In the harbours on the west coast the ordinary breezes are from S.W., with land winds in summer, which, however, are very light and partial. In Manukau the W. winds are peculiarly fresh, the contour of the coast here forming the apex of an obtuse angle. The harbours on the east coast draw the sea breeze into their various channels in summer. In winter the weather is very variable.

"During our experience the maximum temperature in the shade at Auckland in summer was 79°; minimum in winter, 40°; mean in summer, 67°; mean in winter, 52°. And the mean annual fall of rain was 43 inches.

"Mercury Bay to East Cape.—Between Mercury Bay and the East Cape the summer breezes are from the westward, dying away at night in and near the shore, but not in the bay. A N.E. gale may be expected once a month, prevailing from March to July. S.E. winds are common near the East Cape, sometimes lasting for several days, and often very strong, but seldom blowing beyond the Mercury Islands. There is also a very strong S.W. gale, which is dangerous in the roadsteads between Cape Runaway and the East Cape; it is preceded by rollers and unsteady flaws of wind.

"The people in sight of White Island can foretell weather by the appearance of the steam from Whakeri: with W. winds the smoke is low, and more of it is seen. The S.E. wind, they say, smothers the steam. No doubt the density of the atmosphere tells on that vast body of vapour.

"The climate of Mercury Bay may be considered fine, generally.

"From East Cape to Cook Strait.—Going from East Cape to Cook Strait a very marked phenomenon frequently takes place on rounding the East Cape. The strong Westerly wind that drives across the bay carries its line a few miles eastward of the cape, but southward of this the breeze is N.E. Sometimes a vessel may be becalmed for hours between two strong breezes from W. and N.E. The configuration of the coast at once accounts for this:—The W. wind meets with little obstacle in crossing the narrow and comparatively low land north of the ranges forming the southern boundaries of the Bay of Plenty; at the East Cape it meets the lofty Ikonargi, and the breadth of the country now being considerable, the rarefied air over it induces regular sea breezes from the N.E., succeeded in the evenings by the

* We found on an average of three years that there were only twenty days with the wind between S. and E. They were preceded by S.W. winds, and ended in calm. They occurred in April, May, June, and July. Although S.E. gales are common—from a degree S. of Auckland to the southward—we found only one blow home in the Hauraki Gulf (in June, 1852). It lasted forty-eight hours.

land wind for a short distance from the shore. An exception is the N.E. gale, known on this part of the coast as the black north-easter, to distinguish it from the ordinary sea breeze from the same quarter. In winter the sea breeze cannot be depended upon, and S.E. and S. gales set in very suddenly, and even in summer the S.E. winds sometimes last for some days.

"In Hawke Bay in spring there are fierce Westerly winds for days, with a low barometer and variable weather, ending in a cold S. wind, blowing hard for a short time, when the ordinary weather returns.

"This part of New Zealand has a fine climate.

"The barometer rises for N.E., S.E., and S. winds, and falls for N., N.W., and W. winds.

"West Coast, from Kawhia to Cape Farewell.—Along the coast of Taranaki the sea breeze sets in from W.S.W. to S.W., drawing round to S.E. during the day and dying away at sunset.

"A N.E. gale produces a northerly swell at Taranaki, greater than when at N.W.

"N.W. winds blow very hard for about twelve hours, and then change to W.S.W., afterwards to S.W.

"From November to April the weather is fine. In June and July S.E. winds prevail. Gales at any season seldom last more than forty-eight hours. Sometimes a N.W. swell sets in without the wind blowing home. The barometer rises for S. and E. winds, and falls for northerly, and north-westerly, which is the rainy quarter.

"The proportion of N.W. to S.E. winds is about seven to four, which may be assumed as also the proportion of S.W. winds to all others on the West coast.

"Cook Strait.—In Cook Strait, that is, between Cape Campbell and Stephen Island, it may be said there are only two winds, N.W. and S.E. It is easy to account for the wind coming only from these two points, N.W. or S.E., by the configuration of the strait, a channel of that direction, bounded by lofty hills on either side; but it is not so easy to establish the causes of the sudden changes with regard to the winds which are blowing outside the strait. It may, however, be partially accounted for, if we suppose the ordinary ocean wind (W.S.W.) to be represented by the N.W. wind in the strait until overcome by either of the winds prevalent on the near part of the east coast—namely, the black north-easters, the south-easters, or the S. winds; either of these produce a south-easter in the strait, and when the W. wind is very light on the west coast the N.E. sea breeze of the east coast draws through the strait, forming the fine S.E. wind. The varied height of the mountains, the snow-capped Kaikoras, the extensive and heated plains, must concur to produce great effects on the currents of air. The N.W. wind prevails with fine weather, the S.E. with bad weather: both often blow very violently, and succeed each other suddenly. The appearance of the sky indicates the approach of the south-easter by banking up in that quarter, and by the neighbouring mountains becoming capped with clouds. There is also a fine S.E. wind. The finest months are April, August, November, and December. The most windy and rainy are May, June, and July.

"Thunder and lightning are unusual."

The following information was obtained from Staff-Surgeon Prendergast, who

kept a register at Wellington:—"Average fall of rain in 1852, 49 in.; 1853, 67 in. 1854, 39 in.: mean, 52 in. Maximum amount of rain in one day, 2 in. During the same period the barometer (at the sea level) maximum, 30·67; minimum, 28·81 range, 1·86 in.

"The following table of the winds was made from observations at Wellington:—In 1852, N.W. wind 225 days, S. 141 days, gales 29; in 1854, N.W. winds 221 days, S. 144 days, gales 15.

"There were fifteen shocks of earthquake in 1852, and twelve in 1854."

The Meteorology of Nelson was observed during eleven years by the late Samuel Stephens, Esq., to whom Captain Drury was indebted for the following information on that subject.

"The prevailing winds are—

"January.—N.N.E. to N.N.W. S.E. to N.E.
"February.—N.N.E. to N.N.W. S.W. and S.E. to N.E.
"March.—N.N.E. to N.N.W. Variable and calms.
"April.—N.N.E. to N.N.W. S.E. to N.E.
"May.—S.W. Calms and variable.
"June.—S.E. to N.E. Calms.
"July.—S.E. to N.E. Calms.
"August.—N.N.E. to N.N.W. S.E. to N.E.
"September.—S.E. to N.E. and S.W.
"October.—N.N.E. to N.N.W. S.E. to N.E.
"November.—N.N.E. to N.N.W. S.W.
"December.—N.N.E. to N.N.W.

"It appears that the N.W. winds of the strait are represented by those from N.N.E. to N.N.W., and the S.E. winds by those from S.E. to N.E., and that Blind Bay is only partially affected by the gales in Cook Strait.

"For the years 1852-53 we have this proportion:—

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calm or Variable.	Gales.
1852 . .	110	35	62	99	60	28
1853 . .	107	34	45	96	83	21

"The N.E. is the rainy quarter (southward of the strait). It is the N.E. gale of these seas, and is but of short duration, veering to N.W. and S. W.

"The common S.E. wind of the strait seldom blows home to Nelson.

"The ordinary sea breeze begins from the westward, working round to N.W., and drawing to N.E. at sunset. At Nelson the strongest gales are from S.W.

"Rainy weather is generally indicated by vapoury clouds hanging on the hills. When strong gales occur without rain, they are often preceded by a red, wild, and lurid sky. These come mostly from the westward.

"The maximum amount of rain was in May 16th, 1853, when 3½ inches fell in eight hours, the barometer falling to 29·08; on common rainy days about three-quarters of an inch falls in twenty-four hours.

"The average fall of rain in 1852-53-54, for each month, was as follows:—

"January, 2·69; February, 2·78; March, 2·53; April, 2·45; May, 3·41; June, 3·37; July, 2·53; August, 3·24; September, 3·87; October, 3·51; November, 2·56; December, 3·44. September, October, and December, being the most rainy months. Snow rarely falls on the low lands about Nelson, but the mountain ranges are covered for months. The barometer falls considerably previous to snow storms, which occur in the end of May and June.

"Thunder clouds proceed from S.E. to N.W. Thunder occurred on forty-two days during three years, chiefly in January, September, and December. Fogs and misty weather are rare. Dews occur at all seasons. The temperature at Nelson was as low as 26° during three days in August, 1854; the wind being S.S.E. The highest range was 87° in February.

"The greatest amount of pressure was 30·50 in April; wind S.E. to S.W. The lowest 28·74, on May 17th, 1853, with much thunder and lightning.

"The following Table is from observations in 1852–53–54:—

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calms.	Gales.
1852 . .	110	35	62	99	60	28
1853 . .	107	34	45	96	83	21

"N.B.—These observations were made in the town of Nelson, 120 feet above the sea level."

"Cape Campbell to Cape Saunders.—About Lyttelton, nearly central in this district, we find the summer sea breezes blow from the N.E. with hazy weather, occasionally changing to N.W. for two or three days. The summer sea breeze dies away at sunset, and is succeeded by a light S.W., springing up about midnight, which lasts until 9 A.M.

"In winter the prevailing winds are S.E. at sea, but at Lyttelton and Canterbury the wind is S.W., while at sea it is S.E. In spring and autumn the winds are variable from N.E. for two or three days, with very fine weather; then light winds for a day, shifting to N.W., blowing a gale from twelve to forty-eight hours; then a sudden shift to S.W., strong wind and rain for three days, when it comes round again to N.E. along shore.

"Fortunately it seldom blows strong from E., but even light winds from that quarter produce a heavy swell in Port Cooper. This wind is accompanied by fog and misty rain.

"The violent S.W. wind in this harbour off the land is accompanied with more danger to shipping than any wind that has blown in. In December we experienced a south-easter between Canterbury and Otago. It fell calm for an hour, when the S.S.E. wind came up suddenly, and with little warning; it veered to S.S.W. This S.W. wind corresponds to the south-eastern of Cook Strait.

"It is very necessary to be aware of the prognostics of the sudden changes along this coast, especially the north-wester, which comes on at once to blow furiously. The most unmistakable sign is a remarkable transparency of the atmosphere, which is very clear indeed.

"The N.W. wind of this district resembles the sirocco of the Mediterranean; it comes on suddenly, and changes the temperature in a few minutes from 12 to 20 degrees. This change in the temperature perhaps arises from the rapid melting of snow in crossing the Southern Alps, or from crossing heated plains.

"The S.W. wind is preceded by heavy, hard-edged, dark cumuli in that quarter. At sea this is probably S.S.E.

"Again, the mountains are clouded in a south-easter, and partially in a south-wester, while all distant objects, including the Kaikoras, are distinct, with a fine blue tint, on the approach of the N.W. wind. The finest months are December, January, February, and March. Rains and gales are chiefly in June, July, and August. The rainy quarter is N.W. to S.W. The hot north-wester in summer frequently terminates in wet. There is also a wet and a dry south-wester. In autumn or winter the barometer rises very high, with light E. winds, producing fogs and much rain, lasting ten or fourteen days.

"The barometer is very variable on this coast; its fluctuations amount almost to a puzzle on shore. It is supposed the lofty mountains must have some share in producing local pressure, as the mercury is frequently moving, though no apparent atmospheric disturbance takes place.* The following remarks are specially applicable at sea. In winter the mercury falls previously to a S.S.E. or S.W. gale, but immediately before commencing it rises, and when at its greatest height the gale blows strongest. In winter such a gale brings continuous rain for three days; but in spring and autumn severe squalls, with rain, hail, and sleet, the glass remaining high, and it is succeeded by N.E. wind and fine weather. The mercury falls before a N.W. gale, especially if followed by a wet S.W. wind; the change is often immediate. It is very low when snow falls, although without wind.

"At Lyttelton the barometer has been very low for many days without any change: it has been at its highest with very bad weather, and soon after at its lowest with very fine weather. It appears that the cyclone north-easter does not occur above four times a year, then the rain from this quarter is heavy. The greatest fall of rain yet known in twenty-four hours was 2·14 inches in April, 1853.

"The uncertainty of the weather is shown to be remarkable by the following example:—The rain that fell in April, 1852, 3·09 in.; April, 1853, 9·40 in.; April, 1854, 1·08 in.

"April is considered a fine dry month, but in 1853 more rain fell than in any other month. Snow rarely falls on the plains, but it has fallen in May, July, August, and September. In August, 1851, there was a heavy fall of two inches deep, that lay all day. Thunder and lightning are rare. Their clouds proceed from N.W. or S.W., with dense cumulo-stratus. This occurs in spring and autumn.

"The temperature at Christchurch has been as low as 27° (June 10th, 1852); the highest was 91° in the shade on February 1st, 1854, at 3 P.M. The greatest amount of pressure was 30·64, August 14th, 1854; the least pressure, 28·85, May 17th, 1853.

"The following Table is from observations in 1852-53-54 at Christchurch:—

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* Similar effects have been noticed near Tierra del Fuego.

Year.	N.N.E. to N.N.W.	N.W. to West.	S.W.	S.E. to N.E.	Calm or Variable.	Gales.
1852 . .	4	20	112	119	110	...
1853 . .	6	21	115	120	103	...
1854 . .	5	27	99	151	83	...

"On only two or three days in each of the years 1852, 1853, and 1854, was any thunder heard.

"It has been a matter of surprise and speculation that the hot N.W. winds proceeding directly from the snow should produce considerable heat, instead of (as would appear natural) an opposite sensation; nor can it be accounted for by the air traversing the plains, as the heat is found fully as sensible and perhaps more so at the foot of the snowy range.

"We may, perhaps, account for it thus:—We find this hot N.W. wind is preceded by cloudless serenity; therefore a great deal of radiation is taking place. The melting surface of the snow covering the heights releases latent heat, causing the atmosphere to become highly rarefied, which consequently rises, but, meeting an upper current, becomes cool and condensed, and rushes towards the coast, carrying at first a portion of the lower strata of caloric, the immediate sensible precursor of the gale. In a few hours the equilibrium is restored, and condensed moisture falls in rain, which is frequently the termination of the gale.*

"At Akaroa this gale is seldom felt, being sheltered by the Peninsula mountains. In this place the sea breeze follows the bends of the harbour. S.W.† gales follow N.W. winds, and blow very hard. The land wind has more than ordinary strength in passing Akaroa Heads in the morning.

"At Otago no register appears to have been kept previous to 1854.

"Our information regarding the weather there is gathered from an intelligent pilot, who resided sixteen years near the Heads.

"North winds are rare. The ordinary sea breeze is N.E. It seldom blows from E.

"S.E. winds are accompanied by thick, hazy weather, but seldom blow home.

"South winds do not blow strongly, unless they veer to S.S.W. and S.W.

"The winds off the land are the strongest, and W.N.W. winds blow the hardest, the latter being at times a hot wind. The squalls from this quarter are heavy.

"The heaviest gales are in November, often with large hailstones.

"The dirtiest weather is in June and July. January is the hottest, and July the coldest month. Snow falls and lies on the ground for two or three days in June, July, and August. S. to S.E. is the rainy quarter.

"The pilot considered that there are about thirty days in the year when it would not be prudent to cross the bar because of the swell, which is worse in attempting to leave. He states that 1853 was a peculiarly dry season. It is curious that in that year there should have fallen at Canterbury nearly double the annual average amount of rain, and that in all other parts of New Zealand it was remarkably dry.

* Perhaps this hot wind is a tail of an Australian "brickfielder." Compare relative positions on the map, and consider the direction from which this remarkable wind blows. It is not felt far N. or S. of this particular section of New Zealand.—Admiral FitzRoy.

† S.E. outside and in Cook Strait.

"The effects on the barometer may be generally assumed as similar to those of Canterbury, allowing for $2\frac{1}{2}^{\circ}$ higher latitude. At Otago there is much more fog.

"Cape Saunders to Foveaux Strait and to the West Coast of Middle Island.—There is less information of the weather in this district. In the summer season the N.E. winds and Otago weather extend to the Traps; but after passing the meridian of Stewart Island, a very different climate may be met with. We found on two occasions that on approaching the west coast, N.N.W. gales blew down the west coast, with thick, foggy weather.

"It is said that in summer Easterly winds blow occasionally for six weeks at a time. It is, therefore, as well for vessels bound eastward at that season to pass considerably south of this latitude, unless it is wished to make a landfall.

"We may allow the district between Hawke Bay and the East Cape the superiority of climate; although that of Nelson is more bracing.

"The Bay of Islands claims an exemption from the ordinary humidity of the northern district.

"Auckland is subject to more moisture, although no more rain falls than is necessary for the prolific vegetation, which its excellent soil and delightful temperature produce.

"The summer during two years, 1853 and 1854, was even too dry, threatening a drought.

"Having concluded this statement of the Meteorology of New Zealand, as far as we have been able to collect facts from imperfect observations, and our own knowledge of the coast, we may remark that the climate is in general peculiarly adapted fo colonists of our race. That the navigator will experience frequent changes, but is well warned by certain prognostics with the assistance of his barometer. That all gales are of short duration. And that the temperature throughout the year is so equable, especially in the northern portion, that it is difficult to define the limits of summer and winter."

CHAPTER V.

ON THE USE AND APPLICATION OF METEOROLOGICAL INSTRUMENTS.

102. Three instruments—the Barometer, the Thermometer, and the Hygrometer—used together, constitute a perfect Weather Glass. The Barometer indicates the changes in the pressure of the atmosphere,—the mercury falling as the air becomes lighter, rising as it becomes heavier, and remaining stationary so long as there is no change in the air; the Thermometer shows changes in the temperature of the air; and the Hygrometer, the changes in the moisture of the air.

103. Dove comes to the following conclusions as regards the movements of meteorological instruments in connexion with the Law of Gyration:—Calculating the mean of all the readings of the barometer, thermometer, and hygrometer, observed during all the different changes of the wind, taken individually, after the elimination of the periodical changes,—if we define the mean distribution of pressure, temperature, and moisture round the compass, or if, in other words, we construct a *barometrical, thermal, and atmospherical wind-rose*,—it becomes evident that *this wind-rose has two poles of pressure and heat*;—in fact, that there are two points in it situated

opposite to each other, at one of which the weather is coldest, and the reading of the barometer is highest,—and at the other the weather is hottest, and the reading of the barometer is lowest. From the maximum of pressure to its minimum, as well as from the maximum of heat to its minimum, the mean barometrical and thermal influence of the wind decreases in an uninterrupted ratio. The former point happens to be nearly at N.E., and the other nearly at S.W. But from S.W. through W. to the N.E. the mean height of the thermometer decreases, whilst the mean readings of the barometer increase; from N.E. through E. to S.W. the mean height of the thermometer increases, whilst the mean readings of the barometer decrease. What is perceptible in the mean thermal and barometrical influence (in the mean thermal and barometrical movements) of the winds must also occur at the time of their transition into each other,—and just as much on the supposition of a varying as on that of a uniform rotatory velocity. Now, however, as the elasticity of vapour, so far as regards its distribution around the compass, is in close connexion with the thermal wind-rose, but the pressure of the dry air is closely connected with the barometrical one, it follows that the fluctuations in the pressure of the dry air and of the barometer are precisely in an inverse ratio to the changes in the temperature of the air and in the elasticity of the vapour suspended in it. Assuming then that the N.W. point has the same part in the southern hemisphere as the S.W. point in the northern, the S.E. point in the former corresponds to the N.E. point in the latter; consequently we have as the

MEAN MOVEMENTS OF METEOROLOGICAL INSTRUMENTS:—

In the Northern Hemisphere.

1. The Barometer sinks with E., S.E., and S. winds, is arrested in its downward progress by a S.W. wind, rises with W., N.W., and N. winds, and ceases to rise with one from N.E.

2. The Thermometer rises with E., S.E., and S. winds, and ceases to rise with a S.W. wind; it falls with W., N.W., and N. winds, and ceases to fall with one from N.E.

3. The Elasticity of *vapour* increases with E., S.E., and S. winds; its increase changes to a decrease with one from S.W.; it decreases with W., N.W., and N. winds; and its decrease changes to an increase with a N.E. wind.

4. The Pressure of the *dry air* decreases with E., S.E., and S. winds; its decrease changes to an increase with a S.W. wind; it increases with W., N.W., and N. winds; and its increase changes to a decrease with one from N.E.

In the Southern Hemisphere.

1. The Barometer sinks with E., N.E., and N. winds, is arrested in its downward progress by a N.W. wind, rises with W., S.W., and S. winds, and ceases to rise with one from S.E.

2. The Thermometer rises with E., N.E., and N. winds, and ceases to rise with a N.W. wind; it falls with W., S.W., and S. winds, and ceases to fall with one from S.E.

3. The Elasticity of *vapour* increases with E., N.E., and N. winds; its increase changes to a decrease with one from N.W.; it decreases with W., S.W., and S. winds; and its increase changes to a decrease with a S.E. wind.

4. The Pressure of the *dry air* decreases with E., N.E., and N. winds; its decrease changes to an increase with a N.W. wind; it increases with W., S.W., and S. winds; and its increase changes to a decrease with one from S.E.

Thus, the movements of meteorological instruments are the *same* with *east* winds in the NORTHERN HEMISPHERE as they are with *east* winds in the SOUTHERN: the same is the case with *west* winds. The *difference* between the two hemispheres is only quantitative with N.W., N.E., S.W., and S.E. winds; and on the other hand, it is qualitative with N. and S. winds—*i.e.*, the mean fluctuations of the meteorological instruments are greatest in the Northern Hemisphere with N.W. and S.E. winds, and of the least importance (owing to the compensation of the opposite movements) with N.E. and S.W. winds; in the Southern Hemisphere (owing to the compensation of opposite movements) they are of least importance with N.W. and S.E. winds, and, on the contrary, they are greatest with N.E. and S.W. winds. The changes with N. winds in the Northern Hemisphere are, however, different from the changes which occur with N. winds in the Southern Hemisphere; under like climatic conditions, however, they are the same in both, according to their amount,—if, for instance, there be a rise in an instrument with a N. wind in the Northern Hemisphere, it sinks with a N. wind in the Southern, and *vice versâ*. The same occurs with S. winds.

104. It is in reference to these observations, in so far as they appertain to the North Temperate Zone, that DOVE shows that the weather indices (words) on the barometer are of very subordinate importance, because the difference in the temperature and, as a consequence of it, in the pressure of the two currents (polar and equatorial) is generally far greater in winter than in summer. As thus the fluctuations of the barometer are generally far more considerable in winter than in summer, the relative proportions, according to which the scale has been constructed, should be at least double in winter what they are in summer; as they are constructed at present, however, we are easily led astray by them. Properly speaking, the upper part of the index should represent the N.E. wind or a tranquil polar current; the middle part, the E. and W. winds, or, more correctly, the transition of the two aerial currents; and the lower part, the S.W. wind, or, better still, the equatorial current. Now, as the air of the polar current flows from colder to warmer regions, its capacity for creating vapour increases, and the effect of this increase stands on the index thus: "very dry, or fine." If owing to the transition of the currents into each other from E. and W., and their mingling together, precipitation follows, but clearer weather sets in afterwards, this is set down on the index as "changeable." If, as the current from the S. moves onwards into higher latitudes it gradually loses its vapour over the ground, which becomes colder as it advances, this effect is set down as "rainy." If, however, it rushes rapidly into higher latitudes, and its pressure, although diminished, is contrasted when it is strongest, owing to the rarefaction of its air by heat and the loss of its accompanying vapour, with its mean amount, it is set down under the head of "stormy."

105. On these and similar researches ADMIRAL FITZROY has recommended that the old and comparatively useless BAROMETER-SCALES, on which are marked "fair," "change," "rain," "stormy," &c., be abolished, and that the following be substituted, as better adapted to the improved state of meteorological science, and therefore conveying more information to ordinary observers:—

On Barometer-scales the following contractions are for NORTH LATITUDE :—

RISE FOR N.E.-ly N.W.—N.—E. Dry or Less Wind.	FALL FOR S.W.-ly S.E.—S.—W. Wet or more Wind.
Except Wet from N.E.-ward.	Except Wet from N.E.-ward.

In SOUTH LATITUDE substitute South or Southward for North, &c.

And the following summary may be useful *generally* throughout the world :—

RISE FOR Cold, Dry, or Less Wind.	FALL FOR Warm, Wet, or More Wind.
Except Wet from Cold Side.	Except Wet from Cold Side.

Thus, 1. The BAROMETER rises for Northerly Wind (including from N.W., by the North to the Eastward); for Dry or *less* Wet Weather; for *less* Wind; or for more than one of these changes :—

Except on a few occasions when Rain (or Snow) comes from the Northward with *strong* Wind.

The THERMOMETER falls for *change* of Wind towards *any* of the above directions.

Also, 2. The BAROMETER falls for Southerly Wind (including from S.E., by the South to the Westward); for Wet Weather; for *stronger* Wind; or for more than one of these changes :—

Except on a few occasions when *moderate* Wind with Rain (or Snow) comes from the Northward.

The THERMOMETER rises for *change* of Wind towards the Southerly directions *only*.

MOISTURE or Dampness in the air (shown by a HYGROMETER) increases *before* or *with* Rain, Fog, or Dew.

106. Position of the Barometer in a Ship:—It is essentially requisite that the Barometer be suspended in a good light, but out of the reach of sunshine or the heat of a fire or lamp; nearly amidships, and exposed as little as possible to sudden changes of temperature; also in such a position that it may swing freely in the gimbals, and yet be in no danger of a sudden side blow from the rolling of the ship.

The tube of the marine Barometer being contracted to prevent "pumping" or undue oscillation, this instrument is generally considered by mariners to be slow in its indications, hence many now prefer the ANEROID, or the Sympiesometer.

The Aneroid Barometer is a good instrument, inasmuch as it is quick in showing the variation of atmospheric pressure, is easily read, and may be placed out of harm's way better than the ordinary mercurial barometer; but it requires to be occasionally compared with a good barometer.

The Sympiesometer must be set with the thermometer before reading its indications; it is a very delicate instrument, and requires even more care than the marine Barometer; it must never be turned upside down, nor exposed carelessly to casual heat.

107. Well-discussed barometrical observations are still wanted for the Indian Ocean; lacking which, we turn to MAURY's Monograph, No. 2, "The Barometer at Sea," giving the approximate MEAN HEIGHT OF THE BAROMETER IN THE NORTHERN AND SOUTHERN HEMISPHERES, derived from the observations of American and Dutch vessels:—

Lat. 78° 37′ N.	29·759 inches.	DR. KANE.	
59° 51′	29·88 „	St. Petersburgh.	
55° to 50° N.	29·95 „	England.	
50° to 45°	30·060 „	from 8282 observations.	
45° to 40°	30·077 „	„ 5899	„
40° to 35°	30·124 „	„ 5103	„
35° to 30°	30·210 „	„ 4989	„
30° to 25°	30·149 „	„ 4392	„
25° to 20°	30·081 „	„ 3816	„
20° to 15°	30·018 „	„ 3592	„
15° to 10°	29·964 „	„ 4496	„
10° to 5° N.	29·922 „	„ 5343	„
5° to Equator	29·915 „	„ 5114	„
Equat. to 5° S.	29·940 „	„ 3692	„
5° to 10°	29·981 „	„ 3924	„
10° to 15°	30·028 „	„ 4156	„
15° to 20°	30·060 „	„ 4248	„
20° to 25°	30·102 „	„ 4536	„
25° to 30°	30·095 „	„ 4780	„
30° to 36°	30·052 „	„ 6970	„
40° to 43°	29·88 „	„ 1703	„
43° to 45°	29·78 „	„ 1130	„
45° to 48°	29·63 „	„ 1174	„
48° to 50°	29·62 „	„ 672	„
50° to 53°	29·48 „	„ 665	„
53° to 55°	29·36 „	„ 475	„
56½ S.	29·29 „	„ 1126	„

And the following Table, published by the Meteorological Department of the Board of Trade, gives, from verified instruments, the *mean* normal pressure (and range) in the Indian Ocean—between Lat. 0° and 10° N., Long. 50° to 110° E.:—

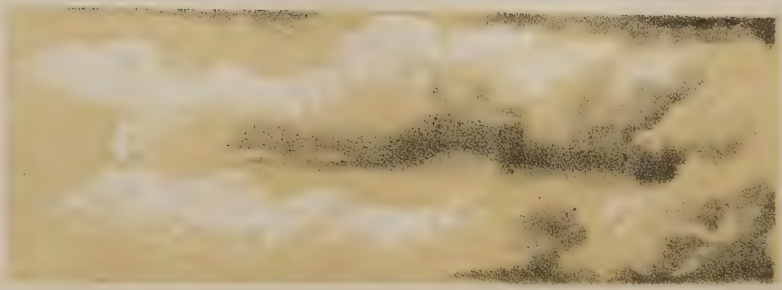
	January.	Feb.	March.	June.	July.	August.	Sept.	October.	Nov.	Dec.
Lat. 10° N.										
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Means	30·036	—	29·946	29·890	29·825	29·824	29·926	29·935	29·961	29·890
Range	0·16	—	0·06	—	0·13	0·22	0·14	0·32	0·30	0·02
No. of Observations	16	—	5	1	6	5	11	13	15	2
Lat. 5° N.										
Means	30·016	29·980	29·883	29·882	29·907	29·950	29·962	29·973	29·888	29·820
Range	0·25	0·10	0·02	0·09	0·10	0·04	0·31	0·30	0·23	0·04
No. of Observations	20	3	3	6	7	2	14	24	7	2
Equator.										

The navigator must always bear in mind that the range of the barometer between the Tropics is very small (a few tenths), and that any deviation from this announces the approach of a tropical gale, or perhaps of a hurricane.

1. *Cirrus.*

3. *Stratus.*

7 *Nimbus.*



2. *Cumulus.*

108. Maury gives the following as the *mean height of the Barometer* in high southern latitudes:—

Bands of Latitude.	As observed between the Meridians of			
	20° W. and 140° E.		140° E. and 80° W.	
	No. of Observations.	Height of Barometer.	No. of Observations.	Height of Barometer.
		Inches.		Inches.
Lat. 40° S. to 43° S.	1115	29·90	210	29·84
„ 43° S. „ 45° S.	738	29·80	155	29·73
„ 45° S. „ 48° S.	611	29·58	226	29·71
„ 48° S. „ 50° S.	175	29·53	247	29·56
„ 50° S. „ 53° S.	108	29·35	198	29·45
„ 53° S. „ 55° S.	6	29·17	92	29·35
S. of 55°	7	29·27	64	29·42

109. It only remains to give the *mean height of the Barometer as observed in* 1429 *gales of wind south of the parallel of* 40° *S.*:—

Bands of Latitude.	No. of Observations.	Height of Barom. with wind between N. & E.	No. of Observations.	Height of Barom. with wind between S. & E.	No. of Observations.	Height of Barom. with wind between S. & W.	No. of Observations.	Height of Barom. with wind between N. & W.
Lat. 40° to 43° S.	36	29·86	17	29·59	88	29·65	116	29·50
„ 43° „ 45° S.	30	29·58	11	29·59	72	29·49	88	29·50
„ 45° „ 48° S.	38	29·42	24	29·51	98	29·48	169	29·38
„ 48° „ 50° S.	25	29·35	10	29·46	63	29·33	88	29·27
„ 50° „ 53° S.	29	29·46	11	29·34	59	29·34	70	29·18
„ 53° „ 55° S.	15	29·31	5	29·07	60	29·23	39	29·19
„ S. of 55° . .	22	29·24	6	29·45	62	29·17	78	29·14

And from this Table it appears that on the polar side of 40° S. *eighty per cent.* of the gales have westing in them, and that they are distributed in the following proportion: from the northward and eastward 14 per cent.; from the southward and eastward 6 per cent.; from the southward and westward 25 per cent.; and from the northward and westward 45 per cent.; consequently, the last is the stormy quarter of the Great Southern Ocean.

110. Clouds and their Variations.*—Howard distinguished, according to their forms, three sorts of clouds—the *cirrus*, the *cumulus*, and the *stratus*, to which four forms of transition were attached—viz., *cirro-cumulus*, *cirro-stratus*, *cumulo-stratus*, and *nimbus*.

The *cirrus*—the cat's tail of sailors [*see* Plate X., fig. 1], is composed of thin filaments, the association of which sometimes resembles a brush, at other times woolly hair, and at times slender network.

* Kaemtz' "Meteorology."

The *cumulus*, or summer-cloud (*ball of cotton* of sailors), frequently presents itself in the form of a hemisphere, resting on an horizontal base. Sometimes these hemispheres are built one upon the other, and form those great clouds which accumulate on the horizon, and resemble at a distance mountains covered with snow. [*See* Plate X., fig. 2.]

The *stratus* is an horizontal band, which forms at sun-set, and disappears at sun-rise. [*See* Plate X., fig. 3.]

Under the name of *cirro-cumulus*, HOWARD designates those little rounded clouds which are often called woolly clouds; when the sky is covered with them it is said to be *fleecy*. [*See* Plate X., fig. 4.]

The *cirro-stratus* is composed of little bands of filaments more compacted than those of the *cirrus;* for the sun has sometimes a difficulty in piercing them with his rays. The clouds form horizontal strata, which, at the zenith, seem composed of a great number of thin clouds; whilst at the horizon, when we see the vertical projection, a long and very narrow band is visible. [*See* Plate XI., fig. 5.]

When the *cumulus* clouds are heaped together, and become more dense, this species of clouds passes into the condition of *cumulo-stratus* [*see* Plate XI., fig. 6], which often assumes at the horizon a black or a bluish tint, and passes into the state of *nimbus*, or rain-cloud. [*See* Plate XI., fig. 7.] The latter is distinguished by its uniform grey tint and its fringed edges; the clouds of which it is composed are so compounded that it is impossible to distinguish them.

Though it be easy to distinguish these clouds when their forms are well characterized, it is often a very difficult matter to designate accurately certain forms of transition; and one observer, for example, will call *cirro-stratus* what another observer would designate under the head of *cumulo-stratus*.

After a continued period of fair weather, and when the barometer slowly begins to fall, well-characterized *cirri* often appear under the form of slender filaments, whose whiteness contrasts with the azure of the sky. At other times they are arranged in parallel bands, scarcely visible, and which are directed from the S. to the N., or from S.W. to the N.E.* Sometimes they separate, and resemble the floating tail of a horse. In Germany these clouds are known under the name of wind-trees (Windsbäume.) These filaments are also seen to cross each other in various ways.

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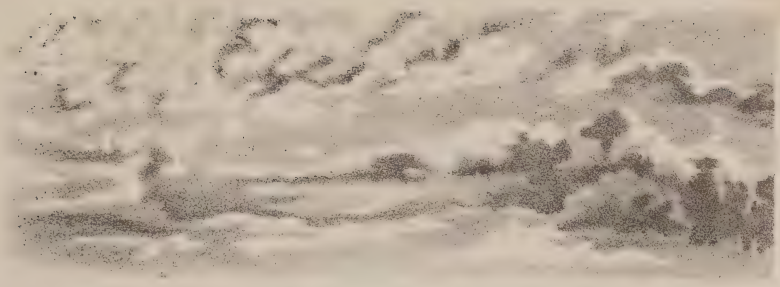
* The tendency which the *cirri* have to arrange themselves in bands parallel to each other is remarkable; and it proves that the cause which directs their filaments to one azimuth rather than another, instead of being merely local and accidental, extends to great distances.

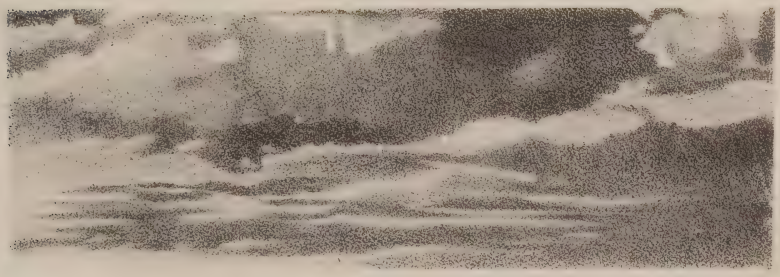
By a well-known law of perspective, parallel bands ought to appear diverging from one point of the horizon, and converging at the point of the horizon diametrically opposite. The observance of these points of convergence greatly facilitates the knowledge of the direction. The observations that I made with M. BRAVAIS, on the Faulhorn, prove, agreeably to M. KAEMTZ' observations, that the predominant direction is that of the S.W. to N.E. The meteorological registers of the members of the Commission of the North, who wintered in Lapland, give a slightly different direction merely: from W. by S. to E. by N. Moreover, the phenomenon occurs more frequently there than in the temperate zones. At the Equator, HUMBOLDT found that the parallel bands were generally directed from N. to S.

The cause, which thus arranges the great axes of these clouds, according to parallel lines, is still unknown. FORSTER was the first who made the very just remark that these clouds almost always travel along a parallel to their great axis, which greatly contributes to render them apparently motionless. M. BRAVAIS, without being aware of FORSTER'S observations, arrived at the same conclusion. Many meteorologists (HOWARD, FORSTER, PELTIER) seem to believe that the *cirri* serve as conductors between two distant foci of electricity of opposite names, the fluids of which tend to combine, and that the flexibility of the conducting clouds terminates in the rectilinear form, which is necessitated by the condition of the shortest path from one focus to the other.—MARTINS.



4. Cirro-cumulus.

5. Cirro-stratus.



6. Cumulo-stratus.

Cumulonus.

These clouds frequently resemble carded cotton, and pass into the state of *cirro-cumulus* and *cirro-stratus*. The white colour by which they are characterized does not always permit their structure to be recognised, or their transformations to be followed; but by means of the mirrors of blackened glass, which landscape painters use, this may be managed with the greatest facility. The eye is not dazzled, and the cloud reflected in the glass may be studied at leisure.

The *cirri* are the most elevated clouds; it is difficult to determine their height. Measures made at Halle have often led me to assign to them a height of four miles. Travellers who have passed over high mountains are unanimous in asserting that, from the highest summits their appearance is the same. During a stay of eleven weeks within sight of Finsteraarhorn, the elevation of which is 13,800 feet, I never observed any *cirri* below the summit of that mountain. It is among the *cirri* that halos and parhelia are formed; and on studying these clouds by means of the blackened mirror, it is a rare case not to find in them traces of halos. These phenomena being due to the refraction of light in frozen particles, we may conclude that the *cirri* are themselves composed of flakes of snow floating at a great height in the atmosphere. Observations continued for ten years have convinced me of the truth of this assertion; and I know of no observation tending to prove that these clouds are composed of vesicles of water. We may feel astonished, no doubt, that in summer, when the temperature frequently attains 77° Fahr., the clouds which float above our heads are composed of ice; but the doubt will disappear when we reflect on the decrease of temperature with height. During one of those hot days, when rain falls on the plains, this rain is snow on the summits of the Alps.

The appearance of *cirri* often precedes a change of weather. In summer they announce rain; in winter frost or thaw. Even when the vanes are turned towards the N. these clouds are often carried along by S. or by S.W. winds; and the latter are soon felt also at the surface of the earth. We can admit that these clouds are brought by the S. winds, which determine the fall of the barometer, and the vapours of which are precipitated in the form of rain. Such at least is Dove's theory: it justifies the denomination under which the Swiss peasants have designated this class of clouds.

When the S.W. wind prevails, and extends to the lower regions of the atmosphere, the *cirri* also become more and more dense, because the air is moister. They then pass into the condition of *cirro-strati*, which first appear under the form of a mass like carded cotton, the filaments of which are closely interlaced, and they gradually take a greyish tint; at the same time, the cloud seems to get lower, and vesicular vapour is formed, which fails not to be precipitated in the form of rain.

The same meteorological circumstances sometimes determine the formation of light *cirro-cumuli*, which are entirely composed of vesicular vapour. They do not weaken the light of the sun, for it passes through them; and Humboldt has often been able to see through these clouds stars of the fourth magnitude, and even to recognise the spots on the moon. When they pass before the sun or the moon, these bodies are surrounded with an admirable corona. The *cirro-cumuli* foretell heat: it seems that the hot S. winds, which prevail in the lower regions, do not convey a sufficient quantity of vapours to cover the sky entirely with clouds, and that they only act by their elevated temperature.

While the clouds of which I have spoken are the produce of the S. wind, the

cumuli owe their existence to ascending currents: their height varies greatly, but it is always less than that of the *cirri*. The *cumuli* are most characteristic in the fine days of summer. When the sun rises in a clear sky, a few small clouds may be seen appearing about eight o'clock in the morning, which seem to increase from within outward. They become thicker, and accumulate to form masses clearly circumscribed and limited by curved lines, which cut each other in different directions. Their number and size increase till the hour of greatest heat in the day; they then diminish, and at sunset the sky is again perfectly serene; in the morning they are very low, but they continue ascending until mid-day, when they again re-descend in the evening. I convinced myself of this by direct measurement, and observations made in the mountains. How often have I seen the *cumuli* under my feet in the morning! They then rise: toward mid-day I was surrounded by clouds for about an hour, and the rest of the day I saw above my head clouds, which in the evening re-descended to the plain.*

Cumuli are formed when ascending currents draw the vapours into the higher regions of the atmosphere, where the air, being very cold, is rapidly saturated. If the current increases in force, the vapours and clouds become more elevated; but there they increase in greater ratio, on account of the reduction of temperature. Hence it happens that the sky, though fine in the morning, is entirely clouded at mid-day. When the ascending current relaxes towards evening, the clouds descend: as, on arriving into strata of air which are less heated, they again pass into the state of invisible vapour. According to SAUSSURE, the rounded form of clouds is due to this mode of formation. Indeed, when one liquid traverses another in virtue of the resistance of the ambient medium, and the mutual resistance of its parts, the former takes a cylindrical form with a circular section, or one composed of arcs of a circle. We may convince ourselves of this by letting a drop of milk or of ink fall into a glass of water. Thus the masses of ascending air are great columns, the shape of which is defined by the clouds. Add to this the little whirlwinds on the borders of the clouds, which are frequently observed in mountains, by means of the blackened mirror, and which also contribute to give to the whole rounded forms analogous to those of whirls of smoke escaping from a chimney.

The *cumuli* do not always disappear toward evening; on the contrary, they often become more numerous, their borders are less brilliant, their tint deeper, and they pass to the state of *cumulo-stratus*, especially if a stratum of *cirrus* exists below them. We may then expect rains or storms, for in the higher and the mean regions the air is near the point of saturation. The S. wind and the ascending currents give rise to changes of temperature which determine the precipitation of aqueous vapour in the form of rain.

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* There exists a great number of measurements of the heights of clouds. KAEMTZ ("Lehrbuch der Meteorologie," t. i., p. 385) relates several which are due to RICCIOLI, BOUGUER, HUMBOLDT, LAMBERT, CROSTHWAITE, and to himself. The extremes are 440 and 7000 yards. During the cruise of the *Venus*, 1000 and 1500 yards were found on the Atlantic and the South Sea as the extreme terms.

M. PEYTIER, staff-officer, communicated to the Institut, January 2nd, 1837, forty-eight measures of the height of clouds, made in 1826, during the triangulation that he executed in the Pyrenees with M. HOSSARD. The extremes for the lower plane of clouds were 500 and 2700 yards; for the upper plane, 1000 and 3300. They obtained these different determinations by aid of the heights previously measured, of the peaks to which the clouds were tangents by their superior or inferior surfaces. On September 29th the two observers were so placed as to see at the same moment the two opposite surfaces of a cloud. Its thickness was 500 yards. Next day it was 900.—MARTINS.

The *cumuli* that are heaped up on the horizon in the fine days of summer are those which are most fertile for plays of the imagination. Who has not fancied that he recognises in the changing forms of these clouds men, animals, trees, and mountains? They furnish comparisons to the poets; and OSSIAN has borrowed from them his most beautiful images. The popular traditions of mountainous countries are full of strange events, in which these clouds play a prominent part. As they are often of the same height, an appearance results which I should mention. When I was living at the Faulhorn, the sky was frequently clear above my head; but a little above the horizon, a belt of clouds, the width of which did not exceed double or treble that of the moon, extended like a pearl necklace along the West Alps, from France to the Tyrol. My station, at 8800 feet above the sea, was a little more elevated than the clouds, and their projection on the sky formed a narrow belt, although they were spread over a vast extent of the sky. From this projection, it follows that it is often very difficult to distinguish the *cumulus* from the *cumulo-stratus*. How frequently do we see *cumuli* spread over the sky! The horizon appears charged with clouds; it seems that the heavens will in a short time be entirely covered with them; and yet the sun continues to shine without intermission. A very simple reasoning proves that the eye has been deceived by a projection. Imagine a series of globular clouds of the same size, equi-distant from each other: if the observer draws two lines from the station he occupies to the limits of the clouds, the interval between those which are at the zenith will be very great, but it will be contracted in proportion as they approach the horizon, when it becomes entirely null.

While the true *cumuli* are formed, and disappear during the night, another variety of these clouds is seen under very different circumstances. It is common to observe in the afternoon dense cloudy masses, rounded or extended, with borders badly defined, the number of which increases towards evening, until, during the night, the sky is completely overcast. The next day it is still overcast, but, some hours after sunrise, all disappears; the true *cumuli* then occupy the sky, where they float at a more considerable height. I have determined this by direct measurements. At evening, clouds of the former class again replace the true *cumuli*. These clouds are composed of very dense vesicular vapour, like the *cumulus* and the *cumulo-stratus*. They differ in their dependence on the hours of the day; they have also an analogy with the *stratus*, on account of their extent, and are distinguished from them by their greater height. However, they approach nearer to them than to the *cumulus*, and I propose designating them under the name of *strato-cumulus*. During winter this kind of cloud frequently covers the whole sky for weeks together; their presence is probably due to the decrease of temperature, reckoning from the ground, being more rapid than usual. But as the sun rises, its rays dissolve the clouds, the vapours ascend, and *cumuli* are formed.

This influence of the sun on the clouds gives rise to atmospheric variations, which are well known to husbandmen. In the morning the sky is clouded, and it rains abundantly; but towards nine o'clock the clouds separate, the sun shines through, and the weather is fine for the rest of the day. At other times, during the morning, the sky is clear, but the air moist. The clouds soon appear; toward mid-day the sky is covered, the rain falls, but it ceases towards evening. In the former case, they were *strato-cumulus;* in the latter, *cumulo-stratus*. The former are dissipated by the rays of the sun, the latter are formed under their influence. If the temperature

and hygrometric conditions of the air at two or three thousand yards above the earth were as well known as at its surface, these apparent anomalies which astonish us might be more easily explained.

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111. Beaufort's Notation of Wind and Weather.—The following method, first devised by the late Hydrographer to the Admiralty, Sir Francis Beaufort, is generally used by seamen to indicate the State of Weather, and the Force of Wind at Sea; also in lighthouses, and at many stations on land:—

b	Blue Sky	*also*	1
c	Clouds (detached)		2
d	Drizzling rain.		
f	Foggy		3
g	Gloomy.		
h	Hail		4
l	Lightning.		
m	Misty (hazy)		5
o	Overcast (dull) (*also* g) . . .		6
p	Passing showers.		
q	Squally.		
r	Rain		7
s	Snow		8
t	Thunder. Lightning		9
u	Ugly (threatening) appearance of weather.		
v	Visibility. Objects at a distance unusually visible.		
w	Wet dew.		

Note.—A letter repeated augments its signification:—thus f f very foggy, r r heavy rain, r r r heavy and continuing rain. Sometimes a bar (—) or dot (.) is used for this purpose, as r̲ heavy rain.

0	Calm.
1	Steerage way.
2	Clean full—from 1 to 2 knots.
3	Ditto 3 to 4 knots.
4	Ditto 5 to 6 knots.
5	With royals.
6	Topgallant sails over single reefs.
7	Two reefs in topsails.
8	Three reefs in topsails.
9	Close-reefed maintopsail and courses.
10	Close-reefed topsails and reefed foresail.
11	Storm staysails.
12	Hurricane.

From 2 to 10 being supposed "close-hauled."

The above method is very general, and in practice it answers well—not only for seamen, but even for popular use on land, by *estimating* the force of wind, proportionally, between the extremes of its slightest motion and its utmost violence.

Mr. Glaisher, of the Royal Observatory, Greenwich, considers the following notation (0 to 6) of the wind preferable to the above, at least for land purposes, where there can be no definite reference to the power of the sails:—

Scale of Wind:—			
(Beaufort . . .	1—12	1—3 Light . . .	1
corresponding to		3—5 Moderate . .	2
Land	1—6)	5—7 Fresh . . .	3
		7—8 Strong . . .	4
		8—10 Heavy . . .	5
		10—12 Violent . . .	6

TABLE SHOWING THE FORCE AND VELOCITY OF THE WIND FROM LIGHT AIRS TO HEAVY GALES AND TEMPESTS.

Pressure in lbs. on Square Foot.	Velocity.		Popular Descriptions.
	Feet per Second.	Miles per Hour.	
0·002	1	0·68	Gentle airs (unappreciable by gauge).
0·004	1·47	1	
0·005	1·56	1·06	
0·019	3	2	Light airs (just appreciable by gauge); would fill the lightest sail of a yacht.
0·028	3·67	2·5	
0·032	3·9	2·66	
0·043	4·5	3	
0·052	4·9	3·3	
0·065	5·58	3·8	Light breezes; such as would fill the lightest sails of a large ship.
0·071	5·87	4	
0·090	6·6	4·5	
0·100	6·98	4·75	
0·112	7·34	5	
0·130	7·89	5·38	
0·136	8·1	5·5	
0·162	8·8	6	
0·228	10·4	7	
0·260	11	7·6	
0·291	11·8	8	Moderate breezes, in which ships can carry all sail.
0·364	13·2	9	
0·390	13·6	9·27	
0·452	14·7	10	
0·521	15·8	10·77	
0·551	16·2	11	
0·650	17·66	12	
0·780	19·3	13	Fresh breezes,—topgallant-sails and royals.
0·830	20	13·6	
0·884	20·6	14	
0·910	20·9	14·25	
1·042	22	15	
1·170	23·6	16	
1·250	24·2	16·5	
1·302	25	17	Fresh winds; reefs.
1·430	26·2	17·8	
1·470	26·5	18	
1·563	27·39	18·67	Strong winds; treble-reefed topsails.
1·630	28	19	
1·790	29·35	20	
1·820	29·55	20·14	Gales; close-reefed topsails and reefed courses.
2·084	31·15	21·47	
2·600	35·32	24	
3·126	38·73	26·40	Strong gales; close-reefed topsails and staysails.
3·647	41·83	28·52	
4·168	44·83	30·56	
4·689	47·44	32·34	
5·200	50	34	
7·800	61·18	41	Heavy gales and storms.
10·400	70·72	48·2	
13·000	79·07	53·91	
15·600	86·61	59	
20·800	100	68·18	Very heavy gales; great storms; tempests.
26·000	111·74	76·18	
31·200	122·62	83·6	
36·400	132·18	90·12	Tornadoes; cyclones; hurricanes.
41·600	141·30	90·34	
52·000	157·98	107·7	
62·400	173·06	120	

112. The Moon's Influence on the Weather.—Sailing directions, as well as popular belief, very commonly attribute *changes of weather to the moon's influence.* As the subject has been critically tested it may not be amiss to place the results before the seaman.

Toaldo made a series of observations, continued for forty-five years, at Padua, in which changes of weather were recorded in juxta-position with lunar phases: without detailing the particulars, it will be sufficient to state at once the results. He found that for every seven *new* moons the weather changed at six, and was settled only at one; for every six *full* moons, the weather changed at five, and was settled at one; for every three epochs of the *quarters*, there were two changes of weather.

He also examined the state of the weather in reference to the moon's distance from the earth, which is subject to some variation. The position of the moon when most distant from the earth is called *apogee*, and her position when nearest is called *perigee*. He found that of every six passages of the moon through *perigee* there were five changes of weather; and of every five through *apogee* there were four changes of weather. If these results would bear the test of rigid examination, they would be decisive in favour of the popular notion of the lunar influence. But let us see in what manner Toaldo conducts his inquiry.

He was himself an avowed believer in the lunar influence, not merely upon the atmosphere, but even on the state of organized matter. In his memoir on the subject he has not stated what atmospherical changes he has taken as *changes of weather;* and it is not unfair to presume that the bias of his mind would lead him to class the slightest vicissitudes under this head. But further, Toaldo, in recording the changes of weather coinciding with the epochs of the phases, did not confine himself to changes which took place upon the particular day of the phase. On the pretext that time must be allowed for the physical cause to produce its effect, he took the results of several days. At the new and full moon he included in his enumeration all changes which took place two or three days before or two or three days after the day of new or full moon; while for the quarters he only included the day preceding and the day following the phases; and for epochs not coincident with the lunar phases, he only counted the changes of weather which took place on the particular day in question.

It appears, then, that for the changes coinciding with a new and full moon, as recorded by Toaldo, may be taken any changes occurring within the space of from four to six days; also, for the changes recorded at the quarters are to be understood those which occurred within the space of three days; and for those not coinciding with the phases may be taken the changes which occurred on a single day. It will not require much sagacity to perceive that the results of such an inquiry must have been just what Toaldo found them to be; and that, if instead of taking the epochs of the lunar phases, he had taken any other periods whatsoever, and tried them by the same test, he would have arrived at the same results. Five days at the new and full moon would include a third of the entire lunar month; and thus a third of all the changes of weather which occurred in that period were ascribed by Toaldo to the lunar influence.

Professor Pilgrim has also examined a series of observations on the *lunar phases as connected with the changes of weather*, made at Vienna, and continued from 1763 to 1787—a period of twenty-five years—and he has found that, of every hundred

cases of the phases, the proportion of the occurrence of changes to that of the settled state of the weather was as follows :—

	Changes.	Settled Weather.
New moon	58	42
Full moon	63	37
Quarter	63	37
Perigee	72	28
Apogee	64	36
New moon at perigee	80	20
New moon at apogee	64	36
Full moon at perigee	81	19
Full moon at apogee	68	32

Admitting these results, it would follow, contrary to popular belief and to the observations of TOALDO, that the new moon is the least active of the phases; and that the full moon and quarters are equally active; also that the influence of *perigee*, or the nearest position of the moon, is greater than that of any of the phases; while the influence of *apogee*, or its greatest distance, is equal to that of the quarters and full moon, and greater than that of the new moon.

But PILGRIM'S calculations are liable to objections similar to those which vitiate the observations of TOALDO; for he included in his enumerations of changes corresponding to the phases, changes which occurred the days preceding and following the phases: this being the case, the only wonder is that the proportion which he found especially for the new moon, is not more favourable to his hypothesis. But independently of this, PILGRIM'S results are not entitled to any confidence: they not only bear internal evidence of inaccuracy, but the observations were not continued for a sufficient length of time to give a safe and certain conclusion.

In the years 1774 and 1775 DR. HORSLEY directed his attention to the question, and published two papers in the *Philosophical Transactions*, with a view to dispel the popular prejudice on the subject of lunar influences. HORSLEY'S observations, however, were confined to so short a period of time (two years), that they could not be expected to afford any satisfactory results. He found that in the year 1774 there were only two changes of weather which corresponded with the new moon, and none with the full moon; and that in the year 1775 there were only four changes which corresponded with the new moon, and three with the full moon.

Examining the question of lunar influences in a more general point of view, to see whether observation has supplied any ground for the supposition of any relation whatever of periodicity between the moon and the weather, it appears that M. SCHUEBLER made a series of observations, with considerable care, and published the following results, which, shortly after, were re-examined by M. ARAGO.

SCHUEBLER'S calculations were founded on meteorological observations made at Munich, Stutgard, and Augsburg, for 28 years.* His object was to ascertain whether any correspondence existed between the lunar phases and the quantity of rain which fell in different parts of the month. He defined a rainy day to be one in which a fall of rain or snow was recorded in the meteorological journals, provided it affected the rain-gauge to an extent exceeding the six-hundredth part of an inch.

* At Munich, from 1781 to 1788 inclusive; at Stutgard, from 1809 to 1812 inclusive; and at Augsburg, from 1813 to 1828 inclusive.

So far as his observations may be relied upon, it would follow, that in the places where they were made, out of 10,000 rainy days the following are the number of those days which would happen at the different lunar phases :—

New moon	306
First octant	306
First quarter	325
Second octant	341
Full moon	337
Third octant	313
Last quarter	284
Fourth octant	290

Now, as there are about $29\frac{1}{2}$ days in the lunar month, if we suppose the fall of rain to be distributed equally through every part of the month, the total number of these 10,000 days which should happen on the eight days of the phases, would be found by simple proportion, since it would bear to 10,000 the same proportion that 8 bears to $29\frac{1}{2}$:—the number would therefore be 27·12. Whereas, it appears from the above Table, that the actual number which fell upon these days was 52·02; and thus less than the proportional amount occurred upon them.

Pilgrim had already, in 1788, attempted to ascertain the influence of the lunar phases on the fall of rain; and he found that in every hundred cases there were 29 of rain on the full moon, 26 at the new moon, and 25 at the quarters.

The preceding observations refer only to the number of wet days. Schuebler, however, also directed his inquiries to the influence of the lunar phases on the *quantity* of rain and on the clearness of the atmosphere. From observations continued for sixteen years at Augsburg, including 199 lunations, he obtained the following results :—

Epochs.	Number of clear days in 16 years.	Number of overcast days in 16 years.	Quantity of rain in 16 years, in inches.
New Moon	31	61	26·551
First quarter	38	57	24·597
Second octant	25	65	26·728
Full Moon	26	61	24·686
Last quarter	41	53	19·536

In this Table, by a clear day, is meant such days as exhibit a cloudless sky at seven in the morning, and at two and nine o'clock in the afternoon; those that were not clear at these hours were counted as cloudy days. These results are in accordance with the former. It appears that the number of clear days is more frequent in the last quarter, which is an epoch at which, by the former method of inquiry, the number of rainy days was least; also the number of cloudy days is greatest at the second octant, which is a period at which the number of rainy days is found to be greatest; the depth of rain also agrees with this, being the greatest about the second octant, and least at the last quarter. Schuebler extended his inquiries to the influence of the moon's distance on rain; and he found that, on examining 371 passages of the moon through the positions of her extreme limits of distance,—during

the seven days nearest to *perigee* it rained 1169 times; and during the seven days nearest *apogee* it rained 1096 times. Thus, *cæteris paribus*, the nearer the moon to the earth, the greater would be the chances for rain.

The latest theory relating to the influence of the moon on the quantity of rain is that of M. MATHIEU, as announced in his work "*De la Prédiction du Temps.*"

M. MATHIEU, though disbelieving in lunar influence, entertained the idea that all the aqueous meteors with which our atmosphere is visited or affected obey laws as fixed and immutable as those which regulate the movements of the planets. With the view, therefore, of ascertaining these laws, he commenced an investigation which resulted in the admission that what he had previously considered mere popular prejudice is perfectly philosophical. He became convinced that whilst the sun plays the principal part in raising vapours, it is the moon that determines their precipitation and distribution; and further, that this is effected by the agency of atmospheric tides and the changes of the wind consequent thereon.

Avoiding the methods usually adopted, which he considers necessarily produce negative results, M. MATHIEU was led to examine the relation which exists between the moon's phases and the four cardinal positions of the sun, viz., whether the changes occur whilst that luminary is on the upper or lower meridian, and whether near the rising or setting. He then, it appears, extracted, from the meteorological register kept by SAUSSURE at Geneva (from 1796 to 1856), the observations of rain for the several days of the lunation, and arranged them in categories according to the time of the day and season of the year when the change occurred. The difference in the quantity of rainfall thus elicited is very considerable; and though the number of observations is not large, it should be remembered that they are spread over an extended series of years; and the results, according to M. MATHIEU, appear to be remarkably uniform.

For example, in the case of the new moon in the months of September, October, November, and December, if that phase occurred between the hours of 8 A.M. and 9.30 A.M., the amount of rain greatly exceeded the quantity registered when the new moon arrived between 7 A.M. and 8 A.M. During sixty years there were seventeen instances of its occurrence between 8 and 9.30 A.M.; and fifteen instances between 7 and 8 A.M.

The 17 instances gave 532 millimetres rain.
The 15 instances gave 266 mm. rain.

M. MATHIEU, after giving other examples at new moon, passes on to the first quarter, which he finds of the four phases is the one "which gives or transmits the most rain."

Two Tables are given of the amount of rain which was registered, in June, July, and August, in the 60 years, at first quarter.

From these Tables it appears that the first quarters which arrived between 11.30 A.M. and 3 P.M. brought more rain than those which occurred between 10 P.M. and 1 A.M. There were twenty instances of the former, and twenty-three instances of the latter time of the change:

The 20 instances gave 509 mm. rain.
The 23 instances gave 336 mm. rain.

In the case of the twenty-three instances which occurred between 10 P.M. and

1 A.M., nearly the whole rain-fall was registered in quarters where the phase arrived between *ten and eleven* o'clock P.M.

Again, the first quarters which occurred in the months of July and August between 4 A.M. and 5.30 A.M. were found to bring more rain than those which arrived between 6 A.M. and 8 A.M. There were nine instances of the first hour of the change, and fifteen instances of the second.

The 9 instances gave 301 mm. rain.
The 15 instances gave 108 mm. rain.

Encouraged by these results, and tempted by the numerous coincidences and indications of system which have led many, from TOALDO downwards, to believe it possible to foretell the weather by the aid of our satellite, M. MATHIEU enters into a full analysis, from which new combinations of hours and phases are obtained, by means of which he believes *rainy* periods may be predicted.

It is well to notice that M. MATHIEU's theory deals strictly with *aqueous meteors*, and not with the weather of any particular day.

M. MATHIEU having appealed to the French Emperor on behalf of his theory, M. LEVERRIER was directed to examine and report on its merits; the following is the result of M. LEVERRIER's investigation of his theory of the lunar influence:—

Following M. MATHIEU over his own ground, that of figures, I shall perhaps not arrive at the same conclusions as he has done. However, he will have no reason to complain that he has been condemned without a sufficiently serious examination.

M. MATHIEU bases his researches on the quantity of rain upon the meteorological observations commenced at Geneva on Jan. 1, 1796, by M. DE SAUSSURE, and continued without interruption from that time. He takes account of the quantity of water fallen and collected each day; he groups the results according to the phases of the moon, and the hour at which it entered into this phase; and discussing what he calls *the horary influence of the moon upon a phase taken isolately*, he finishes by setting forth this first rule:—

"SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER.—The new moon that occurs between 8 and 9 A.M. presents more water than that which occurs between 7 and 8 A.M.

"The first case occurred	17 times.
The second „	15 „
The seventeen former cases presented	532^{mm} of water.
The fifteen latter „ „	266 „
Mean of the former cases	31·5 „
„ „ latter „	17·11 „"

Let us dwell upon this first rule. Doubtless the author will have placed at the head of his precepts the one that he would consider as the best established; and it is right that we should begin where he has himself begun.

M. MATHIEU does not give the different quantities of rain, of which he offers only the sum. This could not satisfy us. We conceive that the author had desired to be brief; but he should at least have given a complete illustration of his mode of discussion. In statistical researches, illusion is easy; it requires a great amount of skill to avoid the errors that too frequently arise from an artificial grouping of the figures.

In order to fill up this blank, I have had recourse to the publications of the Observatory of Geneva, and have extracted the figures upon which M. MATHIEU has laid his foundation.

Following the plan laid down by the author, I have had regard to the day on which the new moon occurred, and neglected that on which the first quarter occurred. I am not aware whether he took a precaution that I have taken. I reduced all the quantities of rain to a like duration of seven days. When the duration of the phase was only six days, I have added a sixth to the quantity of water measured; when the phase was of eight days, I have abstracted from it an eighth. However, this correction has no influence over the general results.

On tabulating the figures on which M. MATHIEU based his theory, M. LEVERRIER comes to the conclusion that when the new moon occurs from 6 to 7 A.M., or from 9.30 to 11.30 A.M., the rain is at a mean of from 21 to 22 millimetres.

From 21 to 22 millims. are also collected when the moon occurs between 7 and 8 A.M.

Finally, when the new moon occurs from 8 to 9.30 A.M., the mean quantity is still the same.

We may therefore conclude that the assumed rule, given by M. MATHIEU *for Geneva, has no foundation.*

The fact which caused M. MATHIEU's illusion is palpable. It is the great quantity of rain (107 millims.), which fell at Geneva in 1840, during the first phase of the moon, which commenced on October 25th at 9.7 A.M. Suppress that year (1840), and nothing of the law remains. At this point, which for the fifteen other years, in which the moon occurred from 8.11 to 9.26 A.M., which is according to M. MATHIEU the great period of rain, the mean amount, on the contrary, is not more than $18\frac{1}{4}$ millims., which is the smallest of all.

This answer, extracted from the figures, may yet assume another form, under which it will strike every one. The mean quantity of rain in the lunar conditions under consideration, is 22 millims. Very well: in the seventeen years for which the new moon occurs between 8 and 9.30 A.M., and which according to M. MATHIEU should be very rainy, *there are eleven* in which the rain is below the mean, and only six in which it is superior to this mean. Where then, we ask, is the law which is false more than half the time? I even think that, had M. MATHIEU first considered the question under this point of view, he would have deduced a result diametrically contrary to the rule that he has given.

Besides, it is perfectly well known that, when we desire to establish physical laws, we must carefully guard ourselves against every combination of figures in which the result is exceptionally influenced by a solitary fact, as takes place in the case before us.

The connexion of barometric oscillations with atmospheric disturbances is so obvious, that the inquiry as to a correspondence between the lunar phases and the variations of the barometer would necessarily claim the attention of meteorologists, if any value were to be attached to lunar influence on the weather. M. FLAUGERGUES accordingly made a series of observations at Viviers (in the department of Ardêche), in France, which was continued from 1808 to 1828, a period of twenty years, on the heights of the barometer in relation to the lunar phases: that the influence of the sun might be always the same, the observations were made at noon, and the heights

of the barometer were reduced to what they would be at the temperature of melting ice. The following are the mean heights of the barometer, deduced from these observations :—

New Moon	29·743
First octant	29·761
First quarter	29·740
Second octant	29·716
Full moon	29·736
Third octant	29·751
Last quarter	29·772
Fourth octant	29·744

According to these observations, the height of the barometer is least about four days before full moon, and greatest six or seven before new moon. These times approximate to those at which the investigations of Schuebler give the greatest and least quantity of rain; and, since the fall of the barometer generally (but not always) indicates a tendency to rain, the results are so far in accordance. But, at the same time, it must be admitted that the variation of the barometer is in this case so minute that a sensible effect could hardly be expected from it; still, though minute, it is quite distinct and decided.

M. Flaugergues also observed the mean height of the barometer when the moon was at her greatest and least distance from the earth, and found that at *perigee* it was 29·713, and at *apogee* 29·753. And thus, so far as this small difference can be supposed to indicate anything, it would indicate a greater prevalence to rain at *perigee* than at *apogee*, which is in accordance with the observations of Schuebler.

Any theory of the moon's attraction applied to explain atmospheric tides similar to those of the ocean would lead to the conclusion that the height of the barometer observed at noon when the moon is in her quarters, would be less than its height at noon at new and full moon; observation, however, shows the very reverse as a matter of fact. Flaugergues found the mean height of the barometer at quadratures 29·756, and at new and full moon 29·739, the height at quadratures being in excess to the amount of 0·017. This result was further confirmed by the observations of Bouvard, at the Paris Observatory. He found the mean height of the barometer at the quarters 29·786, and at new and full moon 29·759, the excess at the quarters being 0·027.

Arago also submitted to rigorous investigations a series of barometric observations made in relation to the lunar phases at the Paris Observatory, and continued for twelve years. He found that the effect of the lunar attraction on the barometer at the epochs of the high and low atmospheric tides could not have exceeded the one-sixhundredth of an inch—a quantity such as could produce no conceivable effect upon the weather, and showing that it has no influence on the atmosphere analogous to that which produces the tides of the ocean.

Captain Byron Drury, R.N., in his observations on the meteorology of New Zealand, says, "We are not able to state that particular phases of the moon are coincidental with changes in the weather; indeed, after having kept a careful register every two hours, night and day, in these seas during four years, we could not recognise elemental changes corresponding with lunar phases."

In connexion with these remarks may be introduced an extract from the work of

Captain Flinders, who, during his six years' captivity in the Mauritius, never lost an opportunity of communicating the results of investigation. In his "Voyages," vol. ii., p. 444, after noticing the hurricanes that island is so liable to, he says—"An opinion commonly entertained in Mauritius, that hurricanes are little to be apprehended except near the time of full moon, does not seem to be well founded."

The so-called "Herschel's Weather Table" is a fiction of the most absurd character, and requires no comment; it was never issued by the authority of either of the illustrious astronomers whose name it bears.

So with regard to all other "predictions" *a year or more in advance.* The periods of atmospheric disturbance are generally given—according to the phases of the moon and its position in apogee and perigee—for intervals of six or seven days, and are further stated to apply to all parts of the earth's surface; this is a very safe way of stating the case; for, as Humboldt said of earthquakes, "if we could obtain information regarding the daily condition of all the earth's surface, we should probably discover that it was almost always undergoing shocks at some point or another;" so we may with tolerable certainty predict that a gale or considerable atmospheric disturbance is every day taking place at some part or another of so large a superficial area as 197 millions of square miles.

The "forecasts" of Admiral Fitzroy are of a character totally distinct from these: they rely mainly on the indications of the barometer, thermometer, &c., together with other meteorological observations obtained from distant stations and forwarded to the central office,—these only profess to be valid for a brief interval in advance.

CHAPTER VI.

HURRICANES OR CYCLONES,—AND THE LAW OF STORMS.

113. Revolving Storms, which partake of a twofold motion—one of *rotation*, as it were on an axis, and another of *progression*—and which, originating within the Tropics, generally invade the extra-tropical and temperate regions of the globe, have already been briefly discussed in connexion with Dove's "Law of Gyration," pp. 8-12. They are known as Hurricanes in the West Indies and South Indian Ocean, as Cyclones in the North Indian Ocean, and as Typhoons in the China Sea; they are also occasionally encountered in the Pacific Ocean.

The names most familiar to seamen in connexion with the history and origin of hurricanes or cyclones, are Redfield, Reid, and Piddington; but there are also others who, in their various works at different times, have done good service in elucidating what has been aptly termed the "Law of Storms"—these are Capper, Thom, Sir J. Herschel, Espy, Meldrum, Fitzroy, and Birt. It is the *result* of the labours of these men which will, in the first place, be collected together, and the *well-established laws of rotatory gales as developed in both hemispheres* brought briefly under the notice of the navigator; after which the storms of the Indian Ocean and China Sea will receive some special remarks—those relating to the Southern Indian Ocean, derived chiefly from the observations of that able meteorologist, Mr. C. Meldrum (of the Mauritius Observatory), who has done so much towards investigating the origin of hurricanes in the Monsoon region.

114. Veering of the Wind-Vane.—Reverting to what has already been said (pp. 7–12), it appears that when the storm is an equatorial one, whirlwinds are produced in the Northern Hemisphere in a direction contrary to that in which the hands of a watch move, and in the Southern Hemisphere in the same direction as the hands of a watch; and hence the following shiftings of the wind-vane:—

1. In the *Northern Hemisphere*—
   (*a*) When the vortex (or centre) of the storm passes to the westward of the place of observation, the rotation is ⇝ S., W., N., E., S., ⇝ with the sun.
   (*b*) When the vortex of the storm passes to the eastward of the place of observation, the rotation is ⇝ S., E., N., W., S., ⇝ against the sun.

2. In the *Southern Hemisphere*—
   (*a*) If the vortex of the storm passes to the westward of the place of observation, the rotation is ⇝ S., E., N., W., S., ⇝ with the sun.
   (*b*) If the vortex of the storm passes to the eastward of the place of observation, the rotation is ⇝ S., W., N., E., S., ⇝ against the sun.

Thus, in both hemispheres, the passage of an equatorial whirlwind storm on the west side of the place of observation produces normal revolutions (*i.e.*, revolutions in accordance with the Law of Gyration); while on the other hand, its passage on the east side produces anomalous revolutions (*i.e.*, contrary to the Law of Gyration).

When the vortex of a whirlwind storm passes over the place of observation the vane may shift, after a brief interval of calm, from one direction to that immediately opposite to it.

Bearing in mind, therefore, the direction of the rotation of the wind in each hemisphere—viz., against watch hands in the Northern, but with watch hands in the Southern Hemisphere,—certain portions of the storm are characterized by certain *hurricane winds;* and dividing the storm-area at any given place by diameters drawn from the northern to the southern margin, and again from the eastern to the western margin, we find that, in the Northern Hemisphere, on the northern margin the wind will be *easterly;* on the eastern margin, *southerly;* on the southern margin, *westerly;* and on the western margin, *northerly.* (*See* Plate XII., fig. 5.)

The relation of the winds to the margins in the Southern Hemisphere will be exactly the reverse of their relations in the Northern: thus, it is the southern margin of the storm, south of the Equator, that exhibits an *easterly* wind; the western margin a *southerly;* the northern margin a *westerly;* and the eastern margin a *northerly* wind. (*See* Plate XII., fig. 6.)

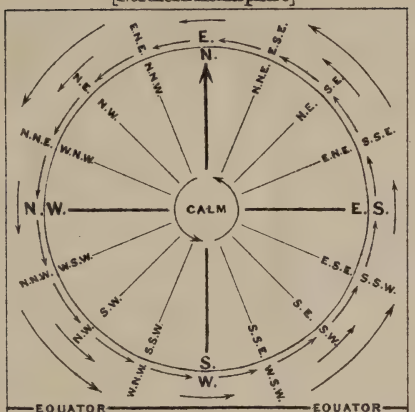
Hence each portion of the hurricane has its appropriate wind.

115. The Bearing of the Storm's Centre.—From this fact there results a very simple *Rule for determining the bearing of the Centre* of the storm from the ship—viz.,—*Look to the wind's eye and set its bearing by compass, the* EIGHTH *point to the* RIGHT *thereof, when in the* NORTHERN HEMISPHERE, *but to the* LEFT *of the wind's direction when in the* SOUTHERN HEMISPHERE, *will be the bearing of the storm's centre.*

Thus, in the NORTHERN HEMISPHERE, from an *easterly* wind which characterizes the northern margin of the storm, its centre will bear *south;* from a *northerly*

HURRICANE WINDS

FIG. I
[Northern Hemisphere]



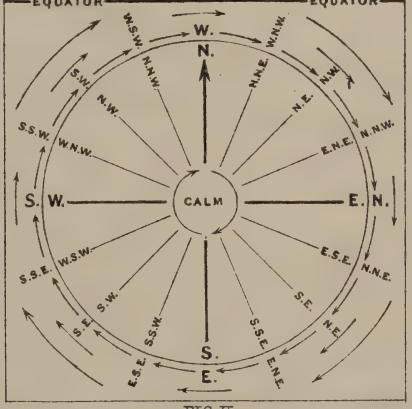
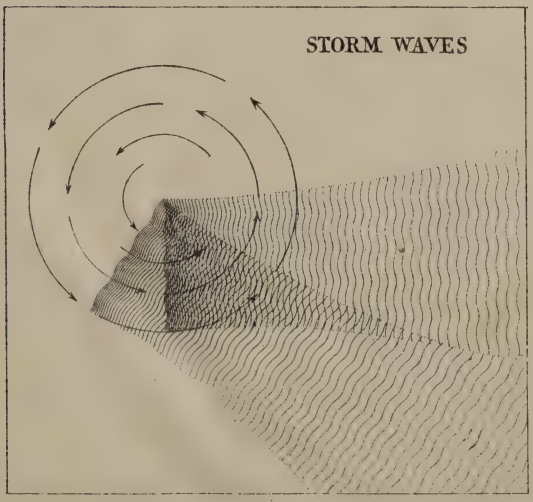


FIG. II
[Southern Hemisphere]

STORM WAVES



MOVEMENTS OF METEOROLOGICAL INSTRUMENTS

FIG. III.
[Northern Hemisphere]

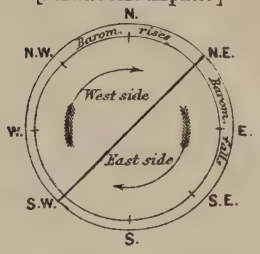


FIG. IV
[Southern Hemisphere]

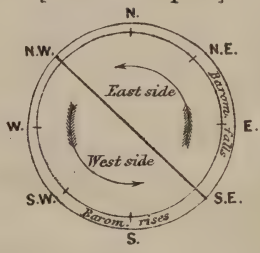


FIG. V
[Northern Hemisphere]

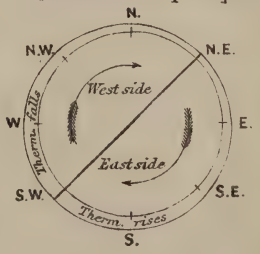
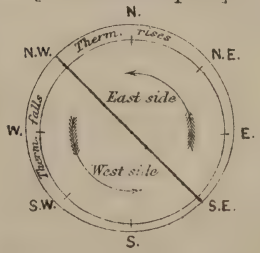


FIG. VI
[Southern Hemisphere]



wind the centre will bear *east;* from a *westerly* wind it will bear *north;* and from a *southerly* wind, *west.*

But, in the SOUTHERN HEMISPHERE, from an *easterly* wind, the centre of the storm bears *north;* from a *southerly* wind the centre bears *east;* from a *westerly* wind, *south;* and from a *northerly* wind, *west.*

The above rule is perfectly clear and definite, but as it is especially important to avoid the centre of the storm, the following Table shows at a glance its relative bearing in each hemisphere:—

IN THE N. HEMISPHERE.		IN THE S. HEMISPHERE.	
If the Wind be	The centre of the Storm will bear from the Ship	If the Wind be	The centre of the Storm will bear from the Ship
North	East.	North	West.
N. by E.	E. by S.	N. by E.	W. by N.
N.N.E.	E.S.E.	N.N.E.	W.N.W.
N.E. by N.	S.E. by E.	N.E. by N.	N.W. by W.
N.E.	S.E.	N.E.	N.W.
N.E. by E.	S.E by S.	N.E. by E.	N.W. by N.
E.N.E.	S.S.E.	E.N.E.	N.N.W.
E. by N.	S. by E.	E. by N.	N. by W.
East	South.	East	North.
E. by S.	S. by W.	E. by S.	N. by E.
E.S.E.	S.S.W.	E.S.E.	N.N.E.
S.E. by E.	S.W. by S.	S.E. by E.	N.E. by N.
S.E.	S.W.	S.E.	N.E.
S.E. by S.	S.W. by W.	S.E. by S.	N.E. by E.
S.S.E.	W.S.W.	S.S.E.	E.N.E.
S. by E.	W. by S.	S. by E.	E. by N.
South	West.	South	East.
S. by W.	W. by N.	S. by W.	E. by S.
S.S.W.	W.N.W.	S.S.W.	E.S.E.
S.W. by S.	N.W. by W.	S.W. by S.	S.E. by E.
S.W.	N.W.	S.W.	S.E.
S.W. by W.	N.W. by N.	S.W. by W.	S.E. by S.
W.S.W.	N.N.W.	W.S.W.	S.S.E.
W. by S.	N. by W.	W. by S.	S. by E.
West	North.	West	South.
W. by N.	N. by E.	W. by N.	S. by W.
W.N.W.	N.N.E.	W.N.W.	S.S.W.
N.W. by W.	N.E. by N.	N.W. by W.	S.W. by S.
N.W.	N.E.	N.W.	S.W.
N.W. by N.	N.E. by E.	N.W. by N.	S.W. by W.
N.N.W.	E.N.E.	N.N.W.	W.S.W.
N. by W.	E. by N.	N. by W.	W. by S.

To those who prefer it, the rule just enunciated may be put in another form, not, however, equally clear to all—*the centre of a revolving storm bears eight points from the direction of the wind at the ship, reckoned with the apparent course of the*

sun; and in this view, one rule holds good for both hemispheres, for though the bearings are precisely the reverse in the one hemisphere, of those in the other, so is the apparent motion of the sun also reversed, since in the southern hemisphere that luminary rises in the east, *culminates in the north*, and sets in the west.

Thus from the direction of the wind *only*, in a revolving storm, two very important points are made known—the exact position of the ship in the Hurricane or Cyclone, and the bearing of the storm's centre from the ship.

116. The Rotatory and Progressive Motions of Hurricanes.—From the very nature of whirlwind storms the wind has a rotatory motion, as it were, on an axis. But the body of the storm has a progressive motion, generally from the Equator towards the Pole, at first with westing, but as the storm advances towards the Tropics it recurves, and then moves polarwise with easting.

The hurricane is impelled to the *west* in *low* latitudes because the tendency of the two currents of air (polar and equatorial) is in those regions to the westward *along the surface;* the equatorial current *is much less so*, and diminishing until actually altered to easterly, near the Tropic, after which its preserved equatorial rotatory force becomes more and more evident, while the *westwardly* tendency of the polar current *diminishes;* as a consequence, near the Tropic, the whirlwind ceases to move westward—it recurves—and then in its polarwise progression moves towards the eastward. (Admiral FITZROY.) Thus, in general terms, the progressive motion of the Hurricane in the NORTHERN HEMISPHERE is from S.E.-ward to N.W.-ward; and after recurving, from S.W.-ward to N.E.-ward. (Plate XIII., fig. 1.) In the SOUTHERN HEMISPHERE from N.E.-ward to S.W.-ward; and after recurving, from N.W.-ward to S.E.-ward. (Plate XIII., fig. 2.) The place of recurvature is very dangerous, for the hurricane-winds are deceptive, owing to the storm being comparatively stationary for a brief period.

The area over which these rotatory storms have been known to expand—*i.e.*, where the rotatory winds prevail—varies from 30 or 40 to 1000 miles; but while the diameter of the storm, so long as it is within the Tropics, expands very gradually, it suddenly increases in a remarkable manner after recurving.

The rate at which a Hurricane travels onward also varies greatly not only in different parts of the globe, but even in the same locality and at the same season: in general, however, the progressive motion is greater after, rather than before, its recurvature.

117. Upon combining the Rotatory with the Progressive Motion, some very valuable Rules may be deduced,—the path which the axis of rotation describes is not inappropriately termed the *axis line*, and this divides the cyclone into *two semicircles*,—the right or *starboard* semicircle, and the left or *port* semicircle; there are consequently three divisions of a storm, each characterized by different phenomena. In the right hand semicircle, the hauling of the wind resulting from the passage of a cyclone in the Northern Hemisphere is in the same direction as the apparent course of the sun; but in the left hand semicircle it is reversed, being against the apparent course of the sun. On the axis line there is no change of wind *until the centre has passed*, when, after a brief interval of calm, the wind springs up with great fury from the opposite quarter.

Thus, the direction of the wind at the ship gives her position in the storm as re-

HURRICANE PATHS

FIG. I.

[NORTHERN HEMISPHERE]

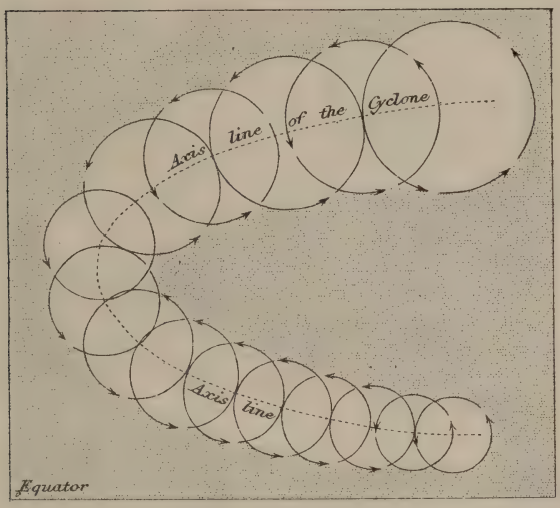
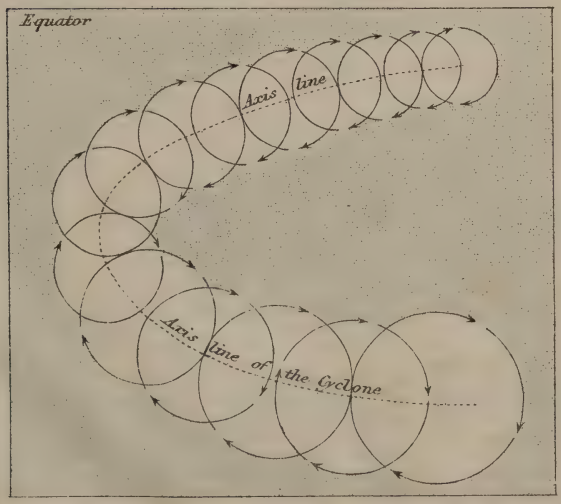


FIG. II.

[SOUTHERN HEMISPHERE]



ferred to the points of the compass, and what is of the greatest importance—the bearing of the centre from her; the hauling of the wind announces her position relatively to the axis line of the storm, which, combined with her track through the cyclone, will give the progressive direction of the storm itself; if the wind be found to increase in force *without hauling*, the ship is on the axis line; and if a calm occur, succeeded by a terrific and violent wind from the *opposite quarter*, the ship has passed through the centre.

From these remarks it will appear evident, that in manœuvring a vessel when overtaken by a rotatory gale IN THE NORTHERN HEMISPHERE, if she receive the wind on her *port* side, her head is directed (more or less) *towards the centre;* but if she receive it on her *starboard* side, her head is turned *from the centre:* and these facts indicate the means to be adopted to draw from the centre when lying-to; —if, with the ship's head from the centre, she receives the wind on the starboard side, then in lying-to (or drawing from the centre) she must be trimmed on the *starboard tack.*

IN THE SOUTHERN HEMISPHERE the reverse of this takes place;—a vessel sailing *out of* the gale receives the wind on her *port* side, and she must therefore be trimmed on the *port tack.*

118. On the Use of the Barometer in a Hurricane or Cyclone.—It was long ago remarked by PIDDINGTON, that "he who watches his barometer, watches his ship." This invaluable instrument, if well understood, invariably announces the approach of a revolving storm,—shows whether the vessel is plunging into the vortex, or if she be receding from it;—and hence, by carefully noticing its indications, the disastrous consequences of a hurricane may, to a great extent, be avoided—for the laws of its oscillations are very distinctly marked. The barometer often stands unusually high before the commencement of a cyclone, and frequently (if not always) just *around* the storm; and conceiving the cyclone to be divided into two parts by a diameter at right-angles to its path, it may be noted that—

(*a*) The barometer always *falls* during the passage of the *advancing* semicircle of a revolving storm.

(*b*) The barometer always *rises* during the passage of the *receding* semicircle of a revolving storm.

In cases of manœuvring to take advantage of the hurricane winds and to keep just within the verge of the storm, the barometer is of signal benefit,—it should be kept as high as possible without losing the wind. In whatever position the ship may be, the rising of the mercury announces that the first (or dangerous) half of the storm has passed.

The barometer is a faithful guide; in the zone of the Trade-winds its ordinary variations are so small that any deviation from the normal height requires attention; its fluctuations are larger beyond the Tropics, but the indications are scarcely less certain if used in conjunction with the thermometer and hygrometer,—hence, more watchfulness is required on the part of the navigator, and it is of the utmost importance to have such a knowledge of the Law of Storms, of Storm Instruments, and of the Signs of the Weather, as to be able to detect the presence of a hurricane (or cyclone), when as yet sky and sea betoken but little of that wild fury during the height of which it is so difficult to guide the vessel in safety: one great advantage

of such knowledge is a quick apprehension of the indications which forewarn to make all snug *in time*.

119. Meteorological Signs preceding a Hurricane.—The meteorological signs indicating the approach of a hurricane or cyclone have been collected from various sources by Mr. Birt,* and are enumerated and classed according as the phenomena may be presented to the external sensations of feeling, sight, or hearing.

Meteorological signs recognised by the feelings—

1. A sultry, oppressive state of the atmosphere.
2. A calm.

Meteorological signs recognised by the eye—

3. A remarkably clear state of the atmosphere, so that the stars may be seen to rise and set with nearly the same distinctness as the sun and moon.
4. A peculiar white appearance in the zenith, more or less of a circular form.
5. A remarkably red or fiery appearance of the sky. This is not unfrequently of such intensity as to tinge all the surrounding objects with a deep crimson; and when this is observed, there can be no question that the violent portion of the cyclone is not far from the vessel. When this red light is seen at night, the impression on the seaman's mind is, that "day has broken before its time."
6. A peculiar colouring of the clouds, more especially of an olive green. This is generally the precursor of a most violent and terrific hurricane.
7. A thick, hazy appearance in that quarter of the horizon in which the cyclone is raging.
8. A remarkable and peculiar appearance of the heavenly bodies. When shining through a haze, they are said to shine with a pale, sickly light, and are not unfrequently surrounded by rings of light, or halos. Some observers describe the stars as "looking big with burrs about them." Others speak of their dancing, and, generally, they have been noticed as being remarkably bright and twinkling.
9. The sun on some occasions has exhibited a blue appearance, and white objects have been seen of a decided light-blue colour. The sun has also been observed of a pale and somewhat similar appearance to that of the full moon.
10. A dense, heavy bank of cloud in the direction of the hurricane.
11. A peculiar appalling appearance in this bank, more particularly as if it were a solid wall drawing down upon and closing around the ship.
12. A darting forward of portions of this bank, as if torn into rags and shreds by some violent force, and driven before, *not borne* by, the wind. When this indication is distinctly recognised, a run of about two hours *towards the centre* will involve the vessel in a destructive hurricane.
13. A peculiar motion exhibited by small bodies, as branches of trees, when

* "Handbook of the Law of Storms; being a Digest of the Principal Facts of Revolving Storms." By W. R. Birt. 1853.

agitated by the wind, consisting of a sort of whirling, *not a bending forward, as if bent by a stream of air.*

14. Lightning of a remarkably columnar character, shooting up in stalks from the horizon, with a dull glare; also like flashes from a gun, and sparks from a flint and steel.

Meteorological signs recognised by the ear—

15. A distant roar (probably of the hurricane itself), as of wind rushing through a hollow vault.
16. A peculiar *moaning* of the wind, indicative of the close proximity of the violent portion of the hurricane.

The meteorological phenomena accompanying a revolving storm may also be enumerated thus:—

1. A very rapid motion of the air, constituting the hurricane, and increasing in velocity as the centre is approached.
2. A fitful variation of intensity in the force of the wind, which sometimes blows with fearful violence, carrying away everything that opposes its progress, then sinking to a gentle breeze, or even lulling to a calm, but almost immediately afterwards springing up with greater violence than before. The hurricane winds are nearly, if not entirely, without exception puffy, violent, and blowing in gusts.
3. An immense condensation of aqueous vapour, forming large banks of cloud, which precipitate torrents of rain. The condensation appears to be so exceedingly rapid that large quantities of electricity are generally developed, giving rise to incessant flashes of lightning.
4. A general darkness and gloominess within the area of the cyclone, relieved only by the fitful glare of the lightning, or the appearance of the imperfect circle of light near the centre or axis of the storm.
5. A separation of the clouds in or near the centre of the hurricane, so as to produce in the immediate neighbourhood of the axis a clear sky, through which the sun and stars are often seen with great brilliancy.
6. A calm in the centre of the cyclone.

Indications of approaching or existing hurricanes manifested by the ocean, of special utility to vessels at anchor in roadsteads, &c.:—

1. A swell produced by the storm-wave rolling in upon the shore, at first of a gentle character. The direction of this swell will pretty surely indicate the bearing of the storm, and its changes will point out, in some localities, the course the hurricane may be pursuing.
2. A swell rolling in, *without changing its direction*, may be regarded as indicative of a hurricane *approaching* the shore. The same phenomenon met with at sea (the ship's course being taken into account), will indicate the bearing down of the cyclone on the vessel.
3. A dirty green appearance of the ocean; on some occasions its assuming a muddy or brown colour, on others its being remarkably clear; its temperature increasing, and its smelling stronger than at other times, are all indications of the proximity of a cyclone.

120. The Storm-Wave.—The rotation of the wind in a hurricane violently agitates the surface of the ocean in the direction of the wind, producing a *swell* or STORM-WAVE, the undulations of which roll on to an extraordinary distance; the wave thus propagated advances as a tangent to the whirlwind. The wind, however, veers; and thence there results a series of undulations rolling from the margin of the storm, both in advance and regression of the storm itself, and the succession of undulations encountering each other produces, in the area of intersection, *cross seas* more or less dangerous according as they are met in advance of or behind the hurricane. It is easy to see that such a series of undulations must always *fringe* the storm's wake, and be found to the right and left of the path over which the cyclone has advanced; while the long rolling swell generally precedes it, and thus indicates the approach of the gale many hours—if not a day—before it is encountered by the ship. In the NORTHERN HEMISPHERE it is on the *left* side of the storm's wake, in the SOUTHERN HEMISPHERE on the *right* side of the storm's path, that the cross pyramidal sea is found; and when a ship meets with such a sea, it may be taken as a tolerably certain indication that a rotatory gale has passed over the locality. Generally the storm-waves undulate in a direction which, the further they are from the vortex, is more at right-angles with the direction of the wind: in a heavy gale they merely proceed in the direction of the gale itself.

DOVE says, that the undulations of the waves, during a whirlwind storm, proceed from the centre in such directions that the farther they are from it the less is their radial difference; thus their course is from the centre of the storm to its circumference—in a direction somewhat inclined forward in relation to the gyration of the cyclone wind, and to which REID'S attention was particularly called; consequently, the three descriptions of storms more closely examined differ in the following manner, viz.:—

1. In a whirlwind storm the waves undulate in a direction which is more at right angles with the direction of the wind the farther they are from the vortex.
2. In a heavy gale they proceed in the same direction as the gale itself.
3. In a gale which arrests the progress of a wind blowing from the opposite quarter, seamen say that the two winds are fighting.

121. Rules for Trimming the Ship in a Hurricane.—PIDDINGTON long ago said that all *positive* rules for manœuvring tend to mislead; every ship must have its own peculiar management depending on the four great elements of the problem, which are—1, the ship and her sea-room; 2, the track of the cyclone; 3, its rate of travelling; and 4, the ship's run and drift; while on the part of the commander, caution and watchfulness are essentially requisite. Still, all the circumstances being favourable, *rules* may be given in a very brief compass *for trimming a vessel to the hurricane-winds;* these are embodied in the following Tables, where the directions of the wind-vane as set down in the first column, are tangents to the whirlwind in its course—these indicate the quarter from which the storm sets in; the points of the compass in the second column show the position of the storm's centre as regards the vessel; the fourth column gives the direction in which to steer when the wind shifts as indicated in the third column; but if it shifts, as indicated in the fifth column, then bear away, as told in the sixth column.

1. For the Northern Hemisphere:—

Direction of Wind at commencement of Storm.	If the Centre (or Vortex) bears	And the Wind shifts from	Steer	But if the Wind shifts from	
N.W.	N.E.	N.W. to W.	S.E.	N.W. to N.	Put the Ship on the Starboard Tack.
N.W. by N.	N.E. by E.	N.W. by N. to W.	S.E. by S.	N.W. by N. to N.	
N.N.W.	E.N.E.	N.N.W. to W.	S.S.E.	N.N.W. to N.	
N. by W.	E. by N.	N. by W. to W.	S. by E.	N. by W. to N.	
N.	E.	N. to W.	S.	N. to E.	
N. by E.	E. by S.	N. by E. to N.	S. by W.	N. by E. to E.	
N.N.E.	E.S.E.	N.N.E. to N.	S.S.W.	N.N.E. to E.	
N.E. by N.	S.E. by E.	N.E. by N. to N.	S.W. by S.	N.E. by N. to E.	
N.E.	S.E.	N.E. to N.	S.W.	N.E. to E.	
N.E by E.	S.E. by S.	N.E. by E. to N.	S.W. by W.	N.E. by E. to E.	
E.N.E.	S.S.E.	E.N.E. to N.	W.S.W.	E.N.E. to E.	
E. by N.	S. by E.	E. by N. to N.	W. by S.	E. by N. to E.	
E.	S.	E. to N.	W.	E. to S.	
E. by S.	S. by W.	E. by S. to E.	W. by N.	E. by S. to S.	
E.S.E.	S.S.W.	E.S.E. to E.	W.N.W.	E.S.E. to S.	
S.E. by E.	S.W. by S.	S.E. by E. to E.	N.W. by W.	S.E. by E. to S.	
S.E.	S.W.	S.E to E.	N.W.	S.E. to S.	
S.E. by S.	S.W. by W.	S.E. by S. to E.	N.W. by N.	S.E. by S. to S.	
S.S.E.	W.S.W.	S.S.E. to E.	N.N.W.	S.S.E. to S.	
S. by E.	W. by S.	S. by E. to E.	N. by W.	S. by E. to S.	
S.	W.	S. to E.	N.	S. to W.	
S. by W.	W. by N.	S. by W. to S.	N. by E.	S. by W. to W.	
S.S.W.	W.N.W.	S.S.W. to S.	N.N.E.	S.S.W. to W.	
S.W. by S.	N.W. by W.	S.W. by S. to S.	N.E. by N.	S.W. by S. to W.	
S.W.	N.W.	S.W. to S.	N.E.	S.W. to W.	

2. For the Southern Hemisphere.

Direction of Wind at commencement of Storm.	If the Centre (or Vortex) bears	And the Wind shifts from	Steer	But if the Wind shifts from	
S.	E.	S. to W.	N.	S. to E.	Put the Ship on the Port Tack.
S. by E.	E. by N.	S. by E. to S.	N. by W.	S. by E. to E.	
S.S.E.	E.N.E.	S.S.E. to S.	N.N.W.	S.S.E. to E.	
S.E. by S.	N.E. by E.	S.E. by S. to S.	N.W. by N.	S.E. by S. to E.	
S.E.	N.E.	S.E. to S.	N.W.	S.E. to E.	
S.E. by E.	N.E. by N.	S.E. by E. to S.	N.W. by W.	S.E. by E. to E.	
E.S.E.	N.N.E.	E.S.E. to S.	W.N.W.	E.S.E. to E.	
E. by S.	N. by E.	E. by S. to S.	W. by N.	E. by S. to E.	
E.	N.	E. to S.	W.	E. to N.	
E. by N.	N. by W.	E. by N. to E.	W. by S.	E. by N. to N.	
E.N.E.	N.N.W.	E.N.E. to E.	W.S.W.	E.N.E. to N.	
N.E. by E.	N.W. by N.	N.E. by E. to E.	S.W. by W.	N.E. by E. to N.	
N.E.	N.W.	N.E. to E.	S.W.	N.E. to N.	
N.E. by N.	N.W. by W.	N.E. by N. to E.	S.W. by S.	N.E. by N. to N.	
N.N.E.	W.N.W.	N.N.E. to E.	S.S.W.	N.N.E. to N.	
N. by E.	W. by N.	N. by E. to E.	S. by W.	N. by E. to N.	
N.	W.	N. to E.	S.	N. to W.	
N. by W.	W. by S.	N. by W. to N.	S. by E.	N. by W. to W.	
N.N.W.	W.S.W.	N.N.W. to N.	S.S.E.	N.N.W. to W.	
N.W. by N.	S.W. by W.	N.W. by N. to N.	S.E. by S.	N.W. by N. to W.	
N.W.	S.W.	N.W. to N.	S.E.	N.W. to W.	

122. The following Memoir on the Hurricanes of the Southern Indian Ocean, by Mr. C. Meldrum, illustrative of the origin of these storms from the antagonism of the N.W. Monsoon and the S.E. Trade, will be interesting to navigators:—

Hurricanes and Weather in the Indian Ocean.

From the 17th of January to the 18th of February, 1860.

The hurricane of the 8th to the 16th of January had scarcely disappeared when another originated near the same locality, and under similar circumstances. This second hurricane, which was of small extent, but very violent, commenced on the 17th or 18th, and lasted till the 21st or 22nd. The Portuguese brig of war *Mondega*,* with 46 of her crew, went suddenly down on the 22nd; and the *Cossipore* and *Yarra*, the former vessel having on board 350 passengers (chiefly soldiers' wives and children), were in danger of a like fate.

From the 24th to the 29th of the month a third hurricane, also of small extent, but of considerable violence, occurred in almost the same latitudes, to the northward and westward of Mauritius, where it was encountered by the *Atieth Rahaman*, *Gironde*, and other vessels.

The object of this paper is to present some of the leading facts connected with those two hurricanes, and to show that both were cyclones travelling to the south-westward.

We begin with the hurricane of the 17th to the 22nd.

On the 18th the centre of the storm was probably in 15° 30′ S. and 75° 30′ E., between the S.E. Trade and the N.W. Monsoon, the Trade extending from about 30° S., and the Monsoon (so far as our observations show) to 13° S.

From noon to midnight the *Cossipore* steered N.E. 42 miles, with a falling barometer and an increasing gale from S.E. By 6 p.m. the gale had increased to a hurricane from S.E., with heavy rain, the barometer standing at 28·844. "At 8.30 blew away the mizen staysail. At 9.45 the hurricane still increasing;—blew away the jib and flying boom and sails, bringing the fore-royal mast with them; barometer 28·644. At 11, bar. 28·364. Midnight, the hurricane still increasing (barometer 28·384); blew away the main and mizen topmasts over the side, staving the decks and bursting one of the scuttles; washed away the port quarter-boat, &c."

None of the other vessels had as yet got involved in the storm. The *Uriel*, however, at some distance to the N.E.-ward of the *Cossipore*, had fresh gales from E.N.E., with "doubtful weather," a low barometer (29·50), and a heavy swell from the northward.

The *Yarra* and *Lawrence*, both standing to the W., had the Trade from E. and E. by S. in fresh breezes, but increasing in strength, with rain and an ugly appearance in the afternoon. In the early part of the day the *Yarra* experienced a heavy swell from W. ½ N.

The storm at noon on this day (the 18th) had a diameter of about 240 miles.

South of the 30th parallel, and from 30° E. to 62° E., there were several vessels all having Northerly (chiefly N.W.) winds; and west of 30° E. the winds were Southerly.

The following are the positions of some of the vessels at noon, with the direction

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* The *Mondega's* log-book was probably lost at sea.

of the wind, &c. (The force is indicated by BEAUFORT's notation, in brackets, thus (2); BEAUFORT's notation is also used for the *weather* in the Port Louis observations):—

Marquise:—36° 30′ S.; 6° 25′ E.; wind S.W. (2); cloudy, drizzling rain.

Eagle:—33° 3′ S.; 14° 4′ E.; wind S. (6); clear.

Therese:—34° 4′ S.; 18° 3′ E.; wind S.S.E. (9); cloudy, hazy.

Tullochgorum:—37° 40′ S.; 23° 15′ E.; wind S. (4); cloudy and passing showers.

Jules and Aglaé:—40° 2′ S.; 33° 6′ E.; wind N.W. (5); cloudy, squally, and heavy sea.

Galatea:—38° 21′ S.; 36° 40′ E.; wind N.W. (6); bar. 29·919; cloudy, squally.

La Bretagne:—38° 14′ S.; 39° 28′ E.; wind N. (2); bar. 29·93; ther. 61° fine.

Marguerite d'Anjou:—38° 34′ S.; 40° 51′ E.; wind N.N.W. (5); fine.

Stag:—41° 31′ S.; 44° 57′ E.; wind N.N.W. (6); bar. 29·94; ther. 59°; cloudy, passing showers.

Arthur and Mathilde:—40° 39′ S.; 44° 40′ E.; wind N.N.W. (6); bar. 29·716; cloudy.

Ambroisine:—48° 33′ S.; 54° 40′ E.; wind N.N.W. (6); bar. 29·76; ther. 69°; showers, squally, hazy.

George Washington:—39° 34′ S.; 61° 41′ E.; wind N.E. (6); cloudy, squally.

These extra-tropical counter-currents of air were observed during the hurricane of the 8th to the 16th of January.

THURSDAY, THE 19TH OF JANUARY:—At noon on this day the S.E. Trade, as observed by eleven vessels, prevailed from nearly 30° S. to 19° S., blowing in strong gales in about 21° S. and 73° E., where it formed part of the cyclone,—the winds to the northward of that position curving from W. to N.W., N., and E.N.E.

The positions, &c., of some of the vessels which had the Trade are as follows:—

Ravenscraig:—22° S.; 84° 5′ E.; wind E.S.E. (5); bar. 29·898; ther. 78°; passing showers, squally, hazy.

Cantero:—24° 27′ S.; 80° E.; wind E.S.E. (6); cloudy.

Lawrence:—21° 27′ S.; 72° 31′ E.; wind E.N.E. to E. (8); bar. 29·80; squally, rain, very windy appearance.

Yarra:—20° 36′ S.; 73° 27′ E.; wind E. by S. to E. (8); bar. 29·91; cloudy, rain.

Thomas Blyth:—23° 44′ S.; 62° 9′ E.; wind E. by S. to E. (2); bar. 30·15; fine clear weather.

Lucy:—20° 28′ S.; 59° 33′ E.; wind E.S.E. (1, 2); fine and clear.

Australia:—18° 28′ S.; 62° 18′ E.; wind E. to S.E. (5); fine.

The winds and weather to the north of the *Lawrence* and *Yarra* were as follows:

Walmer Castle:—15° S.; 71° 15′ E.; wind W. (2); cloudy, heavy swell from southward.

Hyderee:—14° 14′ S.; 73° 10′ E.; wind N.W. (4); bar. 30·044; fine; midnight, lightning.

Cossipore:—17° 35′ S.; 74° 19′ E.; wind N.N.W. to N.; bar. 29·244; hurricane; rain.

Uriel:—19° 19′ S.; 74° E.; wind E.N.E. to N.N.E. (9); bar. 29·51; ther. 77° squally, rain; terrific sea.

From these observations it is evident that there was a revolving storm at noon on this day, having its centre in about 17° 15′ S. and 73° 30′ E.

It appears from the log of the *Cossipore*, that "at 1 A.M. (bar. 28·394), the calm centre passed over the ship, the wind then veering to the westward, and blowing as hard as before, with heavy rain. At 2 A.M., wind N.N.W.; course west; barometer 28·364. At 5, barometer 28·444. At 5.30, the mainsail blew away in the gaskets. At 6, barometer 28·644, and at 7, 28·744. At 8, the hurricane still blowing hard, with heavy rain. At 10, the hurricane still blowing at its strength, the sea washing over all; barometer 29·044. At 4 P.M., fresh gales from N., with heavy rain. At 6, barometer 29·644. Midnight, strong gales from N., and heavy rain. Bore away for the Mauritius to refit."

The log does not state how long the calm lasted; but if, as recorded in the log, the wind at 1 A.M. ceased at S.E., and was from N.N.W. at 2 A.M., the duration of the calm cannot have exceeded an hour.

In the centre the barometer apparently stood higher than it did both before and after the calm.

With the *Uriel* the wind veered in the course of the day from E.N.E. to N., and at 11 P.M. was blowing a hurricane, with an awful sea running. The barometer attained its lowest reading (29·48) at 4 P.M.

In the early part of the day the *Yarra* had an increasing gale from E. by S, with heavy rain; and, as she ran W. by N., at the rate of eight knots per hour, the wind veered to S.E., the barometer at 4 P.M. standing at 29·858, and at midnight at 29·608.

As the *Cossipore* was in the central calm, at 1 A.M., in 16° 20′ S. and 74° 25′ E.—the centre travelled from noon on the 18th to that hour, S. 46° 50′ W. 86·24 miles, or at the hourly rate of 6·6 miles.

From 1 A.M. to noon on the 19th the storm travelled S. 48° 53′ W. 69·96 miles, which gives an hourly rate of 6·3 miles.

The course and distance from noon on the 18th to noon on the 19th were S. 47° 45′ W. 156·2 miles; so that the hourly rate of progression for the 24 hours was 6·5 miles.

Although the wind had a circular movement over a space of about 400 miles in diameter, it did not blow hard except near the centre.

The observations taken at Port Louis were:—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·950	81·0	79·5	75·0	Calm	0·00	Fine
9½ „	30·000	85·0	85·0	76·0	N.E.	0·20	„
3½ P.M.	29·956	83·0	81·0	76·0	W.-ward	0·15	o. r.
9½ „	30·030	82·0	81·0	75·0	E.-ward	0·40	c.; fine

These observations gave no indication of the hurricane that raged at a distance of 926 miles.

Between 30° and 40° S., and between 7° and 64° E., the Northerly and Southerly counter-winds were still blowing, generally in fresh breezes, with fine weather; but owing to want of observations from 25° to 37° E., the inner boundaries of the two winds, and the space between them, cannot be determined.

Friday, the 20th of January:—On this day, the Trade prevailed from 30° to 19° S., except between 68° and 75° E., where the cyclone was still raging. Between those meridians Northerly winds extended as far as 21° S., where they encountered the Trade, and, with it, formed the hurricane. These Northerly winds were probably a continuation of the N.E. Trade which was then blowing fresh in the space from 9° to 6° N. and 80° to 90° E., while in 3° to 5° S. and 70° to 80° E. the wind was N.W.

The winds nearer the storm, on its northern side, were as follows:—

Augusta:—14° 56′ S.; 70° 58′ E.; wind N.E. (4); fine; a swell from southward.

Hyderee:—14° 38′ S.; 71° 33′ E.; wind N.E. by E. (4); bar. 30·044; at 6 A.M. lightning; at noon, fine.

Walmer Castle:—15° 30′ S.; 70° 59′ E.; wind N. by W. (2); cloudy, passing showers.

Cossipore:—18° 2′ S.; 72° 46′ E.; wind N. (8); bar. 29·744; very squally, much rain.

Uriel:—21° 12′ S.; 71° 17′ E.; wind N. by W.; bar. 29·52; ther. 81°; blowing terrifically.

The *Yarra*, at noon, was in the central calm. Till 1 A.M. she ran to the W. "with square sail, but was then obliged to heave-to on the port tack (wind S.E.). At 2 A.M., a furious gale with a terrific sea; barometer 29·410. At 3, increased to a hurricane; ship heading S.S.W. At 6, the sails went to pieces; ship under water; shipped some heavy seas. At 8, barometer 28·710; bent the storm sail. At 9, the hurricane more furious; the ship lying dead down in the water; the long-boat under water; expecting the ship to go down. From 10 to 11½, the hurricane was at its greatest height; barometer 28·310; the lee-side under water; could not say whether there was any sea or not,—it appeared to be smooth, as the ship never moved; could not stand on deck or hold on,—the Captain gave orders for all hands to go into the cabin; the sight was frightful; it seemed as if the sea and sky had met together; the royal braces were carried away with the force of the wind, &c. At 11½, it *fell calm*; the sea was then running in masses all round, one sea meeting another and making a clean breach over us, on both sides; the barometer suddenly rose to 28·610."

Lat., D. R., 20° 46′ S.,—Long., D. R., 71° 1′ E.;—"P.M.—Commences with a calm and a fearful sea running in all directions. At 1, blowing a heavy gale from N.N.E., which lasted two hours; it then blew from N.E. and E. At 4, the barometer, which had been gradually going up, went suddenly down to 28·410; it then blew another hurricane, but not so furiously as from 10 to 11½ A.M. At 6, the barometer commenced to rise regularly one-tenth an hour, until 2 A.M. (on the 21st), when it went down two-tenths."

While the *Yarra* was becalmed at noon, and the *Uriel* (a few miles to the eastward and southward of her) had a hurricane from N. by W., the *Lawrence*, in 21° 43′ S. (D. R.) and 70° 49′ E. (D. R.), had a heavy gale from E., with

terrific squalls and much rain, the wind in the afternoon veering with her to N.E.

On all sides of those vessels, except on the northern, the S.E. Trade was blowing. Thus, the *Ravenscraig* in 19° S. and 83° 54′ E. had a strong breeze from the S.E., with cloudy weather and passing showers; in 24° 30′ S. and 77° 18′ E. the *Cantero* had also strong breezes from E.S.E. and similar weather; and near Mauritius and Rodriguez, several vessels had light winds from the E.S.E.-ward, with fine weather.

The centre of the storm must have been in about 20° 30′ S. and 70° 18′ E., although the *Yarra's* position, by dead reckoning, would place it a little further E.

From the previous noon, therefore, the storm travelled S. 42° 59′ W. 266·5 miles, or at the rate of 11·1 miles per hour.

The revolving body of air had still a diameter of about 400 miles.

It would appear that the barometer of the *Yarra* rose $\frac{3}{10}$ of an inch in the centre, and then fell, just as the *Cossipore's* barometer had done (though not to the same extent) at 1 A.M. on the 19th.

The observations taken at Port Louis were—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb. Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
$3\frac{1}{2}$ A.M.	29·982	82·0	81·0	75·3	Calm	0·00	c. but fine
$9\frac{1}{2}$ „	30·042	82·0	81·0	75·8	E.-ward	0·20	o. g.
$3\frac{1}{2}$ P.M.	30·004	84·0	82·0	75·3	„	0·30	o. p.
$9\frac{1}{2}$ „	30·060	82·0	80·1	74·3	E.S.E.	1·50	c. but fine

We see from the above Table that the barometer at Port Louis was rising, although the centre of the storm was 200 miles nearer than at noon on the 19th.

From 40° to 50° E. and 36° to 40° S. five or six vessels had light winds from the N.W.-ward, with fine weather; and these N.W.-ly winds extended to at least 48° 59′ S. and 64° 44′ E. West of those vessels, again, from 11° to 24° E. and from 33° to 39° S., the wind was S. We have still evidence, therefore, of the existence of the oppositely directed Northerly and Southerly winds which were observed on the previous days, although the limits of the space between them are unknown.

Saturday, the 21st of January.—The hurricane still existed; but it was apparently abating. The positions, winds, &c., of some of the vessels, at noon, were as follows:—

Augusta:—15° 30′ S., 69° 48′ E.; wind N. to N.E. (4); cloudy, passing showers, lightning in the morning.

Walmer Castle:—16° 5′ S.; 69° 17′ E.; wind N.N.E. (2); cloudy and sultry; swell from southward.

Hyderee:—15° 56′ S.; 69° 34′ E.; wind N.E. (2); bar. 30·044; fine; at 6 P.M. passing showers, squally, much thunder and lightning.

Cossipore:—18° 2′ S.; 70° 51′ E.; wind N. (5); bar. at 1 A.M. 29·744; ther. 80°; squally, much rain, heavy sea.

Yarra :—21° 31′ S.; 70° 31′ E.; wind E. by S. (9); bar. 29·51; cross sea; lying to on port tack.

Lawrence :—22° 3′ S.; 69° 39′ E.; wind E. by N. (9); very squally, rain.

Uriel :—23° 10′ S.; 70° 5′ E.; wind E.N.E. (9); bar. 29·74; ther. 82°; rain; awful sea.

Cantero :—24° S.; 74° 23′ E.; wind E. to E.N.E. (6); bar. 30·134; ther. 78°; cloudy, squally, rain.

As from 10° N. to 6° S. and from 66° to 94° E., the wind, as observed by ten vessels, was from N.E. and N.W., it is probable that the Northerly winds, from 15° to 18° S., experienced by the *Augusta, Hyderee, &c.*, were a continuation of the N.E. Trade.

The S.E. Trade prevailed both to the east and to the west of the northerly stream of air, as if the latter had penetrated into the former. In 15° 43′ S. and 84° 11′ E., for example, the *Ravenscraig* had a fresh breeze from E.S.E.; while at Mauritius, and a few degrees to the eastward of it, the wind was also from E.S.E.-ward.

If the storm was a revolving one at noon on this day, its centre was in about 21° 40′ S. and 69° 15′ E.; but whatever may have been its character near the centre, the winds at some distance were not moving round a central point.

Since noon on the 20th the centre travelled S. 39° 35′ W. 90·8 miles, or at the hourly rate of 3·8 miles. Its rate of progression had, therefore, greatly diminished.

The gale at noon on this day seems to have extended over an area of about 350 miles in diameter.

The observations taken at Port Louis were—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·992	81·0	80·0	73·0	E.S.E.	2·00	o.; fine
9½ „	30·038	84·0	83·0	75·0	„	3·00	q.; „
3½ P.M.	29·974	86·0	84·5	75·0	„	2·00	q.; „
9½ „	30·044	82·0	80·5	73·5	E.-ward	0·30	b. c. „

Comparing the above observations with those of the 20th, we find that the barometer was now beginning to go down a little, with an *increasing* breeze from E.S.E.

The Northerly and Southerly winds, beyond the S.E. Trade, prevailed in the same locality as yesterday.

Sunday, the 22nd of January.—At noon, on this day, we have no observations in the space from 24° to 36° S. and from 60° to 80° E.; but the winds to the northward of 24° S., being from N.E. over eight degrees of latitude, they do not appear to have belonged to a cyclone beyond the Tropic. These N.E.-ly winds were experienced by the following vessels :—

Augusta :—16° 6′ S.; 68° 26′ E.; wind N.E. (2); cloudy, and much lightning.

Walmer Castle:—16° 25′ S.; 68° 9′ E.; wind N.E. (1); cloudy, and swell from S.

Hyderee:—16° 58′ S.; 68° 28′ E.; wind N. by E. (4); bar. 30·064; cloudy, lightning; at 8 P.M. squally, rain, thunder and lightning.

Cossipore:—18° 2′ S.; 69° 16′ E.; wind N.N.E. (2); bar. at 1 A.M. 29·894; ther. 80°; cloudy, rain.

Lawrence:—22° 3′ S.; 66° 21′ E.; wind N.E. (4); fine.

Cantero:—22° 52′ S.; 71° 29′ E.; wind N.E. (6); clear.

Yarra:—22° 57′ S.; 70° 11′ E.; wind E. by N. (8); clearing up; cross sea.

Uriel:—23° 39′ S.; 68° 6′ E.; wind E.N.E. (8); bar. 29·98; ther. 79°; moderating.

The N.E. Trade extended as far as 4° S., between 75° and 83° E.; so that the N.E.-ly winds reported by these vessels may have been a continuation of the Trade.

The S.E. Trade existed on each side of the N.E.-ly stream of air, and extended, to the S.W.-ward of Mauritius, as far as 29° S.

The observations taken at Port Louis were—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·990	81·0	79·1	72·8	E.-ward	0.40	Fine; light q.
9½ „	30·036	83·0	83·1	74·3	„	1.00	o.; fine.
3½ P.M.	29·988	86·0	84·1	74·3	„	1.00	„ „
9½ „	30·040	82·0	80·6	73·3	Calm	0.00	Clear.

It will be seen that the barometer at Port Louis had still a downward tendency.

North of Mauritius, the *Launceston*, in 17° 45′ S. and about 57° E. had heavy squalls from eastward and bad weather.

Considering, then, the N.E.-ly stream of air, from 16° 6′ S. and 68° 26′ E. to 23° 39′ S. and 68° 6′ E.,—the winds and weather with the *Launceston*,—and the existence of the S.E. Trade at Mauritius and to the S.W.-ward of it,—we may infer the probability of a gyratory movement of the atmosphere on this day, as if *another* hurricane were being formed to the northward of the island. At all events, we cannot trace the *Yarra's* hurricane beyond this day.

The logs of the following vessels show that between 35° and 44° S. and between 43° and 64° E., there were two contrary currents of air.

Jules and Aglaé:—39° 10′ S.; 43° 10′ E.; wind S.S.W. (6); squally, and heavy sea.

Royal Bride:—39° 58′ S.; 45° 34′ E.; wind S.W. (5); heavy sea.

Galatea:—37° 29′ S.; 48° 54′ E.; wind S. (9); bar. 30·07; hazy, rain.

Marguerite d'Anjou:—35° 46′ S.; 51° 11′ E.; wind N.E. (2); fine.

Arthur and Mathilde:—35° 38′ S.; 52° 37′ E.; wind N.W. (2); bar. 30·11; clear.

La Bretagne:—36° 19′ S.; 52° 21′ E.; wind N.N.W. (2); bar. 29·92; ther. 73°; cloudy, thunder.

Stag :—36° 37′ S.; 58° 6′ E.; wind N.N.W. (5); bar. 30·06; ther. 67°; fine.

George Washington :—36° 33′ S.; 63° 34′ E.; wind N.E. (2); cloudy and hazy.

Pharamond :—43° 15′ S.; 59° E.; wind N.W. (6); cloudy.

The first three of these vessels had the wind, at the preceding noon, from N.N.E. and N.W., and it veered, or shifted, by the W. With the *Royal Bride* it shifted, at 8 P.M. on the 21st, from N.W. to S.W., in a squall; and it seems to have shifted also with the *Jules and Aglaé* and the *Galatea*. The barometer of the latter vessel rose 0·26 inch with the Southerly winds, it having at the previous noon, with the wind fresh from N.N.E., been at 29·81.

MONDAY, THE 23RD OF JANUARY.—As we have no observations from 23° to 30° S. and from 60° to 80° E., it is impossible to say whether the winds in that locality belonged to a rotatory gale. From 16° to 23° S. and from 64° to 71° E., however, the wind was from N.W.-ward to N.E.-ward,—and at Mauritius and to the S.W.-ward of it, from E.S.E.-ward, as if there were an aerial movement round a central point, not south of the Tropic, but to the northward of Mauritius. This will appear from the logs given below :—

Augusta :—16° 29′ S.; 67° 26′ E.; wind N.W. (1, 2); cloudy, rain.

Walmer Castle :—16° 55′ S.; 67° 3′ E.; wind N.W. (4); threatening appearance, rain, thunder.

Hyderee :—17° 36′ S.; 67° 5′ E.; wind variable (1); bar. 30·064; squally, rain.

Cossipore :—18° 10′ S.; 67° 46′ E.; wind N. by W. (4); bar. at 1 A.M. 29·944; ther. 82°; at 4 A.M. much thunder and lightning, with rain; noon, squally with rain.

Lawrence :—21° 52′ S.; 64° 50′ E.; wind N.E. (2, 1); cloudy, showers, dark weather.

Yarra :—22° 14′ S.; 68° 19′ E.; wind N. by E. (8); gloomy, rain and thunder; swell from N. by E.

Cantero :—22° 30′ S.; 70° E.; wind N.E. (4); fine; P.M. lightning.

Swallow :—25° 20′ S.; 51° 53′ E.; wind S.E. (4); fine.

Tyrian :—27° 58′ S.; 46° 15′ E.; wind E.S.E. (6); hazy, rain.

The barometer at Port Louis was going down, as the following observations show :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb. Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·980	81·0	80·1	72·0	E.S.E.	0·12	Clear and fine
9½ „	30·026	84·0	82·5	74·0	„	1·00	c. g.
3½ P.M.	29·950	86·0	84·5	75·0	„	1·50	b. c.; fine
9½ „	30·000	82·0	80·5	74·0	E.-ward	2·00	c.; l. to N.-ward

In about 17° 40′ S. and 58° E. the *Launceston* had an increasing gale from N.N.E.-ward, with heavy rain.

These winds and positions show that the N.W. Monsoon and the S.E. Trade had

at least a tendency to rotate; and we thus obtain some idea of the manner in which revolving storms are generated.

On this, as on previous days, lightning was frequently observed where the Northerly winds prevailed.

In the Eastern part of the Ocean the S.E. Trade seems to have extended from 27° S. and 101° E. to 8° S. and 83° E.

South of the 30th parallel, from 45° to 65° E., the winds were from S.E. to S. and S.S.W., as shown by the logs of nine vessels, the Northerly winds which were found yesterday, at noon, from 51° to 64° E. having either veered, or shifted, through the West. The following were the positions, &c., of the vessels at noon :—

Jules and Aglaé :—39° 9′ S.; 45° 2′ E.; wind E.S.E. to E. (1); cloudy and heavy swell on.

Royal Bride :—39° 30′ S.; 46° E.; wind E. by S. (2); clear and fine.

Galatea :—35° 36′ S.; 50° 56′ E.; wind S.E. by E. (9); cloudy.

Marguerite d'Anjou :—34° 1′ S.; 54° 33′ E.; wind S.S.E. (6); fine.

Arthur and Mathilde :—32° 56′ S.; 54° 35′ E.; wind S.E. (5); bar. 30·11; cloudy, passing showers.

La Bretagne :—33° 34′ S.; 55° 24′ E.; wind S.E. (5); bar. 30·39; ther. 70°; fine.

Stag :—33° 40′ S.; 58° 51′ E.; wind S.W. (6); bar. 30·17; ther. 67°; fine.

George Washington :—34° 36′ S.; 63° 34′ E.; wind S.W. (2); fine.

Pharamond :—42° 12′ S.; 64° 34′ E.; wind S.W. (6); at 4 A.M. hail; at noon, fine.

These winds were, no doubt, the Trade-wind, stretching, on this day, from 40° S. up to Madagascar and Mauritius; and it is to be remarked that the vessels farthest West (the *Royal Bride* and the *Jules and Aglaé*) had the wind from Eastward.

Tuesday, the 24th of January.—The S.E. Trade (so far as our observations enable us to judge) extended, as yesterday, in the Eastern part of the ocean, as far as 8° S. and from 72° to 82° E.,—the N.E. Trade crossing the Equator between the same meridians.

We have also, as yesterday, a S.E.-ly wind from 36° S. and 52° E. to the vicinity of Mauritius; and in about 40° S. and from 46° to 50° E. the *Royal Bride* and the *Jules and Aglaé* which, at the previous noon, had the wind from Eastward, have it now from N.E.-ward, as if this N.E.-ly wind were a deflection of the S.E.-ly wind to the northward of it,—or, it may be, the *equatorial* winds appearing on the surface.

The observations taken at Port Louis were as follows :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·928	81·5	80·1	74·3	E.	1·50	c. but fine
9½ ,,	29·962	83·0	81·6	76·3	,,	2·50	c. q.
3½ P.M.	29·900	85·0	83·6	76·8	,,	0·40	c. p.
9½ ,,	29·960	80·5	74·8	74·8	N.E.	2·00	c. q. r.; much t. l. to N.W.

The barometer, which was now going down more rapidly, indicated, with the direction and increasing force of the wind, the existence of a second hurricane, to the Northward of Mauritius.

The *Augusta*, *Hyderee*, *Yarra*, and *Cantero*, from 16° 29′ S. and 66° 59′ E. to 23° 15′ S. and 68° E. had the wind light from N.W.-ward, with fine weather—the *Yarra*, in the early part of the day, having had a fresh gale from N.W.-ward, with thunder.

In 17° 56′ S. and about 58° E. the *Launceston* had a gale from N.N.E.-ward.

We have, therefore, as yesterday, signs of a stormy gyration to the Northward of Mauritius.

Wednesday, the 25th of January.—On this day the N.E. Trade was still crossing the Equator in from 72° to 84° E., and the S.E. Trade seems to have stretched from about 30° S. and 100° E. to 10° S. and 72° E.

The S.E. Trade prevailed also from 30° S. and 60° E. to Reunion and Mauritius.

From 16° to 19° S. and in about 67° E., the *Augusta* and *Hyderee* had still light winds from N.W.; and a few degrees farther South the *Yarra* and *Cantero* had light winds from S.W.-ward.

Observations taken at Port Louis:—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·888	81·0	80·1	74·8	East	3·00	c. p. q.
9½ „	29·940	82·0	81·6	71·9	„	1·00	c. p.
3½ P.M.	29·890	84·0	82·1	77·3	E.N.E.	0·20	t. l. r.
9½ „	29·946	82·0	81·1	75·8	E.S.E.	0·50	c. t. l.

The *Atieth Rahaman*, in 18° 40′ S. and 56° 54′ E., at noon, had a strong breeze from E.N.E., with fine weather. As she held to the Northward (she was bound to Calcutta from Port Louis), the wind increased from E. and E. by S. "At 6.30 P.M., in first reef of topsails. At 8, barometer 29·60 (ind. err. not known). At 9, in mainsail; split mizen topsail, &c. At 10, hauled down fore-topsail, &c.; fore-topgallant mast carried away; barometer still falling. Midnight, in the vortex; heavy cross sea; barometer 29·40."

The *Launceston* (her position is not given), not far from the *Atieth Rahaman*, had the wind, at noon, strong from E. by N., with squalls and heavy rain,—the wind in the afternoon increasing to a hard gale and veering to E., S.E., S., S.W., &c., till at midnight it was from N.W.

It is probable, therefore, that a revolving storm existed at noon on this day, with its centre in about 16° 40′ S. and 57° E.

Beyond the S.E. Trade the wind, as observed by seven vessels, was from N.E. and N.W.; between 48° and 55° E. it was from N.E., except with the vessel next the Trade, in 32° 29′ S. and 48° 26′ E., where it was blowing a fresh gale from E.; in 37° 6′ S. and 30° 55′ E., it was moderate from N.W.

It is interesting to observe how these N.E.-ly winds appeared to the South-

ward of the Trade whenever the second rotatory gale commenced near its equatorial limits.

Thursday, the 26th of January.—We find that on this day the N.E. Trade was still crossing the Equator, between 73° and 90° E.; and that the S.E. Trade was coming up to within a few degrees of it in that part of the ocean.

From 50° to 70° E., the S.E. Trade was blowing from about 27° S. to the neighbourhood of Mauritius and Reunion, where it formed the Southern and Western sides of the cyclone the existence of which had been noticed since the 24th. The following were the positions, winds, &c., of some of the vessels at noon :—

Hyderee :—18° 39′ S.; 65° 37′ E.; wind N.E. (4); bar. 30·064; fine.

Stag :—22° 7′ S.; 58° 48′ E.; wind E.N.E. (5); bar. 29·84; ther. 80°; fine.

Lawrence :—24° 21′ S.; 62° 54′ E.; wind N.E. (2); fine.

La Bretagne :—25° 22′ S.; 59° 25′ E.; wind E. (1); bar. 30·34; ther. 81°; cloudy and fine.

Arthur and Mathilde :—25° 7′ S.; 57° 29′ E.; wind E. (5); bar. 29·913; cloudy, squally.

Marguerite d'Anjou :—26° 22′ S.; 59° 2′ E.; wind E.S.E. (5); cloudy, squally.

Swallow :—26° S.; 51° 30′ E.; wind S.E. (5); fine.

Nadir :—20° 28′ S.; 51° 43′ E.; wind Southerly (2); fine.

Auffredy :—20° 46′ S.; 54° E.; wind S.E. (6); cloudy, squally.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·880	81·5	80·0	74·3	E.S.E.	4·50	Fine
9½ „	29·924	81·5	80·0	73·0	East	4·00	o. p. q.; a heavy sea from N.N.W.
Noon	29·920	85·0	...	...	E.b.N.	5·00	„ „
3½ P.M.	29·860	83·0	81·1	75·0	E.N.E.	4·00	„ „
7 „	29·866	79·0	...	...	„	9·00	o. r.
9½ „	29·874	79·0	78·0	75·0	„	5·00	„
Midt.	29·824	78·0	...	...	„	8·00	o. r. t. l.

It would appear from the log of the *Atieth Rahaman*, that at midnight of the 25th she was in the central calm, after having had the wind from E. to N.E. At 1 A.M. on the 26th, the barometer being at 29·25, she had "thick, dark, cloudy weather, with rapid lightning. At 3, the wind from N.W. struck the ship with the force of a hurricane, and laid her on her beam ends; vessel making more water than usual,—obliged to keep the pumps going. At 4, barometer 29·30. At 6, sent hands aloft to secure the torn sails. At 8, sent down main-royal yards, fore-royal and top-gallant yards; barometer 29·40. Noon, still blowing very hard; ship's scuppers under water; ship labouring heavily, and making much water; no sails set; blowing a regular hurricane; barometer 29·40.

"Lat. (D. R.) 18° S., Long. (D. R.) 57° E. P.M.—Wind N. to N.N.W.

Flying jibboom snapped short off; unable to send down fore-topgallant mast and yard, and being afraid of its seriously damaging topmast rigging and braces, cut it away, after having managed to send down top-gallant yards at great risk. Ship labouring heavily, and still lying to under bare poles; blowing a perfect hurricane; hands kept at the pumps. Midnight, no change; barometer 29·40."

The *Launceston*, probably in about 17° S. and 58° E., had a gale from N.N.W., with hard squalls and rain.

From all these observations we infer that the centre of the cyclone was in about 18° 30′ S. and 55° 54′ E.

Since the preceding noon, therefore, the storm travelled S. 29° 39′ W. 126 miles,—or at the rate of 5·2 miles per hour.

Its diameter was at least 400 miles, though the wind did not blow with hurricane force within the whole of that space.

South of the 30th parallel, from 33° to 76° E., five vessels had fresh and moderate breezes from Northward, chiefly from N.N.E.

Friday, the 27th of January.—On this day there were vessels on all sides of the storm, and showing, in the clearest manner, that the wind was circling round a centre. The following were the winds, &c., of those vessels at noon:—

Launceston:—17° 15′ S.; 57° 30′ E.; wind N.N.W. (2); fair; made all sail.

Auffredy:—19° 15′ S.; 56° 23′ E.; wind N.W. (5); cloudy, squally.

Gironde:—19° 50′ S.; 55° 30′ E.; wind N.W. (11); squally; under bare poles.

Stag:—20° 32′ S.; 58° 16′ E.; wind N.N.E. (9); bar. 29° 70′; ther. 82°; rain, lightning.

La Bretagne:—22° 37′ S.; 59° 50′ E.; wind E.N.E. (4); bar. 30·12; ther. 79°; cloudy, rainy.

Arthur and Mathilde:—23° 25′ S.; 57° 23′ E.; wind E. to E.N.E. (6); squally, rain.

Swallow:—25° 5′ S.; 51° 6′ E.; wind S.E. (5); fine.

Nadir:—20° 11′ S.; 53° 10′ E.; wind Southerly (4); cloudy, squally, rain.

With the *Auffredy*, the wind veered from S.W., on the 26th, to S., S.W., &c.; so that the centre passed to the eastward of her.

The *Gironde* left St. Denis (Reunion) early on the 26th, and steered N.E., with the wind from W.N.W.-ward. In the afternoon, she ran S.E. with the wind from N.N.W., but at 5 P.M. hove-to on the starboard tack.

As the direction of the wind is not given in the log of the *Atieth Rahaman*, that vessel has been omitted in the above Table. At midnight on the 26th, she had a hurricane from Northward. "At 3 A.M. (27th) more moderate. At 4, hard gales, with passing rain; barometer 29·50; sent down the mizen top-gallant yards and mizen top-gallant mast. At 6, moderating fast. At 7, set foresail and mizen. At 8, strong breeze and cloudy; barometer 29·60. At 11, set mizen topsail and mainsail. Noon, moderate breeze and cloudy; barometer 29·80. Lat. 19° 19′ S.; Long. 57° 12′ E.

"P.M. Moderate breeze and fine."—She had, no doubt, the wind still from the Northward.

In the afternoon, the wind and weather with the *Arthur and Mathilde* "assumed every appearance of a storm, and from 4 to 8 the wind blew with extraordinary

violence; the sea high, the sky overcast and gloomy; the breeze always from the same quarter (E.N.E.) without varying. At 9, barometer 29·685; blowing with extreme violence and much rain. Midnight, ditto winds and weather."

The following observations were taken at Port Louis:—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
1 A.M.	29·816	78·5	...	...	N.E.b.E.	7·00	o. r.
3½ „	29·784	79·0	78·0	75·0	N.E.b.N.	3·00	o. g. q. r. t. l.
5 „	29·810	79·0	...	...	N.N.E.	12·00	„
7 „	29·850	79·0	...	...	N.b.E.	4·00	„
9½ „	29·910	80·0	78·0	76·0	North	4·00	o. g. r.
3½ P.M.	29·914	81·0	80·0	76·0	„	2·50	o.; finer
9½ „	29·986	81·0	79·0	76·5	N.E.	0·20	o. m.

The centre of the storm at noon was in about 20° S. and 55° 30′ E.; so that it travelled since the previous noon S. 14° 11′ W. 93 miles,—or at the rate of 3·8 miles per hour.

Although the diameter of the whirling body of air was at least 600 miles, the wind did not blow hard over all that space.

The N.E. Trade on this day was extending beyond the Equator between 75° and 82° E.; and the S.E. Trade from 25° S. and 85° E. to about 12° S. and 69° E.

From 60° to 70° E. and from 21° to 17° S. the S.E. Trade was deflected to E. and E.N.E. towards the cyclone.

The south-western side of the cyclone was evidently formed by the Trade.

South of the Trade, in that part of the Ocean, the wind, as observed by four vessels, from 35° to 59° E., was fresh and moderate from Northward, with fine weather.

Saturday, the 28th of January.—The N.E. Trade prevailed in the northern part of the Ocean, and was crossing the Equator in about 80° E.

We have evidence that the wind was still moving round a point to the southward of Mauritius. The storm, however, seems to be dying away. From the following Table it will appear, also, that the Northerly winds extended over several degrees of latitude, as if the cyclone was flattened on its eastern side.

Eastern Empire:—16° 31′ S.; 72° 57′ E.; wind S.E. (5); bar. 30·07; ther. 83½°; cloudy, passing showers.

Neptune:—14° 43′ S.; 68° 47′ E.; wind S.E. (6); fair.

Augusta:—18° 9′ S.; 61° 53′ E.; wind Easterly (2); cloudy; swell from the S.E.

Lawrence:—19° 41′ S.; 60° 41′ E.; wind E.N.E. (2); fine.

George Washington:—21° 4′ S.; 59° 12′ E.; wind N.N.E. (4); fine.

La Bretagne:—21° 43′ S.; 59° 24′ E.; wind N.N.E. (5); bar. 29·95; ther. 82°; fine.

Marguerite d'Anjou:—21° 20′ S.; 58° 29′ E.; wind N.E. (5); fine; lightning at 5 P.M.

Auffredy :—19° 20′ S.; 57° 30′ E.; wind N.W. (6); fine; a sea on.

Gironde :—21° 2′ S.; 56° 28′ E.; wind North (6); very heavy sea.

Arthur and Mathilde :—23° 45′ S.; 58° 5′ E.; wind North (7); bar. 29·834; squally, rain.

Swallow :—24° 45′ S.; 51° 47′ E.; wind E.S.E. (5); squally, rain.

Nadir :—20° 24′ S.; 54° 13′ E.; wind S.W. (1); fine.

The S.E. Trade prevailed in the eastern part of the Ocean, and apparently curved away towards the storm, becoming successively an E., E.N.E., N.N.E., and N. wind.

At Port Louis the following observations were taken :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·978	80·0	79·0	76·0	E.-ward	0·10	c.; fine
9½ „	30·032	82·0	81·0	76·8	N.N.E.	1·00	o.; „
3½ P.M.	30·016	85·0	83·1	78·3	N.-ward	0·50	c.; „
9½ „	30·088	82·0	80·0	77·0	Calm	0·00	Fine; l. to S.-rd

The *Arthur and Mathilde's* barometer at 1 A.M. was at 29·724, and at 5 A.M. at 29·763,—the weather improving a little. From 4 to 8, the squalls were less violent and at longer intervals, with overcast sky and rain. At 9 A.M. the barometer was 29·842, with the wind squally from North, but the weather improving.

We infer that the centre at noon on this day was in about 24° 15′ S. and 57° 18′ E. Hence the storm travelled, since noon on the 27th, S. 19° 59′ E. 271 miles,—or at the rate of 11·3 miles per hour.

The storm had a diameter of about 450 miles.

As the centre must have passed close to Reunion, information from that island would be interesting.

From 34° to 39° S., and from 54° to 59° E., the wind was moderate and fresh from N.E.-ward, with fine weather.

Sunday, the 29th of January.—On this day we have nearly the same winds as on the preceding, except that the cyclone has disappeared.

The N.E. Trade was crossing the Equator in about 80° E., and the S.E. Trade, which prevailed in the eastern part of the Ocean, was apparently curving towards Mauritius, forming an E.S.E., E.N.E., and then a Northerly wind, as yesterday. The positions, &c., of some of the vessels were as follows :—

Phantom :—23° 23′ S.; 80° 46′ E.; wind S.E. by E. (5); bar. 30·206; clear and fine.

Neptune :—16° 59′ S.; 66° 59′ E.; wind E.S.E. (5); fair.

Augusta :—18° 33′ S.; 60° 7′ E.; wind Easterly (3); fine.

Hyderee :—19° 46′ S.; 60° 15′ E.; wind E.N.E. (2); bar. 30·144; fine.

Lawrence :—19° 24′ S.; 58° 20′ E.; wind E.N.E. (2); fine.

George Washington :—20° 29′ S.; 58° 33′ E.; wind N.E. by N. (2); fine.

Gironde:—20° 32′ S.; 56° 50′ E.; wind North (4); fine; heavy sea.

La Bretagne:—21° 32′ S.; 59° 16′ E.; wind N.N.E. (2); bar. 30·14; ther. 82°; fine.

Arthur and Mathilde:—23° 46′ S.; 58° 27′ E.; wind N.N.W. (2); bar. 30·173; weather finer.

Between the *Arthur and Mathilde's* position and 30° S. we have no observations; but in 31° 52′ S. and 58° 19′ E., the *Galatea* had, in the morning, a fresh gale from the E., and at noon a strong gale from E.S.E., with her barometer at 29·90. In the afternoon, the wind veered to S.S.E.

It is possible, therefore, that the cyclone still existed, having its centre in about 28° S. and 61° E.

South of the *Galatea*, in 38° 10′ S. and 56° 20′ E., the *Jules and Aglaé* had a fresh breeze from N. to N.N.W., and fine weather.

Summary of Results.—The *Yarra's* hurricane originated on the 17th of January, between the S.E. Trade and the N.W. Monsoon. Its course, rate of progression, &c., were as follows:—

Date.	Centre at Noon.		Course.	Distance in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S. ° ′	E. ° ′				
Jan. 18	15 30	75 30	.....	...	...	240
„ 19	17 15	73 30	S. 47° 45′ W.	156·2	6·5	400
„ 20	20 30	70 18	S. 42° 49′ W.	266·5	11·1	400
„ 21	21 40	69 15	S. 39° 35′ W.	90·8	8·8	350

The storm, therefore, so far as we have been able to ascertain, travelled a total distance of 513·5 miles, gently curving as it advanced to the southward.

Two vessels, the *Cossipore* and *Yarra*, experienced a calm in the centre of the hurricane.

The *Cossipore* seems to have lost the wind at S.E., and to have got it again at N.N.W., after an interval of nearly an hour; and this, according to the rate at which the meteor was travelling, would give the central calm a diameter of about 7 miles. Ten hours afterwards, the wind with the *Yarra* ceased (probably at E.S.E. or E.), and, after an hour or so, recommenced at N.N.E.; which would make the diameter of the calm space about 13 miles. If these numbers are correct, there must have been a dilatation of the central calm.

It does not appear that this hurricane, except near the centre, was very circular. At its commencement the centre lay between an Easterly and a Westerly stream of air; so that at first the storm was probably flattened on its northern and southern sides. It then became more circular (as on the 19th), and afterwards elongated from N. to S., the Northerly winds extending over several degrees of latitude.

These Northerly winds were an extension of the N.E. Trade; and the storm lay between them and the S.E. Trade.

Although the storm was of small dimensions, it was very violent; and the barometer fell to nearly 28 inches.

The *Cossipore's* barometer fell with the S.E.-ly wind from 29·944 at noon on the 17th, to 28·364 at 11 P.M. on the 18th, shortly before the calm. In the calm it *rose* to 28·394, and at 2 A.M., with the wind from N.N.W., it again fell to 28·364. It then began to rise, and by 1 A.M. on the 22nd was at 29·894. The total fall, therefore, was 1·58 inches.

The *Yarra's* barometer fell with the S.E.-ly wind from 29·91 at noon on the 19th, to 28·31 at 11½ A.M. on the 20th, just before getting the calm. In the calm it "suddenly rose to 28·61." Shortly afterwards, it "went suddenly down" to 28·41. At length it commenced to rise, and by noon of the 21st was 29·51. The total fall was 1·60 inches, or nearly the same as with the *Cossipore*.

From the 18th to the 21st there was constant heavy rain on all sides of the centre.

On the 17th, lightning was observed nearly on all sides of the space where the storm took its origin; and the weather there was sultry and oppressive, with light winds. Lightning was observed, also, on the following days, in the Northerly winds, particularly by the *Hyderee*.

The Northerly winds advanced as far as the Tropic on the 22nd and 23rd (though the storm cannot be traced beyond the 21st); and much thunder and lightning was observed on the latter day.

From the 17th to the 23rd of the month, a system of Southerly and Northerly winds, travelling to the eastward, was observed south of the 30th parallel, as had also been observed from the 9th to the 12th or 13th, while a previous hurricane was raging to the northward.

The Southerly winds advanced from about 25° E. on the 17th, to 65° E. on the 23rd; the winds, with the vessels in the Northerly current to the eastward, veering or shifting, by the N. and W., to S.W., S., and S.E.

By the time (the 23rd) that all the winds, observed to the south of the 30th parallel, were Southerly (chiefly from S.E.), and the N.W. Monsoon had, as already stated, extended to the Tropic amidst much lightning, the second hurricane was apparently setting in to the northward of Mauritius.

The barometer at Port Louis began to go down a little on the 21st; but we cannot determine the centre of the hurricane (supposing it existed) till the 25th or 26th. The following Table gives its course, rate, extent, &c.:—

Date.	Centre at Noon.		Course.	Distance travelled in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S. ° ′	E. ° ′				
Jan. 25	16 40	57 00	.....	...	...	...
„ 26	18 30	55 54	S. 29° 39′ W.	126·0	5·2	400
„ 27	20 00	55 30	S. 14° 11′ W.	93·0	3·8	600
„ 28	24 15	57 18	S. 19° 59′ E.	271·0	11·3	450

It appears, therefore, that the storm travelled a distance of at least 490 miles.

At Port Louis, the barometer fell from 30·038 at 9½ A.M. on the 21st, to 29·784 at

3½ A.M. on the 27th; the total fall of rain, from 9½ A.M. on the 24th to 9½ A.M. on the 28th was 8·277 inches; and the anemometer indicated a maximum pressure of 12 lbs. per square foot.

This storm, also, was characterized by a central calm in which the *Atieth Rahaman* remained about three hours. The wind seems to have ceased at N.E. to E., and to have recommenced at N.W. It is probable, therefore, that the central calm had a diameter of about 20 miles.

In the centre, the barometer with the *Atieth Rahaman* fell only to 29·25 inches, which is nearly an inch higher than it was with the *Yarra* and *Cossipore* in the centre of their hurricane.

On the 26th and 27th, the storm was circular, but on the 28th it was flattened—at least on its eastern side.

There was much rain in the body of the storm, especially near the centre.

Frequent lightning was observed at Port Louis, and in other places, with the Northerly winds.

Whenever signs of the hurricane appeared to the northward of Mauritius, a N.E.-ly wind set in beyond the S.E.-ly winds which prevailed as far as 36° S., and speedily occupied, so far as our observations show, the whole space from 30° to 40° S. and from 15° to 70° E. On the 27th, however, a Southerly wind made its appearance to the westward of the Northerly wind, and it seems to have advanced rapidly to the eastward, till at noon on the 30th all the vessels from 30° to 40° S. and from 50° to 70° E. had again the wind from S. and S.S.W.-ward in fresh breezes.

With most of the vesssls which had the Northerly winds, the veering or shifting took place through the N. and W.; but with one or two of those farthest north, and next the storm, it took place from W.N.W. to E.N.E., E. and E.S.E.

On the 28th and 29th, the S.E. Trade, east of the 60th meridian, and from 18° or 17° S. to 20° S., curved away to the S.W.-ward, towards the storm, forming a S.E. E.S.E., East, N.E., and N. wind.

The Northerly winds advanced to the Tropic, as was the case in the *Yarra's* hurricane.

After the hurricane of the 24th to the 29th January, the S.E. Trade resumed its ordinary state, and prevailed from nearly 30° to 5° S. in about 80° E.,—and to 14° S. on the western side of the Ocean.

At noon, on Feb. 6th, it was prevalent, as observed by several vessels, from 21° 45′ S. and 104° 2′ E. to 4° S. and 78° 3′ E.,—and from 29° 7′ S. and 39° 4′ E. to 13° 21′ S. and 58° 45′ E.,—blowing in hard gales, with rain, in about 25° S. and 49° E.

South of the 30th parallel, between 18° and 42° E., the wind was from N.N.E. and the N. W.-ward, in strong breezes.

The N.E. Trade extended from 13° 45′ N. and 93° 20′ E. to the Equator.

Tuesday, the 7th of February.—There was scarcely any change in the winds and weather on this day; but a N.E.-ly wind had made its appearance to the

northward of Mauritius. The positions of the vesssels which experienced it were as follows:—

Launceston:—4° 50′ S.; 64° 35′ E.; wind N.N.E. (1); cloudy, squally.

Allies:—13° 6′ S.; 60° 8′ E.; wind N.E. by N. (4); bar. 30·093; ther. 89°.

Vanguard:—14° 36′ S.; 58° 14′ E.; wind N.N.E. (4); bar. 29·958; ther. 89°.; squally with rain; threatening appearance.

These vessels had a higher temperature than was observed in any other part of the Ocean.

With the *Vanguard*, the wind at 10 P.M. on the 6th "passed from E.S.E. to N.W. with squalls, rain, and a threatening appearance."

The *Allies*, farther north, lost the Trade on the morning of the 6th; she had then for a few hours light airs from W.N.W., and, in the latter part of the day, a light breeze from N.

The following observations were taken at Port Louis:—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	30·000	82·0	80·0	74·0	E.-ward	1·00	Clear and fine
9½ „	30·036	82·0	81·0	75·5	„	1·50	c. p. q.
3½ P.M.	29·974	81·0	79·0	74·0	East	4·00	o. p. q.
9½ „	30·040	80·0	78·0	73·5	„	3·00	o. q. r.

To the S.W.-ward of the island, the Trade was squally, with rainy weather; and, in 21° 26′ S. and 49° E., the *Swallow* was lying to with a strong gale from S.E., and heavy rain.

From 36° to 39° S., and nearly in 44° E., two vessels had strong breezes from N.E.; and from 36° to 40° S. and 23° to 32° E. three other vessels had strong to moderate breezes from N.W.

We thus see, that while the S.E. Trade reigned at Mauritius and to the southward of it, a Northerly wind was observed to the northward of the island, and also a Northerly wind beyond the polar limits of the Trade.

The N.E. Trade prevailed north of the Equator.

Wednesday, the 8th of February.—East of 68° E., the S.E. Trade extended to 10° S.: it prevailed also at Mauritius and to the southward of it; but, to the N.W.-ward and northward of the island, the wind was from W.S.W.-ward and N.N.W.-ward, as if a cyclone existed, or was being formed, between the S.E. Trade and the N.W. Monsoon. The following are the observations which have led to that inference:—

Swallow:—25° S.; 48° 50′ E.; wind E.S.E. (9); lying to.

Tyrian:—22° S.; 56° E.; wind E.S.E. (6, 7); cloudy, squally.

Jules and Aglaé:—19° 57′ S; 58° 13′ E.; wind Eastward (5); cloudy, squally with rain.

Marie Sarah:—17° 51′ S.; 52° 1′ E.; wind W.S.W. (4); bar. 30·010.

Vanguard :—14° S.; 57° 29′ E.; wind N.N.W. (4); bar. 29·978; ther. 85°; gloomy and squally.

Launceston :—5° 27′ S.; 65° 54′ E.; wind N.W. (5); cloudy.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·978	81·5	80·0	75·0	E.N.E.	3·50	c.; fine
9½ „	30·050	78·0	76·0	73·0	E.-ward	2·00	c. r.
3½ P.M.	29·990	82·0	81·0	75·5	E.N.E.	0·30	c.; fine
9½ „	30·050	80·0	78·0	73·5	Var.	0·04	o. r.

In 29° 23′ S. and 35° 34′ E., the *Royal Arthur* had a fresh breeze from S.S.W., with a rising sea; barometer 30·10; thermometer 79°.

South of the 30th parallel, the winds were still from the Northward, except with the *Good Hope*, in 36° 42′ S. and 47° 12′ E., where it was blowing a heavy gale from the S.W. This vessel, on the whole of the 7th, had the wind from N.E.-ward, with the barometer at noon at 29·80. Towards midnight the breeze fell light, and it remained so till about 8 A.M. on the 8th, when it passed from N.E. to S.W., the barometer at noon standing at 29·75, but soon afterwards rising.

About 150 miles S.S.E. of the *Good Hope*, the *Marquise*, in 38° 43′ S. and 47° 43′ E., had the wind from N.E., with heavy rain, but an hour or two afterwards it passed to W.S.W.

Farther east, in 37° 44′ S. and 59° 14′ E., the *Tullochgorum* had the wind fresh and strong from N.E.-ward throughout, with cloudy, but fine weather.

West of 33° E. the wind, as observed by five vessels, was from N.W.-ward, with fine weather.

The N.E. Trade was blowing in light to fresh breezes, from Calcutta to the Equator.

THURSDAY, THE 9TH OF FEBRUARY.—On this day we have, generally, the same winds and weather as yesterday.

The S.E. Trade east of 66° E. extended to 10° or 8° S.

West of that meridian, however, the Northerly Monsoon prevailed, to at least 14° S.; and there were still signs of the formation of a rotative wind to the northward of Mauritius, as will appear from the following observations :—

Tyrian :—21° 10′ S.; 57° 20′ E.; wind E.S.E. (8); squally with rain.

Marie Sarah :—16° 49′ S.; 50° 34′ E.; wind W.S.W. (5); bar. 29·930; squally with rain; heavy cross sea; midnight, lightning.

Vanguard :—13° 33′ S.; 57° 49′ E.; wind N. (2); bar. 29·928; ther. 86°; fine; at 6 P.M. squally.

Launceston :—3° 59′ S.; 64° 45′ E.; wind N.N.E. (4); bar. 29·86; ther. 84°; cloudy, fine.

Black Friar :—4° 34′ S.; 67° 8′ E.; wind N. (5); cloudy.

The following observations were taken at Port Louis:—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·950	79·0	78·0	73·5	E.-ward	0·20	o.; fine
9½ „	29·999	81·0	80·0	74·5	„	0·30	o. g. r.
3½ P.M.	29·950	81·0	79·0	75·0	Calm	0·00	o. g. r.
9½ „	29·982	79·0	78·0	73·5	E.-ward	0·50	c.; fine

It appears from these observations that the barometer was going down at Mauritius as well as with the *Marie Sarah* and *Vanguard*.

The *Swallow*, in 26° 28′ S. and 48° 49′ E., had now calms and fine weather; and the *Royal Arthur*, in 29° 40′ S. and 33° 4′ E., a light breeze from S.E., with hazy weather; barometer 30·19; thermometer 76°.

In 35° to 39° S. and 49° to 52° E., the *Good Hope* and *Marquise* had light winds, the former from S., and the latter from W.S.W. The barometer of the *Good Hope* at noon stood at 29·90, or 0·15 higher than yesterday.

West of those two vessels, the *Tullochgorum*, in 37° 25′ S. and 61° 19′ E., had at noon a fresh breeze from the W., with misty weather. The N.E. wind, which she had on the previous day, increased, in heavy squalls, to a double-reefed topsail breeze, and veered to N. and W.; and at 2 P.M. on this day (the 9th), she had a moderate breeze from S.

It is clear, therefore, that the *Good Hope*, *Marquise*, and *Tullochgorum*, experienced the same changes of wind and weather, and that the Southerly current of air, which they got in succession, was travelling to the eastward at the rate of 15° a day, or of about 29 miles per hour.

From 19° to 35° E. and from 36° to 40° S., the wind was from Northward and N.W.-ward; and in 40° 47′ S. and 14° 13′ E., the *Robert and Alexander* had a moderate breeze from W.S.W. and misty weather.

The N.E. Trade still prevailed in the Bay of Bengal; and between it and the S.E. Trade, in 82° E. and south of the Equator, two vessels had light airs and calms.

Friday, the 10th of February.—At noon on this day, the N.E. Trade apparently extended from 11° N. to 14° S., as will be seen from the following vessels:—

Bentinck:—11° N.; 84° 55′ E.; wind E.N.E. (2); fine.

Meteor:—6° 6′ N; 82° 6′ E.; wind N.N.E. (4); clear.

Martha:—4° 9′ S; 81° 27′ E.; wind Northerly (2); fine.

Launceston:—4° 22′ S; 68° 41′ E.; wind N.N.E. (2, 5); squally.

Black Friar:—4° 29′ S.; 65° 32′ E.; wind N. (2); bar. 29·942; ther. 85°; fine.

Rosalie:—6° 23′ S.; 78° 50′ E.; wind Northerly (2); cloudy.

Narwhal:—7° 44′ S.; 78° 53′ E.; wind N.N.E. (2); fine.

St. Bernard:—12° 57′ S.; 71° 37′ E.; wind E.N.E. (6); bar. 30·040; squally with rain.

Vanguard :—13° 9′ S.; 57° 12′ E.; wind N.N.E. (5); bar. 29·978; ther. 85°; squally.

In 17° S. and 50° 57′ E., the *Marie Sarah* had fresh breezes from W.S.W. to W., with heavy rain, and the barometer at 29·78. At midnight she had heavy rain, lightning, and light airs from W.S.W.

The *Chillingham*, in 19° 17′ S. and 56° 6′ E., had a strong gale from E. to N.E., with a wild appearance, and rainy weather.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·928	79·0	77·5	74·0	N.E.	2·00	o. q. r.
9½ „	29·982	79·5	79·0	73·5	E.-wrd.	2·00	o. r.
3½ P.M.	29.950	78 0	76·0	73·0	N.E.-wrd.	0·30	o. r.
9½ „	29·992	77·0	76·0	72·5	E.N.E.	2·00	c.; fine

The S.E. Trade extended towards 10° S. in 95° E. It prevailed also to the eastward and southward of Mauritius, as shown by the following vessels :—

Flatworth :—17° 50′ S.; 64° 30′ E.; wind S.E. (4); fine.

Radnagore :—18° 17′ S.; 65° 6′ E.; wind E. by S.; bar. 30·010; ther. 84°.

Mona :—19° 23′ S.; 63° 54′ E.; wind E. by S. (5); clear.

Lord of the Isles :—22° 51′ S.; 55° 22′ E.; wind S.E. (6); squally with rain.

In 26° 10′ S. and 49° 7′ E., the *Swallow* had calm and fine weather; but in the afternoon a strong breeze sprang up from S.E.

These observations would lead us to infer that there was a locality of *minimum* atmospheric pressure to the north-westward of Mauritius, and that the adjacent air was flowing either towards it or around it.

From 35° to 38° S. and from 49° to 62° E., the *Good Hope*, *Marquise*, and *Tullochgorum*, had still Southerly winds.

Further west, the winds and weather were as follows :—

Royal Arthur :—30° 15′ S.; 30° 33′ E.; wind E. by S. (4); bar. 30·201; ther. 82°; fine.

Prince :—36° 50′ S.; 36 19′ E.; wind N.N.E. (5); clear.

Jalawar :—37° 39′ S.; 33° E.; wind E.N.E. (3); clear.

Isis :—39° 45′ S.; 29° 28′ E.; wind E.N.E. (5); clear.

Jeanne de Montfort :—40° 5′ S.; 20° 59′ E.; wind N.N.E. (5); fine.

Centaur :—37° 28′ S.; 18° 12′ E.; wind S. (2); bar. 30·314; ther. 68°; clear.

Robert and Alexander:—40° 44′ S.; 15° 26′ E.; wind S. by W. (3); cloudy, fine.

Louis Gaveaux :—37° 26′ S.; 14° 37′ E.; wind N.W. (2); fine.

It would appear from these observations that a second system of Southerly winds was setting in to the westward of the Northerly winds in the above Table.

From 34° to 37° S. and from 104° to 117° E., the following winds and weather were experienced by four vessels :—

Dominick Daly :—34° 26′ S.; 104° 27′ E.; wind S.W. (8); heavy sea.

Bon Accord :—36° 43′ S.; 113° 4′ E.; wind N.W. (9); bar. 29·80; cloudy.

Prince of the Seas :—36° 33′ S.; 112° 59′ E.; wind W.N.W. (6); cloudy, squally.

Zoe :—35° S.; 116° 47′ E.; wind W.N.W. (8); cloudy, squally.

The wind with the *Dominick Daly* veered on the previous day from N.W. to W. and S.W., and it veered with the other vessels in the same way, but at a later period.

Saturday, the 11th of February.—The N.E. Trade extended on this day to about 4° S. and 70° E., and, farther west, apparently to 13° S.

At the same time, the S.E. Trade prevailed from about 27° S. and 96° E. to 10° or 8° S. and 78° to 67° E.—and between it and the N.E. Trade there were light airs and calms.

Over all those parts of the Ocean the weather was fine, and the wind generally light.

But from 48° to 64° E. the weather had a different character; and there was evidently a rotatory movement of the atmosphere round a point to the W.N.W.-ward of Mauritius. The following Table shows the winds, positions, &c. of the vessels between those meridians :—

Marquise :—36° 52′ S.; 53° 9′ E.; wind variable (5); fine.

Good Hope :—34° 8′ S.; 50° 47′ E.; wind S.E. (6); bar. 30·27; clear.

Tullochgorum :—32° 23′ S.; 61° 1′ E.; wind S.E. (6); cloudy, hazy with rain.

Swallow :—25° 40′ S.; 48° 57′ E.; wind S.E. (5).

Lord of the Isles :—24° 45′ S.; 52° 21′ E.; wind S.E. (5); bar. 29·541; down topgallant yards.

(Str.) *Thunder* :—24° 6′ S.; 57° 25′ E.; wind E. (9); bar. 29·944; cloudy, hazy with drizzling rain.

Marie Sarah :—17° 30′ S.; 51° 11′ E.; wind S.W. (6); bar. 29·92; cloudy, squally; heavy cross sea.

Vanguard :—12° 39′ S.; 57° 52′ E.; wind N.N.E. to N. (2); bar. 29·978; ther. 85°; fine.

Chillingham :—19° 17′ S.; 56° 30′ E.; wind N.E. (9); cloudy, squally with rain.

Radnagore :—18° 51′ S.; 63° 34′ E.; wind E. by S. to E.; bar. 30·01; ther. 86°.

Flatworth :—19° 4′ S.; 62° 34′ E.; wind S.E. to E. by S. (4); cloudy.

Mona :—19° 39′ S.; 62° 22′ E.; wind E. (5); fine.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·914	78·0	77·0	73·5	E.N.E.	2·00	o.; fine.
9½ „	29·968	81·0	80·0	75·5	N.E.	2·50	o. g. p. q.
3½ P.M.	29·910	82·0	79·5	75·5	N.E.-ward	1·50	o. p. q.
9½ „	29·942	80·0	79·0	76·0	N.E.	0·50	o. g.

We see that the barometer was still falling, though there was little difference in the direction and force of the wind.

It would appear that the wind blew with greatest force in a line drawn from the *Thunder* to the *Chillingham*.

With the former vessel, the gale, in the afternoon, increased to a hurricane from E. by S. "At 4 P.M., heavy gales with a tremendous confused sea making a complete sweep over the ship; in fore-staysail (bar. 29·97 Index Error,—·086). At 6, blowing a complete hurricane, with thick drizzling rain at times, &c.; a fearful sea running and making a complete sweep over the decks. At 6·30, shipped two very heavy seas forward; stove in fore skylight, port bow life-boat, &c. Midnight, hurricane still blowing with terrific violence; barometer 29·95."

It is plain that the wind was not blowing in a circle, at least at some distance from the centre; for we have positive proof that the centre did not bear either N. or N. by E. of the *Thunder*, when that vessel had the wind from E.

The centre must have been between the *Chillingham* and the *Marie Sarah*, in about 19° S. and 53° 45′ E.; and if the *Thunder* had run to the westward, she would have got into worse weather.

It is impossible, therefore, to avoid the conclusion, that the storm was a contest between a Northerly and a Southerly stream of air. The Northerly winds appear to press against the Trade, deflecting it to E.N.E., on the eastern side of the storm; and the Trade, farther west, as if meeting with less resistance there, sweeps round on the western side of the storm, forming Southerly and S.W.-ly winds.

The direction of the wind with the *Vanguard*, *Mona*, and *Tullochgorum*, beyond the outer circles of the storm, was towards the centre.

From 37° to 41° S. and from 16° to 38° E., we have the two counter-winds which were observed yesterday, as will be seen from the following statements:—

Prince:—37° 50′ S.; 38° 52′ E.; wind E. (6); clear.

Jalawar:—38° 45′ S.; 36° 7′ E.; wind N. by E. (5); clear.

Isis:—40° 17′ S.; 33° 7′ E.; wind E.N.E. (3); clear.

Jeanne de Montfort:—39° 55′ S.; 21° 39′ E.; wind N.N.E. (2); fine.

Robert and Alexander:—40° 9′ S.; 19° 20′ E.; wind S.E. (2); fine.

Centaur:—37° 9′ S.; 19° 31′ E.; wind S. (2); bar. 30·214; ther. 68°; clear.

Louis Gaveaux:—37° 44′ S.; 16° 29′ E.; wind N. (2); fine.

As a general rule, these N.E.-ly winds always appear when a S.E.-ly wind prevails to the N.E.-ward, as on the present occasion.

The *Louis Gaveaux* had the wind at noon from N., but it veered to N.W., and at 4 P.M. was from S.W.

Between 34° and 37° S., and between 104° and 115° E., the *Dominick Daly*, *Bon Accord*, and *Zoe*, had the wind from W. by N. to N.W.

SUNDAY, THE 12TH OF FEBRUARY.—In the northern part of the Ocean we find the N.E. Trade stretching to 10° S., as observed by the following vessels:—

Adelaide:—13° 32′ N.; 87° 10′ E.; wind Northerly (2); bar. 30·012; ther. 82°; clear.

Bentinck:—12° 56′ N.; 83° 29′ E.; wind E.N.E. (2); sultry.

Lafayette:—4° 11′ N.; 80° 38′ E.; wind N.E. (2); fine.

Grassmere:—3° 10′ S.; 80° 9′ E.; wind N. by E. (2); cloudy, with passing showers.

Launceston :—4° 15′ S.; 69° 56′ E.; wind N.W. (5); squally with rain.

Martha :—4° 35′ S.; 81° 27′ E.; wind N.W. (1); fine.

Black Friar :—6° 21′ S.; 67° 50′ E.; wind N.N.W. to N. (2); bar. 29·942; ther. 83°; fine.

Rosalie :—7° 25′ S.; 80° 20′ E.; wind N.E.; cloudy.

Narwhal :—9° 28′ S.; 77° 54′ E.; wind N. by E. (2); bar. 30·026; ther. 82°; fine.

To the southward and eastward of these vessels the S.E. Trade prevailed.

From 10° S. to beyond 30° S., and from 48° to 63° E., there was at noon a vast whirlwind, as the following observations show :—

Marquise :—34° 42′ S.; 53° 23′ E.; wind E.S.E. (5); cloudy; a swell on.

Good Hope :—32° 14′ S.; 51° 21′ E.; wind E.S.E. (4); bar. 30·22; clear; at 5 P.M. double-reefed fore-topsail.

Tullochgorum :—29° 52′ S.; 60° 6′ E.; wind E. (5); cloudy.

Swallow :—25° S.; 51° 30′ E.; wind S.E. (9); cloudy.

Lord of the Isles :—24° 22′ S.; 51° 27′ E.; wind S.E. (9); bar. 29·621; squally, rain.

Marie Sarah :—17° 16′ S.; 50° 19′ E.; wind S.W. (7); bar. 30·00; heavy cross sea; midnight, lightning.

(Str.) *Emeu* :—9° 45′ S.; 55° 38′ E.; wind W. to W.S.W. (2); bar. 30·03; fine; at 4 A.M. ther. 85°.

Radnagore :—19° 32′ S.; 61° 24′ E.; wind E.N.E. (4); bar. 29·93; ther. 82°; gloomy; a short sea from westward.

Flatworth :—19° 47′ S.; 60° 23′ E.; wind E.N.E. (4); squally, rainy.

Mona :—19° 40′ S.; 60° 15′ E.; wind N.E. (5); squally, rainy.

Mallard :—19° 59′ S.; 59° 18′ E.; wind N.N.E. (2); bar. 29·946; squally, rain; windy appearance.

Chillingham :—21° 26′ S.; 56° 6′ E.; wind N.N.E. (8); squally, rain.

(Str.) *Thunder* :—23° 44′ S.; 57° 35′ E.; wind E. (10); bar. 29·874; drizzling rain, squally.

Observations taken at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·894	79·5	78·0	75·5	N.N.E.	0·30	o. r.
9½ „	29·948	81·5	80·0	76·0	N.-ward	0·40	o.; fine
3½ P.M.	29·900	84·0	82·5	77·0	N.W.	0·40	o.; fine
9½ „	29·942	81·5	80·0	76·0	Calm	0·00	fine; light haze

The gale blew with greatest violence from N.N.E., E., and S.E., to the southward of the island. But though the wind had decreased at Port Louis, the barometer stood somewhat lower than on the previous day.

In the morning the *Thunder* had still a hurricane from E., with a fearful heavy sea. At 2 A.M. ship inclining to fall off; set close-reefed mizen, &c. At 4,

terrific squalls, with thick rain (bar. 29·91); ship labouring heavily and straining fearfully. At 8, still blowing a complete hurricane, with a cross confused mountainous sea; tacked ship to eastward, and took in the fore mizen topsail. Noon, less wind, but terrific squalls and thick drizzling rain; a tremendous sea running.

Lat. (D. R.) 23° 44′ S.; Long. (D. R.) 57° 35′ E.:—"P.M.—Gale still blowing with tremendous force; thick drizzling rain, with a high cross sea, and breaking heavily over the ship. At 4, a sea struck the ship on the port bow, starting bulwarks, &c.; wind N.E.; barometer 29·93. At 8, longer intervals between the squalls; a terrific sea. Midnight, gale abating; dense masses of cloud breaking away in patches; stars visible for a few moments, but terrific squalls—and rain at times."

The centre of the storm did not bear north of the *Thunder* at noon; and therefore the wind with her was not moving in a circle, if she had it from E.

From the winds and positions of the *Marie Sarah* and *Chillingham*, and the weather at Port Louis, we infer that the centre was in 20° 30′ S. and 53° E.

Hence the storm travelled, since the previous noon, S. 42° 50′ W. 122 miles, or at the rate of about 5 miles per hour.

The observations show that the western side of the cyclone was formed by the S.E. Trade, which curved from S.E. to S. and S.W., over a great extent in latitude, giving the storm, on that side of it, an elliptical form. It would appear, also, that the N.W. Monsoon formed the eastern side, nearly to the Tropic, where the S.E. Trade, deflected to E., blew with great violence. We should thus have the air moving spirally.

With regard to the extent of the cyclone, its diameter in latitude was about 1400 miles, and in longitude about 800 miles, the force of the wind ranging from light breezes to at least a whole gale.

It will be seen from the following logs that, south and west of the S.E.-ly wind of the cyclone, four vessels were experiencing N.E.-ly winds, while, at some distance to the west of them, the wind was southerly:—

Prince:—38° 29′ S.; 41° 58′ E.; wind N.E. (5); cloudy.

Jalawar:—38° 41′ S.; 39° E.; wind N.E. (4); fine.

Isis:—40° 28′ S.; 35° 31′ E.; wind N.E. (4); squally, rain.

S. G. Glover:—41° 26′ S.; 48° 35′ E.; wind N.E. (4); cloudy, hazy.

Jeanne de Montfort:—38° 52′ S.; 25° 30′ E.; wind S.E. (2); fine.

Centaur:—37° 13′ S.; 20° 58′ E.; wind Southerly (1); bar. 30·214; ther. 68°; clear.

Robert and Alexander:—39° 49′ S.; 19° 14′ E.; wind N.W. (5); cloudy; at 4 P.M. wind W.S.W.

Louis Gaveaux:—37° 4′ S.; 19° 8′ E.; wind S.S.W. (2); fine.

Since noon on the 11th, the Southerly winds had travelled about six degrees to the eastward.

From 33° to 40° S., and from 102° to 119° E., the *Dominick Daly*, *Bon Accord*, *Zoe*, *Prince of the Seas*, and *Fidus*, had the wind from the S.S.W.-ward.

MONDAY, THE 13TH OF FEBRUARY.—At noon, on this day, the N.E. Trade extended to 11° or 12° S. in 78° E., appearing in the Southern Hemisphere as the N.W. Monsoon. This will be seen from the following Table:—

Bentinck:—14° 21′ N.; 83° 18′ E.; wind N.E. (4); clear, sultry.

Adelaide:—11° 50′ N.; 86° E.; wind N. (4); bar. 29·962; ther. 82°; fine.

Lafayette :—1° 39′ N.; 79° 10′ E.; wind N.E. (5); clear, but at times passing clouds.

Meteor :—1° 26′ N.; 79° 25′ E.; wind N. by E. (4); bar. 29·962; cloudy, squally.

Launceston :—3° 36′ S.; 71° 46′ E.; wind N.N.W. (5); squally.

Grassmere :—5° 5′ S.; 80° 25′ E.; wind N. by E.; cloudy, rain.

Martha :—5° 24′ S.; 81° 16′ E.; wind Northerly (1); squally; midnight squally, rain with thunder and lightning.

Rosalie :—8° 37′ S.; 78° 5′ E.; wind N.W.-ly (2); squally.

Black Friar :—8° 42′ S.; 68° 37′ E.; wind N.W. (4); bar. 29·952; ther. 83°; squally, rain.

Narwhal :—11° 19′ S.; 77° 38′ E.; wind N.W. (6); bar. 29·976; ther. 83°; squally, rain.

From 26° to 16° S. and from 91° to 87° E., three vessels had the S.E. Trade and fine weather.

The winds and weather from 10° to 37° S. and from 49° to 60° E., given below, show that the cyclone still existed in that quarter :—

Marquise :—36° 22′ S.; 54° 35′ E.; wind E.S.E. (5); fine.

Good Hope :—35° 55′ S.; 51° 30′ E.; wind E.S.E. (8); bar. 29·97; squally.

Swallow :—25° S.; 48 E.; wind S. (9); lying to.

Lord of the Isles :—24° 19′ S.; 49° 58′ E.; wind S. to S.W. (9); bar. 30·091; ther. 77°; clear.

Marie Sarah :—17° 16′ S.; 50° 11′ E.; wind W.S.W. (1); bar. 30·01; fine.

(Str.) *Emeu* :—13° 52′ S.; 56° 24′ E.; wind W.S.W. (4); bar. 29·98; ther. 82° at 4 A.M.; cloudy, passing showers.

Vanguard :—11° 26′ S.; 59° 24′ E.; wind W. (4); bar. 29·978; ther. 86°; fine.

Radnagore :—19° 32′ S.; 60° 5′ E.; wind Easterly (1); bar. 29·93; ther. 84°.

Mona :—19° 40′ S.; 58° 45′ E.; wind E.N.E. (5); cloudy, rain.

Mallard :—Off Round Island; wind E.N.E. (1); fine.

Chillingham :—21° 46′ S.; 58° 4′ E.; wind E.N.E. (8); finer.

(Str.) *Thunder* :—23° 7′ S.; 57° 27′ E.; wind E.N.E.; bar. 29·96; ther. 80°; cloudy,—a heavy sea on.

Tullochgorum :—26° 58′ S.; 59° 38′ E.; wind E. (5); bar. 29·874; clear.

The following observations were made at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·910	81·0	78·0	76·0	Calm	0·00	c.; fine
9½ „	29·950	82·5	81·0	76·5	N.-ly	0·30	„
3½ P.M.	29·920	85·0	83·0	77·5	N.W.	0·30	o.; fine
9½ „	29·940	82·0	81·0	76·5	„	0·20	b. c.; fine

From these observations we infer that the centre at noon was in about 25° 15′ S. and 52° E.,—to the eastward of the *Lord of the Isles* and *Swallow*.

During the preceding 24 hours, therefore, the storm travelled S. 10° 57′ W. 290 miles, or at the hourly rate of 11·25 miles.

The directions of the wind, as given in the log-books, do not show that the gale was circular at a distance from the centre. We have, as yesterday, the Southerly winds gently curving over many degrees of latitude, and, in about 11° S., apparently veering sharply to W., and meeting the N.W. Monsoon, which forms the eastern side of the storm, the N.E.-ly winds, as they advance to the southward, deflecting the S.E. Trade to east, as was observed yesterday in the case of the *Thunder*, and is on this day observed in that of the *Tullochgorum*.

In the space from 37° to 42° S. and from 22° to 42° E., the wind with four vessels was from N.E.-ward, and with three from Southward. The positions, &c., of those vessels were as follows:—

Samuel G. Glover:—41° 41′ S.; 51° 45′ E.; wind N.E. (2); fine.

Prince:—38° 21′ S.; 44° 41′ E.; wind N.E. (2); fine.

Jalawar:—38° 54′ S.; 42° 5′ E.; wind N.E. (3); fine.

Isis:—40° 14′ S.; 37° 30′ E.; wind N.E. by N. (3); fine.

Jeanne de Montfort:—37° 28′ S.; 29° 51′ E.; wind S.S.W. (5); fine.

Robert and Alexander:—39° 17′ S.; 26° E.; wind S.S.E. (4); clear,—a heavy sea on.

Centaur:—38° S.; 22° E.; wind S.S.W. (5); bar. 30·164; ther. 66°; cloudy, drizzling rain.

At some distance to the northward of the *Robert and Alexander* the wind was from N.W. at noon, and then from W.S.W.

The Southerly wind was still moving laterally to the eastward.

In 30° to 40° S. and from 101° to 118° E. the wind, as yesterday, was from the Southward, and appeared to be the S.E. Trade.

Tuesday, the 14th of February.—From noon on the 13th to noon on this day, the N.W. Monsoon advanced still farther to the southward, being now at, if not beyond, the Tropic, as will be seen from the following logs:—

Napoleon:—16° 3′ N.; 89° E.; wind N.E. (2); bar. 29·95; fine.

Adelaide:—9° 50′ N.; 85° 53′ E.; wind N. (6); bar. 29·912; ther. 83; clear.

Meteor:—0° 6′ S.; 78° 33′ E.; wind N.E. (2); bar. 29·961; fine.

Lafayette: 0° 16′ S.; 81° 11′ E.; wind E.N.E. (5); A.M. thunder and lightning; noon, cloudy.

Launceston:—3° 27′ S.; 73° 28′ E.; wind N.N.W. (5); squally, rain.

Martha:—6° 48′ S.; 81° 16′ E.; wind N.W. (2); cloudy, squally with rain; noon, fine.

Black Friar:—9° 57′ S.; 68° 57′ E.; wind N.W.-ly (1, 2); bar. 29·862; ther. 84°; cloudy, squally appearance.

Rosalie:—10° 10′ S.; 78° 5′ E.; wind W.; squally.

Narwhal:—12° 17′ S.; 76° 59′ E.; wind N.W. (6); bar. 29·936; ther. 83°; squally, with rain; noon, fine.

St. Bernard:—14° 47′ S.; 69° 49′ E.; wind N.W. by W. (2); bar. 29·74; cloudy, squally appearance.

Joseph Bushby:—16° 42′ S.; 86° 27′ E.; wind E. by N. (2); bar. 29·97; fine.

Mandarin:—19° 52′ S.; 85° 48′ E.; wind N. by E. (5); squally, threatening appearance.

Emily Smith :—19° 56′ S.; 77° 18′ E.; wind W.N.W. (2); cloudy.
Chillingham :—22° 47′ S.; 59° 9′ E.; wind N.E. (5); fine.
Jemmy :—24° 43′ S.; 88° 6′ E.; wind E.N.E.; cloudy.
Tullochgorum :—24° 56′ S.; 59° 10′ E.; wind N.E. (4); cloudy, fine.

The Monsoon seems to have been a continuation of the N.E. Trade.

South of the Monsoon we have the S.E. Trade, or at all events a S.E.-ly wind; and the vessels next the Monsoon, as the *Jemmy*, *Tullochgorum*, and *Chillingham*, have the wind from N.E.-ward, as if the S.E. Trade were being deflected.

Several degrees to the S. W.-ward of the two last-named vessels, there were strong gales from the Southward, the S.E. Trade apparently still curving round on the western side of the storm. The winds and positions of those vessels were as follows :—

Good Hope :—30° 24′ S.; 51° 13′ E.; wind E.S.E. (10); bar. 29·77; squally, rain.
Lord of the Isles :—25° 44′ S.; 50° 32′ E.; wind W.S.W. (9); squally, rain.
Swallow :—25° S.; 48° 50′ E.; wind S. (9); squally, rain; lying to.
(Str.) *Emeu* :—17° 33′ S.; 57° 3′ E.; wind S. (2); bar. 29·90; fine.
Vanguard :—9° 53′ S.; 60° 44′ E.; wind S.W. (5); bar. 29·878; ther. 84°; overcast; squally.

It would appear from these observations that the S.E. Trade extended from at least 31° S. to 10° S., becoming Southerly and S.W.-ly as it approached the Equator; and comparing the winds in the above Table with those of the *Black Friar*, *St. Bernard*, *Chillingham*, and *Tullochgorum*, we obtain a figure resembling an elongated ellipse, the centre of the storm being in front, where the Monsoon and Trade were in conflict.

The observations taken at Port Louis were as follows :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·858	80·0	79·0	75·5	S.-ward	0·04	c. p.
9½ „	29·920	82·0	81·0	76·0	Calm	0·00	c.; fine
3½ P.M.	29·880	86·0	84·0	77·5	W.N.W.	0·30	b. c.
9½ „	29·936	82·0	80·0	75·5	Calm	0·00	Clear

The barometer had now reached its minimum, although the weather had improved.

From the winds and positions of the *Good Hope* and *Lord of the Isles* (the vessels which were experiencing the strength of the storm) we infer that the centre at noon was in 27° 48′ S. and 52° E.

Hence the storm travelled, since the previous noon, S. 153 miles.

The following observations will show that the extra-tropical counter-winds still existed :—

Prince :—38° 29′ S.; 46°16′ E.; wind E. to N.E. (2, 4); fine.
Jalawar :—38° 26′ S.; 44° E.; wind N.E. by N. (2); fine.

Isis :—39° 44′ S.; 39° 56′ E.; wind N. by E. (3); fine.

Jeanne de Montfort :—37° 40′ S.; 31° 7′ E.; wind S.W. (5); cloudy.

Robert and Alexander :—37° 25′ S.; 25° 21′ E.; wind S.E. (4); cloudy, fine.

Centaur :—37° 10′ S.; 24° 42′ E.; wind S.S.E. (5); bar. 30·314; cloudy, squally.

Louis Gaveaux :—37° S.; 24° 19′ E.; wind S.W. to S. (5); cloudy, fine.

Juliet Erskine :—37° 44′ S.; 15° 45′ E.; wind S.S.E. (4); bar. 30·102; ther. 65°; fine.

The *Royal Arthur*, about eight miles S.W. by S. of Cape St. Francis, had a fresh breeze from W.N.W., with fine weather, the barometer standing at 29·97, and the thermometer at 74°.

Four vessels from 37° to 29° S. and from 114° to 99° E. had Southerly and S.E.-ly winds, with fine weather.

Wednesday, the 15th of February.—It would appear that at noon of this day the N.W. Monsoon still extended to the Tropic, and that it was, apparently, a continuation of the N.E. Trade; but for greater satisfaction the positions, &c., of the vessels are given below :—

Bentinck :—16° 55′ N.; 84° E.; wind N.E. (2); fine.

Napoleon :—14° 31′ N.; 88° 28′ E.; wind E. (3); bar. 30·016; fine.

Vauban :—9° 29′ N.; 85° 59′ E.; wind E. (6); cloudy.

Adelaide :—8° 9′ N.; 85° E.; wind N.N.E. (6); bar. 29·962; ther. 83°; cloudy, fine.

Meteor :—1° 23′ S.; 78° 56′ E.; wind N.W. (1); bar. 29·961; sultry.

Lafayette :—2° 7′ S.; 81° 59′ E.; wind Northerly (1); cloudy.

Launceston :—3° 11′ S.; 74° 48′ E.; wind N.E. to N. (5); cloudy.

Grassmere :—6° S.; 80° 30′ E.; wind N. by E. (2); cloudy.

Martha :—8° 45′ S.; 80° 53′ E.; wind Westerly (3, 6); cloudy.

Rosalie :—11° 38′ S.; 78° 6′ E.; wind N.W.; squally.

Black Friar :—11° 21′ S.; 69° 34′ E.; wind N.W.; bar. 29·942; ther. 83°; fine.

Narwhal :—13° 12′ S.; 76° 7′ E.; wind N.N.W. (4); bar. 29·946; ther. 82°; cloudy.

St. Bernard :—15° 34′ S.; 68° 47′ E.; wind N.W. by W. (6); bar. 29·86; ther. 82°; squally, rain.

Emily Smith :—20° 47′ S.; 76° 27′ E.; wind W.N.W. (2).

Mandarin :—20° 22′ S.; 83° 58′ E.; wind N.W. (5); finer.

Chillingham :—23° 55′ S.; 60° 22′ E.; wind E.N.E. (4); fine.

Tullochgorum :—24° 26′ S.; 59° 7′ E.; wind N.N.E. (2); clear.

The following observations were made at Port Louis :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·876	79·0	77·0	72·5	Calm	0·00	b.; fine
9½ „	29·940	83 5	82·0	75·5	N.E.-ward	0·20	b. c.; fine
3½ P.M.	29·900	85·0	85·0	78·0	N.W.	0·30	„ „
9½ „	29·970	81·0	79·0	74·0	Calm	0·00	b.; fine

The winds and weather experienced by the *Swallow*, *Lord of the Isles*, and *Good Hope*, at noon on this day, were as follows:—

Swallow:—24° 40′ S.; 48° 20′ E.; wind S.W. (5); squally.

Lord of the Isles:—26° 32′ S.; 50° 31′ E.; wind W. (5); cloudy, squally.

Good Hope:—28° 5′ S.; 52° 19′ E.; wind W.N.W. (9); bar. 29·57; cloudy, squally.

Since noon on the 14th the wind with the *Swallow* veered from S. to S.W.; with the *Lord of the Isles* from W.S.W. to W.; and with the *Good Hope* from S.E. to W.N.W., through the S.

The log of the *Good Hope* states that at 4 P.M. on the 14th the wind (then at S.) began to veer to the Westward at the rate of one point per hour. "At 6, steady gale; barometer 29·53. At sunset, observed all the sky of a brick-red appearance. Midnight, heavy gales and hard squalls." On this day (the 15th) the gale continued with her till 4 P.M., when it began to moderate.

The centre of the storm was probably in 28° 50′ S. and 52° E., which gives for the course and rate, since the previous noon, S. 62 miles.

It does not appear that the greater diameter of the cyclone exceeded 1000 miles.

From 37° to 27° S., and from 93° to 116° E., five vessels had the wind still from the S.E.-ward, with fine weather. These S.E.-ly winds were, apparently, the Trade-wind which had been driven back by the N.W. Monsoon, the line or belt of variables being south of the Tropic.

The rotatory gale on the western side of the ocean seems to have been still between the Trade and Monsoon; for the *Marquise*, in 36° S. and 55° 48′ E., had a light breeze from S.E., while to the N.E.-ward of the storm the winds were Northerly.

There is reason to think also that the wind forming the western side of the gale extended as a S.W.-ly current to 8° S. and 62° 13′ E., where the *Vanguard* had a fresh breeze from S.W.

An inspection of the following logs will show that the extra-tropical counter-winds still prevailed, and that they had, since noon on the 14th, travelled 6 or 7 degrees to the eastward:—

Prince:—38° S.; 47° 35′ E.; wind N.E. (2); fine.

Jalawar:—38° 15′ S.; 46° 15′ E.; wind N.W. (4); cloudy, misty.

Isis:—38° 50′ S.; 42° 47′ E.; wind S. by W. (4); cloudy, passing showers.

Jeanne de Montfort:—36° 55′ S.; 33° 27′ E.; wind S.S.E. (5); cloudy, rain.

Centaur:—36° 15′ S.; 26° 39′ E.; wind S.S.E. (5); bar. 30·264; ther. 78°; cloudy.

Louis Gaveaux:—35° 39′ S.; 26° 14′ S.; wind S.S.E. (5); fine.

Juliet Erskine:—36° 25′ S.; 18° 11′ E.; wind S.S.E. (6); bar. 29·952; ther. 70°; heavy sea.

In the night of the 14th to the 15th, the wind with the *Isis* passed from N. by E. to S. by W., but whether it veered or shifted is not stated.

The *Robert and Alexander*, in 89° 18′ S., and 26° 53′ E., had a fresh breeze from the N.E. by E., with fine weather; so that, if no error has been committed in recording the direction of the wind, it is evident that the S.E.-ly winds did not prevail farther south than the 38th or 39th parallel, at least in 27° E.; and this would lead us to suppose that the Southerly winds were the polar winds making their appearance at the surface, while the N.E.-ly wind was the equatorial current.

Thursday, the 16th of February.—The N.W. Monsoon was still extending as far south as the Tropic, but becoming light and unsteady, as will be seen from the following observations :—

Bentinck :—17° 32′ N. ; 85° 5′ E. ; wind E.N.E. (4) ; clear and fine.

Euxine :—13° 32′ N. ; 70° E. ; wind N. (2) ; bar. 30·00 ; fine.

Napoleon :—12° 38′ N. ; 88° 3′ E. ; wind E. by S. (3) ; bar. 30·106 ; fine.

Vauban :—6° 49′ N. ; 87° 4′ E. ; wind E. (6) ; cloudy and squally.

Adelaide :—5° 58′ N. ; 85° 12′ E. ; wind N. (6) ; bar. 29·962 ; ther. 83° ; cloudy and squally.

Meteor :—2° 44′ S. ; 79° 19′ E. ; wind N.E. (1) ; bar. 29·961 ; sultry.

Launceston :—3° 5′ S. ; 76° 12′ E. ; wind N.E. (5) ; squally, with passing showers.

Grassmere :—6° 27′ S. ; 80° 35′ E. ; wind S.W. and variable (1 to calm).

Vanguard :—6° 45′ S. ; 64° 16′ E. ; wind W. (5) ; bar. 29·978 ; ther. 85° ; fine.

Martha :—9° 48′ S. ; 80° 41′ E. ; wind S.W. (1) ; fine.

Rosalie :—12° 22′ S. ; 75° 30′ E. ; wind variable ; cloudy.

Black Friar :—13° 8′ S. ; 70° 14′ E. ; wind variable (2) ; bar. 29·882 ; ther. 87° ; cloudy ; showers.

Narwhal :—14° 2′ S. ; 74° 46′ E. ; wind N.W. (4) ; bar. 29·964 ; ther. 83° ; cloudy, but fine.

St. Bernard :—16° 10′ S. ; 68° 45′ E. ; wind N.N.W. (2) ; bar. 29·76 ; ther. 83° ; sultry.

Joseph Bushby :—16° 59′ S. ; 83° 20′ E. ; wind N. by W. ; bar. 29·97 ; fine.

Mandarin :—21° 3′ S. ; 83° E. ; wind W.N.W. (1) ; clear and sultry.

Jemmy :—24° 40′ S. ; 82° E. ; wind W.N.W. (2, 1) ; fine.

Emily Smith :—20° 49′ S. ; 75° 5′ E. ; wind S.E. (2) ; cloudy.

Tullochgorum :—24° 5′ S. ; 59° 29′ E. ; wind N.W. and variable (1 to calm) ; cloudy.

The *Emily Smith* had now the S.E. Trade. The wind veered with her from W.N.W. to W., S.W., S., and S.E.

The observations taken at Port Louis were as follows :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·926	80·0	79·0	74·0	Calm	0·00	b. ; fine
9½ „	29·964	83·0	82·0	75·5	N.-ward	0·30	c. ; fine
3½ P.M.	29·968	82·5	79·5	73·5	E.S.E.	1·00	o. p.
9½ „	30·034	80·0	79·0	71·8	Calm	0·00	b. ; fine

We perceive from these observations that the barometer was now rising so rapidly that its usual oscillations were masked.

From 26° to 30° S. and from 95° to 101° E., three vessels had S.E. Trade and fine weather.

Between the Tropic and 38° S., and from 45° and 56° E., the winds and weather, as shown by the following logs, were still indicative of a revolving gale :—

Marquise :—33° 58′ S.; 55° 20′ E.; wind S.S.E. (6, 7); cloudy with rain; heavy sea.

Prince :—35° 30′ S.; 49° 55′ E.; wind S. and S.S.E. (7); cloudy; fine.

Jalawar :—36° 33′ S.; 49° 44′ E.; wind S. (6); cloudy; fine.

Isis :—37° 20′ S.; 45° 20′ E.; wind S.E. by E.; fine.

Lord of the Isles :—27° 22′ S.; 50° 7′ E.; wind S.W. (5); squally, with rain.

Swallow :—24° 28′ S.; 48° 53′ E.; wind S.W. (4); fine.

Good Hope :—27° 18′ S.; 55° 46′ E.; wind W.N.W. (8); bar. 29·79; cloudy and squally.

It is probable that the centre at noon was in 30° S. and 53° 30′ E. If that was its position, it travelled, since the previous noon, S. 33° 7′ E. 83·5 miles.

We have not, however, a sufficient number of observations to determine the centre with precision.

Comparing the observations of this day with those of the 15th, we see that the wind with the *Marquise* was still from S.E., and much stronger; but that with the *Prince* and *Jalawar*, instead of being from the northward, as on the 15th, it was now from the southward.

The change of wind with those two vessels took place through the west, as had previously been the case with the *Isis*, the wind, apparently, shifting to S., when it came to N.W. or W.

Beyond this day, then, we cannot trace the extra-tropical counter-winds, the Northerly winds having disappeared, while the Southerly were now forming the south-western side of the cyclone, as if advancing from the westward, whilst the cyclone was travelling to the southward, they had come up with its southerly winds, and coalesced with them.

West of the Southerly winds (as generally, if not always, happens on such occasions) we find the wind becoming Easterly and then Northerly. Thus, the *Jeanne de Montfort*, in 37° 50′ S. and 35° 44′ E., had a fresh breeze from E.N.E.-ward, with fine weather; and the *Robert and Alexander*, in 40° 3′ S. and 29° 51′ E., had a fresh breeze from N.

To the westward of those vessels, again, there was a Southerly wind.

Friday, the 17th of February.—At noon on this day the N.W. Monsoon still extended far south; but the S.E. Trade was encroaching upon it. The following are the observations at that hour :—

Chowringhee :—20° 28′ N.; 88° 21′ E.; wind N.W. (4); fine.

Bentinck :—17° 46′ N.; 85° 17′ E.; wind N.E. (2); fine.

Euxine :—12° 10′ N.; 70° 6′ E.; wind N. (2); bar. 30·00; fine.

Napoleon :—10° 42′ N.; 87° 9′ E.; wind E. (5); bar. 30·106; fine.

Vauban :—5° 14′ N.; 85° 15′ E.; wind E. (1); cloudy, rain.

Adelaide :—4° 38′ N.; 83° 20′ E.; wind S.E. (1); bar. 29·962; ther. 82°; cloudy, fine.

Launceston :—2° 49′ S.; 77° 30′ E.; wind N. by E. (2); cloudy, squally.

Meteor :—3° 9′ S.; 79° 37′ E.; wind W.N.W. (2); sultry.

Lafayette :—3° 54′ S.; 80° 42′ E.; wind W. (1); cloudy.

Vanguard :—6° 4′ S.; 66° 8′ E.; wind N.N.E. (2); bar. 30·078; ther. 84°; fine.

Grassmere :—7° 11′ S.; 80° 3′ E.; wind variable; cloudy, with passing showers and squalls.

Martha :—11° 7′ S.; 80° 41′ E.; wind N.W. (3); cloudy, fine.

Rosalie :—13° 6′ S.; 77° 50′ E.; wind N.W. and variable; squally.

Narwhal :—15° 29′ S.; 73° 45′ E.; wind W.N.W. (5); bar. 30·016; ther. 83°; fine.

St. Bernard :—16° 24′ S.; 68° 13′ E.; wind N. by W.; bar. 30·03; ther. 86°; fine; sultry.

Joseph Bushby :—16° 56′ S.; 82° 50′ E.; wind N. by W. and W. to S.W.; bar. 30·03; fine.

Good Hope :—25° 6′ S.; 57° 45′ E.; wind N. (4); bar. 29·97; cloudy, with passing showers.

In 20° 56′ S. and 81° 56′ E., the *Mandarin* had a fresh breeze from S., which was the Trade-wind. At noon, on the 16th, she had light airs from W.N.W.; and in the afternoon she got a light breeze from S., after calms, there having apparently been no veering of the wind.

West of the *Mandarin*, the *Emily Smith*, in 21° 5′ S. and 74° 44′ E., had the Trade moderate from S.E.

The observations taken at Port Louis were as follows :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·988	79·0	78·0	73·5	Calm	0·00	b.; fine
9½ „	30·030	82·0	81·0	74·5	W.-ward	0·20	b. c.; fine
3½ P.M.	30·030	86·5	85·0	76·0	W.N.W.	0·30	b.; fine
9½ „	30·050	80·5	79·5	74·0	S.E.-ward	0·20	„

To the southward and S.W.-ward of the *Good Hope* the wind was from the S.E.-ward as observed by five vessels; so that the wind with the *Good Hope*, several degrees to the eastward of those vessels, being from the N., we have signs of two contrary streams of air (the Trade and Monsoon), but no evidence that they formed a revolving gale.

From 36° to 38° S., and from 30° to 47° E., the wind was from the N.E.-ward; and west of 30° E. from the S.-ward. We have, therefore, a third system of extra-tropical counter-winds.

The following were the positions, &c., at noon, of the vessels which experienced those different winds :—

Swallow :—25° S.; 48° E.; wind S.E. (2); fine.

Lord of the Isles :—27° 48′ S.; 47° 16′ E.; wind S.E. (5); fine.

Prince :—33° 26′ S.; 51° 29′ E.; wind S.E. (7); cloudy.

Marquise :—34° 16′ S.; 56° 39′ E.; wind S.E. (5); cloudy; heavy sea on.

Jalawar :—34° 30′ S.; 51° 23′ E.; wind S.E. by E. (4); cloudy; fine.

Isis :—36° 56′ S. ; 46° 17′ E. ; wind E.N.E. (2) ; fine.

Jeanne de Montfort :—38° 27′ S. ; 38° 53′ E. ; wind N.E. (5) ; cloudy ; fine.

Louis Gaveaux :—37° 13′ S. ; 29° 44′ E. ; wind E.N.E. (4) ; cloudy ; rain.

Centaur :—37° 4′ S. ; 30° 21′ E. ; wind S.S.W. (5) ; bar. 30·194 ; ther. 78° ; cloudy ; rain.

Robert and Alexander :—39° 39′ S. ; 31° 44′ E. ; wind S.E. (4) ; cloudy ; rain.

Juliet Erskine :—37° 5′ S. ; 21° 14′ E. ; wind S.S.W. ; bar. 30·042 ; ther. 67° ; cloudy ; fine.

Royal Arthur :—34° 30′ S. ; 19° E. ; wind S.E. (5) ; bar. 30·061 ; ther. 68° ; fine.

In the afternoon, the wind with the *Louis Gaveaux* veered to E., and at 4 P.M. was strong from S.E.

At noon on the 16th, the *Centaur*, in 36° 19′ S. and 28° 4′ E., had a strong breeze from E.N.E., and shortly afterwards a strong breeze from S.S.W.

It is not stated whether the wind veered or shifted with these vessels ; but it is plain that the third system of Southerly and Northerly winds was travelling to the eastward.

SATURDAY, THE 18TH OF FEBRUARY.—By noon on this day the S.E. Trade had advanced nearly as far as 10° S. and 80 E. ; the *Martha*, *Narwhal*, *St. Bernard*, and other vessels, having now the wind from the Southward, generally in light airs and breezes, and the Trade blowing fresh to the southward of them.

The wind passed from W.N.W. to W.S.W., &c.

From the Equator to 8° S., and from 68° to 84° E., the N.W. Monsoon, as observed by five vessels, was blowing in fresh breezes to moderate gales, with cloudy, squally, rainy weather, and occasional lightning. These vessels had the following winds and weather at noon :—

Launceston :—2° 3′ S. ; 79° 53′ E. ; wind Westerly (6) ; squally ; rainy.

Vanguard :—5° 4′ S. ; 68° 14′ E. ; wind N. (5) ; bar. 29·978 ; ther. 84° ; squally.

Meteor :—4° 17′ S. ; 84° 4′ E. ; wind W.N.W. (8) ; bar. 30·051 ; cloudy ; lightning and rain.

Lafayette :—5° 31′ S. ; 82° 21′ E. ; wind S.W. to W. by N. (6 to 4) ; cloudy.

Grassmere :—7° 44′ S. ; 80° 33′ E. ; wind N. by E. ; squally with rain.

The weather with those vessels was such as is generally found in that locality at the commencement of a hurricane, except that the Trade was very light.

The observations taken at Port Louis were as follows :—

Hour.	Barom. Uncorrected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	Wind.		Weather.
					Direction.	Force in lbs. per sq. foot.	
3½ A.M.	29·888	80·5	79·5	74·5	Calm	0·00	b. ; fine
9½ „	30·050	84·0	83·0	75·0	E.N.E.	0·30	b. c. ; fine
3½ P.M.	30·000	85·0	82·5	75·0	S.E.	0·20	c. ; fine
9½ „	30·034	84·0	82·0	75·0	Calm	0·00	b. ; fine

The following observations will show that the system of Northerly and Southerly extra-tropical winds had travelled several degrees to the eastward:—

Isis:—37° S.; 47° 27′ E.; wind N.E. by N. (2); fine.

Jeanne de Montfort:—38° 21′ S.; 40° 26′ E.; wind N.E. (2); cloudy; rain.

Robert and Alexander:—40° 50′ S.; 31° 47′ E.; wind S.E. (2); cloudy; rain.

Louis Gaveaux:—37° 33′ S.; 31° 2′ E.; wind S.S.E. (6); finer.

Centaur:—37° 18 S.; 30° 51′ E.; wind S.E. by S. (6); bar. 30·214; clear; cross sea on.

Summary of Results.—From the 6th to the 15th of February, the N.W. Monsoon advanced to the Tropic; and it was, apparently, an extension of the N.E. Trade.

The Monsoon then receded, the S.E. Trade taking its place, and on the 18th extending nearly to 10° S.

In passing from S.E. to N.W. the wind veered or shifted by the N.; and in passing from N.W to S.E., it veered or shifted by the S.; so that it made a complete circuit. But from the time that it was at W. till it came to S. or S.E., there were generally, calms and variables.

The N.W.-ly winds were attended with rainy, squally weather and occasional lightning; and with some vessels the barometer fell about 0·300 of an inch.

At Port Louis the wind veered from E. to N.W. (by the N.), its maximum force being 4 lbs. per square foot; the barometer fell 0·130 of an inch; and the total amount of rain from the 7th to the 12th was 9·425 inches.

The cyclone originated between the Trade and Monsoon, from the 6th to the 10th of the month, a few degrees to the northward of Mauritius. Its course, rate, &c., from the 10th to the 16th, were as follows:—

Date.	Position of Centre at Noon.		Course.	Distance travelled in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S. ° ′	E. ° ′				
Feb. 11	19 00	53 45	.....	...	...	660 to 900
„ 12	20 30	53 00	S. 42° 50′ W.	122·0	5·0	800 to 1400
„ 13	25 15	52 00	S. 10° 57′ W.	290·0	11·2	„ „
„ 14	27 48	52 00	South	153·0	6·4	„ „
„ 15	28 50	52 00	„	62·0	2·6	700 to 1000
„ 16	30 00	53 00	S. 33° 7′ E.	83·0	3·5	„ „

In giving approximate values of the diameter, it is not meant that the wind blew over all the extent indicated, with hurricane violence, or even in strong gales; but that, over that space, it was moving round a central point.

The storm was a contest between the Monsoon and Trade-wind; the Monsoon forming its eastern, and the Trade its western side,—and the two winds moving spirally round the centre.

The Southerly and Northerly winds extended many degrees south and north of the centre, giving the storm an elliptical appearance; and on at least the 11th, 12th, and 13th, the Trade at some distance to the eastward was directed *towards* the centre.

Hence, the bearing of the centre from most of the vessels was not at right angles to the wind's direction.

None of the vessels experienced a central calm.

The barometer of the *Lord of the Isles* fell to 29·541 with the wind at S.E., and rose to 30·091 when the wind had veered, by the S., to S.W. That of the *Good Hope* fell from 30·270 on the 11th, in 34° 8′ S. and 50° 47′ E., with the wind at S.E., to 29·570 on the 15th, in 28° 5′ S. and 52° 19′ E., with a strong gale from W.N.W.

A considerable amount of rain seems to have fallen in the body of the storm; and lightning was sometimes observed in its northern half.

The storm was probably stationary on the 9th and 10th; it afterwards travelled to the southward as the N.W. Monsoon advanced.

South of the 30th parallel, three systems of Southerly and Northerly counter-winds appeared in succession.

The first of these was observed on the 8th, from 46° to 60° E., the *Good Hope* at noon on that day having a strong gale from S.W., and the *Marquise* and *Tullochgorum*, to the eastward of her, strong and fresh breezes from the N.E.-ward. In the course of the next twenty-four hours the two other vessels also got the wind from S.-ward, after it had veered or shifted by the W.

On the 10th, the second system made its appearance between 14° and 38° E., and, advancing to the eastward, its Southerly winds, on the 16th, formed the south-western side of the cyclone which had been travelling to the southward.

Up to this time, the S.E.-ly wind of the storm lay between the N.E.-ly counter-wind (south of the 30th parallel) and the N.E.-ly wind forming the eastern side of the storm.

It would seem, therefore, that the N.E.-ly wind south of the 30th parallel, was the N.E.-ly wind of the cyclone, which, after passing above the S.E. wind, had re-appeared on the surface.

The third system of counter-winds, which was observed on the 16th, from 18° to 33° E., also travelled to the eastward.

On the 10th of the month a counter-gale (Northerly and Southerly) occurred in 34° to 37° S., and from 104° to 117° E. It, likewise, advanced to the eastward.

There seems to be a constant succession of counter-gales south of the polar limits of the Trade, formed by the polar and equatorial currents of air coming down to the surface and running nearly parallel to each other. But they are (at least at this season of the year), most remarkable when the N.W. Monsoon advances towards the Tropic and a cyclone occurs.

123. The foregoing observations (pp. 152 to 187) by Mr. Meldrum, and especially his *summaries* (pp. 166 to 186), illustrate the fact now generally recognised—that *cyclonic gales* are not (at all times) continuous in their progression, but that these storms frequently travel a considerable distance for two, three, or four days, and a succession of them—occurring in different parts of the ocean—may be linked together to form one HURRICANE TRACK.

124. Hurricane Seasons in the Different Oceans.—It remains now to draw the attention of the navigator to the period of the year at which he may most probably expect a Cyclone or Hurricane in the different parts of the ocean; this is shown in the following tabular form, where the number of recorded cyclones (to 1859) for each locality is ranged under each month:—

Locality.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
North Atlantic and West Indies	5	7	11	6	5	10	**42**	**96**	**80**	**69**	**17**	7
Southern Indian Ocean and Mauritius . .	**9**	**15**	**15**	8	4	...	...	...	1	1	4	6
Northern Indian Ocean:—												
Bay of Bengal { during N.E. Monsoon	1	...	3	...	...	...	...	...	...	**12**	**7**	**6**
Bay of Bengal { during S.W. Monsoon	...	...	...	**6**	**16**	4	1	2	1	...	...	...
Arabian Sea and Bombay { during N.E. Monsoon	1	1	1	...	...	...	...	...	**8**	**12**	**9**	5
Arabian Sea and Bombay { during S.W. Monsoon	...	...	...	**5**	**9**	2	4	5	...	...	...	...
China Sea and North Pacific (Western part)	...	1	...	...	2	2	**12**	5	**18**	**14**	**12**	1
Java Sea and N.W. Coast of Australia . .	**3**	**5**	1	1	2	...	...	...	...	...	...	2

In the foregoing Table the figures are expressed in stronger type under the months when rotatory gales may *especially* be expected in each locality.

125. The **Tracks of these Storms** are of such a varied character that a delineation of a few of them on the CHART DIAGRAMS will probably convey more information than a long description.

PIDDINGTON'S "Horn Book" is a favourite work with navigators on the subject here briefly noticed, but another of considerable merit should be found in every seaman's library—BIRT'S "Hand-book of the Law of Storms." With respect to the cyclones of the North Pacific, an excellent article by REDFIELD will be found in the "Mercantile Marine Magazine," vol. iv.

126. In the Southern Indian Ocean, south of the Cape of Good Hope and thence towards Australia and New Zealand, rotatory gales are most commonly experienced towards the end of autumn and during the winter season of that hemisphere—as is the case in the higher latitudes of the North Atlantic.

127. Cyclones in the Hoogly.—With the great Calcutta cyclone (October, 1864), fresh in the recollection of our readers—and in consideration of the enormous loss of life and waste of property resulting therefrom—we may aptly close these remarks with PIDDINGTON'S "Notes for Ships and Steamers lying in the Stream, or at Moorings at Calcutta, or near it; and for River Boats on the approach of a Cyclone:"—

"A glance at the chart of the river will show us that the Calcutta Reach of it lies about N.N.E. and S.S.W., while Garden Reach runs to the W. by N.; the next Reach, to Akra, about S., and the next S.W. to Oolabariah. This must be borne in mind.

"A cyclone at Calcutta usually commences somewhere between N. and E., say N.E. If, as in 1842, the centre passes over the city, then the north-easterly gale continues to increase in strength till it is a hurricane, the barometer always falling, of course, till the wind abates quickly to a calm more or less perfect and suddenly, which calm may continue for half-an-hour to two or three hours; and then comes another tremendous burst of the hurricane from the south-westward, even more violent and terrific than before, lasting till the rearward portion of the cyclone has passed over; and it is in this second part of the cyclone that the mischief of them is mostly done. If, as in the cyclone of 1852, the centre passes up to the eastward of Calcutta, then the wind veers to the northward, and is heaviest from that quarter; and it ends at N.N.W. or W. If it passed up to the westward of Calcutta, of which we have no instance on record, then the wind, beginning about E. or E S.E., veers to S.E. and S., where it would be heaviest; and ends at S.W. The dangerous cyclones for us, then, are those of which the centre passes over or close to us, so as to bring a sudden shift.

"For, in the first part, where the centre passes over us, as the wind is generally to the eastward of N.N.E., the ships at the moorings are lying more or less under the lee of a weather shore, and no *great* sea gets up for those in the stream, though often a very disagreeable one. But in the second part the whole sea from the lower reaches rolls up, and adds greatly to the strain on the cables; the ships being also

less sheltered than before. In the cyclone of 1842, ships were blown from their anchors, and drifted and sunk as high as Cossipore; and in the mooring tiers the inner ships were on shore, and the others heaped up on the top of them. In a word, every man who has not seen a real tropical cyclone may be well assured that his imagination cannot picture to him half of its tremendous power of mischief, even in a river-port like this, where ships are apparently so safe from the effects of wind.

"And every sailor of the old school knows also that this power of mischief is increased by one-half when the wind's force exceeds a high figure (say nine on the Admiralty scale), and for all ships except men-of-war, by the infatuation of our ship and steamer owners in *under-anchoring* their vessels!—*i.e.*, giving to 1200-ton ships the anchors which an 800-ton vessel formerly carried; and so on. In steamers this has been carried to a preposterous extent—no doubt to ease them forward when driving through a sea. The steam being got up will, it is always supposed, ease the strain on the cable sufficiently. But this is often a dismal mistake, even with paddle-wheel steamers, as witness the stranding of the P. and O. C.'s steamer *Precursor* at Kedgeree in the cyclone of October, 1851, in spite of her steam; the disasters at Balaclava, where not a single captain appears to have thought of *backing* his sheet anchor! and at the Havana, a land-locked basin, where 80 vessels—steamers and sailing vessels—were driven on shore in the Cuba cyclone of 1844.

"We come now to the precautions to be taken in a river-port like Calcutta, and especially for the ships in the stream. Those at the moorings can do little else beyond looking to and doubling their bridles, and getting down as much top-hamper as they can—their topmasts even, if they can manage it, and this they may do by lending each other their scant crews; and if too late at first, doing it in the calm.

"Ships in the stream in Calcutta should first look to their hawse, which I regret to say is rarely kept clear. Then to getting down topgallant and even topmasts and lower yards, before the gale becomes too heavy.*

"The ground tackle has next to be thought of; and here we must bear in mind that in the first part of the cyclone the ship will probably be riding to her ebb anchor, and that if she drags that, even after veering away all she can, she has still to bring both anchors ahead with the longer scope on the northernmost anchor before she is adrift in that part of the gale; but the utmost care must be taken in the calm, and before the shift, to avoid her fouling her anchors, and then to be ready to veer away all the chain that can be afforded on the southernmost anchor, which, foul or clear, will now be the riding anchor till both, perhaps, are again brought ahead. I do not allude to the tides, as it is quite uncertain how they may be running, and indeed both tides are usually blown back at the surface by the force of the wind in the height of the cyclone, if it is against them.

"But in either half of the cyclone, the light anchors we have now-a-days may be insufficient to hold the ship; and as no sailor would, if he could help it, I suppose, go on shore with his sheet anchor at his bows, even in a river-port, I will assume that our ship or steamer has hers ready, with a good scope of chain to it, and the inner end properly clinched to the mainmast, so as to be ready for letting go under foot, or on parting.

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* Nothing so common in our cyclones in the Eastern Seas as for them to rise to such strength in a few hours, that even in men-of-war the top-gallant masts cannot be got down, nor can a man go aloft!

"But in weather such as I have described above, the sheet anchor alone, nor, if the chains have not ere this parted, the sheet and the two dragged bowers may be unable to hold the vessel, *unless the sheet anchor before it is let go is backed*, which should always be done by clinching, say twenty fathoms of hawser or chain to the crown of the sheet anchor and bending them to a kedge which should be ready for letting go from the cathead before the sheet is cut away from the chains. An anchor so reinforced will often hold when nothing else will, because the backer is not subject to the jerks of the lifts from the bight of the chain.

"When the sailor has done all he can with his ground tackle, if he finds himself still drifting, and above or below the shipping, he should cut away or be ready to cut away his masts; for both above and below the Calcutta Reach there are steep and dangerously hard banks; and grounding upon them in any weather is bad, and in a cyclone may prove fatal, especially to a loaded or an iron ship; and this should be borne in mind, because the soft muddy banks give a stranger to our river the idea that its shoals are also mud banks—than which, for the most of them, nothing can be more erroneous.

"*Postscript for Boats, or River Steamers and Flats.*—In cyclones, it may often become with steamers, boats, and small craft, of great importance to know that the shift or veerings of wind will take place in such or such a direction rather than in another; for by this knowledge they can often run at the commencement of a cyclone for an anchorage, at which they can lie sheltered through the whole of it; or they can, if anchored on a weather shore, profit by the lull to get over to the other, before the shift of wind comes on, which would convert their former shelter into a dangerous lee-shore. Let us, as an example, take the Hoogly or Canton River, both much frequented, and running about north and south towards their mouths, and suppose ourselves in them exposed to a cyclone crossing them from east to west, in a launch with treasure on board, or in a steamer. It is clear that for the first half of the tempest, if the wind is to the eastward of N., the centre will pass to the south of the boat, and as the wind will be N.E. and E., and S.E.-ly, the eastern shore or any bank sheltering from these quarters is safe; but that if obliged to anchor to the south of a bank or island, when the centre is passing exactly over the boat's position, the latter part of the cyclone may drive her on shore, or sink her at her anchors. The Storm Card also shows how, if the wind is to the W.-ward of N., it will veer to the W. and S.W., and thus perhaps render an apparently safe berth really dangerous, if due precaution be not taken.

"In a word, the Law of Storms will here, as in many other cases, *forewarn* the mariner of what is to come; and 'forewarned is forearmed.' The tales which we have all read of the wind's '*unfortunately shifting to the opposite quarter*,' when 'the boat (or ship) was driven on shore and all hands perished,' will be changed into—'During the lull (or when the wind had veered to ——) the boat (or ship), in due anticipation of the latter part of the cyclone, changed her berth to the —— shore, where she safely rode out the remainder of it without damage.' And let me add, that every officer and commander of whom this shall be said or written, will be held in that degree of professional esteem which is the rightful meed of such careful and scientific management of the lives and property entrusted to his charge, as contrasted with the fatalism, the fool-hardiness, or the helplessness of ignorance."

CHAPTER VII.

TIDES OF THE INDIAN OCEAN, CHINA SEA, AND WESTERN PACIFIC.

128. The progress of the Tide-wave in the Indian Ocean and China Sea is so broken and uncertain, that too much space would be occupied in following out the investigation; we proceed therefore to show the application of the Table, p. 193 to 205.

Rule.—To find the Time of High Water on a given day at any place where the time of High Water at Full and Change of the Moon is known:— Find the time of the moon's meridian passage at the place; and to this time apply the correction from the following Table according to the proper sign—entering the Table with the ☽'s Mer. Pass. in the side column and the ☽'s Semidiameter at the top; to the result add the time of High Water at Full and Change at the given place, taken from the following list of places; the sum will be the time of high water on the afternoon of the given day. Should, however, this sum exceed 12h. 24m., or 24h. 49m., subtract one or other of those times, as necessary, from it, and the remainder will be the *approximate* time of high water on the afternoon of the given day.

Corrections to be applied to the time of the Moon's meridian passage in finding the Time of High Water.

☽'s Mer. Pass.	☽'s Semidiameter.			☽'s Mer. Pass.	☽'s Mer. Pass.	☽'s Semidiameter.			☽'s Mer. Pass.
	14′ 30″	15′ 30″	16′ 30″			14′ 30″	15′ 30″	16′ 30″	
H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
0 0	−0 4	0 0	+0 5	12 0	6 0	−0 55	−1 2	−1 12	18 0
0 30	−0 10	−0 8	−0 5	12 30	6 30	−0 46	−0 51	−0 58	18 30
1 0	−0 17	−0 16	−0 15	13 0	7 0	−0 32	−0 34	−0 37	19 0
1 30	−0 24	−0 25	−0 25	13 30	7 30	−0 17	−0 16	−0 14	19 30
2 0	−0 31	−0 34	−0 36	14 0	8 0	−0 1	+0 3	+0 9	20 0
2 30	−0 38	−0 41	−0 46	14 30	8 30	+0 8	+0 15	+0 24	20 30
3 0	−0 44	−0 49	−0 55	15 0	9 0	+0 14	+0 21	+0 32	21 0
3 30	−0 50	−0 56	−1 4	15 30	9 30	+0 16	+0 24	+0 36	21 30
4 0	−0 55	−1 2	−1 12	16 0	10 0	+0 15	+0 23	+0 34	22 0
4 30	−0 58	−1 6	−1 16	16 30	10 30	+0 12	+0 19	+0 29	22 30
5 0	−1 0	−1 8	−1 19	17 0	11 0	+0 7	+0 14	+0 23	23 0
5 30	−0 59	−1 7	−1 18	17 30	11 30	+0 2	+0 7	+0 15	23 30
6 0	−0 56	−1 2	−1 12	18 0	12 0	−0 4	+0 0	+0 5	24 0

Ex.—Find the time of High Water at Port Philip Entrance, April 2nd, 1868.

	H. M.
☽'s Mer. Pass. at Greenwich . .	8 19
Cor. for Long. 145° E. . . .	−22
☽'s Mer. Pass. at Port Philip .	7 57
Cor. for Table above for 8h. and ☽'s Semid. 16′ 17″	+ 9
	8 6

	H. M.	
Brought forward . .	8 6	
H.W. at F. and C., p. 201	+1 30	
H.W. at Prt. Philip, Apr. 2nd	9 36	P.M.
	−24	
H.W. at Prt. Philip, Apr. 2nd	9 12	A.M.

The following table (p. 193) explains itself:—It gives the Time of High Water on Full and Change Days at the various places in the Indian Ocean, China Seas, Australia, Tasmania, and New Zealand; together with the Rise of the Tide at Springs and Neaps:—

TIDAL CHART of the INDIAN OCEAN

The lines show the progress of the Tide Wave hour by hour. — The figures must not be understood as showing the local time of High Water.

LONDON, James Imray & Son.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Abd-ul Kuri, Ind. Ocean	8 30	6	
Abú-shehr, Persian Gulf	7 30	7	
Acheen Head, Sumatra	8 45	8	
Adams Port (Mary Id.), Yellow Sea	2 0	10	
Adelaide Port, Australia, S. Coast	5 44	6	
Aden and adjacent Bays, Arabia, S.E. Coast*	7 30 to 9 30	7	4½
Adenara, Flores, Malay Archipelago		8	
Admiralty G., Australia, N.W. Coast	12 0		
Adolphus Island, Torres Strait	12 15	10	
Adou Atoll, Maldives	1 0	4	
Adou Matte Atoll, Maldives	3 0	4	
Adventure Port, New Zealand	12 20	8	6
Agoada Pnt., Hindostan, W. Coast	10 30	9	
Agulhas Cape, Africa, S. Coast	2 50	5	
Akaroa Harb., New Zealand	3 24	8	6
Akasi, Japan Sea	6 36	6½ ?	
Akyab, Aracan R., Bay of Bengal	9 45	9	6
Al Bidá, Persian Gulf	8 30 ?	6 ?	
Alabat Harbour, Luzon	10 0	9	
Albany Ids. (Port Albany), Australia, E. Coast	12 15	10	7
Albert River (Kangaroo Point), Australia, N. Coast	7 30	10–13	
Aldabra Ids., Mozambique	5 0	10	
Algoa B., Africa, S. Cst.	4 0	4–5	
Alligator Rvr., Australia, N. Coast	8 40	19–20	
Amboyna, Moluccas	0 33	7	
Amiranté Isles (St. Joseph Id.), Indian Ocean	5 0	8½	
Amoy (Inner Harbour), China, E. Coast	12 0	18½	14½
Ampanam B., Lombock	8 0	6	
Amsterdam, Indian O.	11 0	3	
Amulgawein, Persian G.	11 40	6	
Amur Strait, G. of Tartary	11 40	5–6	
Andaman Ids., Port Blair, Indian Ocean	10 0	9	6
——— Port Cornwallis	10 0	8¾	
Andaman Strait, Indian Ocean	10 24	9¼	
Andrava Bay, Madagascar	3 30	7	
Angoxa River, Africa, E.C.		13	
Angra Bank, Hindostan, W. Coast	10 30	9	
Antongil Bay (Port Choiseul), Madagascar	4 0	5	
Aor Pulo, Sumatra, N.E. Coast		5	
Aotea Harb., New Zealand	10 0	12	9½
Aracan R. (Bar), Bay of Bengal, E. Coast	9 45	9	6
Arnhem Bay, Australia, N.C.	8 0	6–8	
Arroa, Malacca Strait		10	
Arthur Port, Tasmania	7 52	4	
Asaph St., B., Australia, N. Coast	5 45	14	
Auckland Harbour, New Zealand, N. Island	7 5	11	9
Augustine St., B., Madagascar, W. Coast	4 30	13	
Avon Isles, Australia, E.C.	8 30	5	
Awasima (Inland Sea), Japan	0 14	7	
Awanui R., New Zealand	7 44	7	
Aylen Bay, Yellow Sea	2 30	6	4
Aymaun, Persian Gulf	11 20	6	
Bab-el-Mandeb, G. of Aden	12 0	7	
Bacuit B., China Sea, E.C.	10 0	6	
Badas Id., Linga Bay, Sumatra†	6 0 PM	12	
Badong B. (S. Cst.), Baly	11 0	9½	
Bahreïn, Persian Gulf	5 30	7	
Balabac Id., China Sea, E. Coast	11 0	5	
Balade Harb., New Caledonia	6 30	4 ?	
Balambangan Id., Borneo, N. Coast	10 0	6–8	
Balasore R., B. of Bengal, W. Coast	10 0	15	
Bancoot R. (entrance), Hindostan, W. Coast	2 0	12	
Banda, Moluccas	4 0	6 ?	
Bander Alúleh, G. of Aden	6 45	6	
——— Gorí, Gulf of Aden	8 45		
——— Sháab, Ind. Ocean	7 0	7	
——— Feïkam, Arabia, S.E. Coast	10 0	8½	

* From a Survey of Aden Anchorage by Commander Dayman, R.N., H.M.S. *Hornet*, 1863; but, according to the Surveyors of the Indian Navy, springs at Aden rise 8½ feet.

† From observations made in the month of September by W. Stanton, Master Commanding H.M. Surveying Brig *Saracen*.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Bantam, Java		5	
Barbe St., Sumatra, N.E. Coast	6 0	6	
Barren Id., China Sea, E. Coast	9 30	5¾	
Barren Ids., Madagascar	4 45	12	
Barton Port (Bubon Pnt.), China Sea, E.C.	10 55	6	
Básidúh, Persian Gulf	12 0	10	
Basil Bay, Korea, W.C.	4 15	18	10
Basrah (Bar), Persian Gulf	12 0		
——— Town	6 0?	9?	
Bassein R., Bay of Bengal	10 0	9	6
Batanes, Bashee Islands, China Sea, E. Coast		4	
Batavia, Java	10 0	2	
Batchian, Gilolo, Moluccas	1 0	6	
Bate (Gulf of Cutch), Hindostan, W. Coast	12 20	12	8
Batticalao River, Ceylon	5 0	2–3	
Bay of Islands (Motu Mea Islet), N. Zealand	7 15	9	6
Bazaruto Cape, Africa, E.C.	4 15	10	
Belligam Bay, Ceylon	2 20	2¼	
Bellona Reefs (Middle), Australia, E. Coast	8 30	6	
Bembatooka Bay, Madagascar, W. Coast	4 30	16	
Bencoolen, Sumatra	6 0	3–5	
Berbereh or Burburra (Gulf of Aden), Africa, E. Coast	7 15	9	
Bersiap Point, Banka Strait	6 30	12	
Beypoor R. (entrance), Hindostan, W. Coast	0 15	5	
Bias Bay (Tooniang Id.), China, E. Coast	8 0		
———(Tsangchow Id.) China, E. Coast	8 30		
Biddah R., B. of Bengal, W. Coast	10 0	14	12
Bima Bay, Sumbawa	Noon	6	
Binkang B., China Sea, W. Coast	11 30	5	
Bintula R., China Sea, E. Coast	5 45	6	
Bird Island, China Sea, E. Coast	9 30	6	
—— Ids., Africa, S. Cst.	4 0	4–5	
Blair Harb., China Sea, W. Coast	8 50	9	
Blanche Port, Streaky Bay, Australia, S. Cst.	1 0	5	
Bligh Sound, New Zealand	10 45	8	6
Bluff Harb., New Zealand	1 18	8	6
Bombay Dockyard, Hindostan, W. Coast	11 40	12–17	
Booby Island, Australia, N. Coast	4 30	8	
Botany Bay, Australia, E. Coast	8 15	7–8	
Boteler R., Madagascar	4 30	15?	
Bourbon Island, *see* Reunion Island.			
Bouro (Cajeli Bay) Moluccas	1 0	6	
Bowen Port, Australia, E. Coast	9 35	16	
Boyanna B., Madagascar, W. Coast	4 30	15	
Bramble Cay, Torres Strt.	9 15	12	
Brava, Africa, E. Coast	4 30	8	
Britannia Bay, Sumbawa	1 0	11–12	
British Sound, Madagascar, E. Coast	4 0	9½	
Broad Sound, Australia, E. Coast	11 0	20–30	
Broadway R. (entrance), China, E. Coast	11 0	7½	
Broken Bay, Australia, E. Coast	8 0	6–9	
Bruit River, Borneo	3 0	11	
Bruni R., China Sea, E. Coast	11 0	12	
Brunswick B., Australia, N.W. Coast	12 0	24	
Bubon Point, Port Barton, China Sea, E. Coast	10 55	6	
Buffalo R. (entrance), Africa, S. Coast	3 45	4½	
Bulsaur R., Hindostan, W. Coast	1 45	18	
Buluagan O'sta Ana Port, Filipinas	12 0	5½	
Burong I., China Sea	4 45	7	
Bushire, *see* Abú-shehr.			
Bussorah R. Bar, Persian Gulf	12 0		
Busuanga, Burias Island	12 30	6	
Byron Bay, Australia, E. Coast	9 45	6	
——— Cape, Australia, E. Coast	9 45	6	
Cajeli Bay, Bouro	1 0	6	
Calcutta, Bengal	2 30		
Caledonia Harbour, New Granada	11 40	1½	1
Calicut Roads, Hindostan, W. Coast	0 15	5	
Camaguin, Babuyan Ids.	6 0	6	
Cambing, Banda Sea	noon	6	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Camden Harb., Australia, N.W. Coast	12 0	37½	
Campbell Cape, New Zealand	6 0	8	6
Canton River (entrance), China	10 0	8	
Canton River, (Kuper Id.) In March	2 40	5½	
——— " In May & June	1 40	5½	
Careening Bay, Australia, N.W. Coast	11 45	30	
Carelmapu, Patagonia, W. Coast	0 50	10	
Cargados Garayos Shoals, Indian Ocean	2 0	4	
Carteret Port, New Ireland		6	
Castries B., G. of Tartary	10 30	6	
Casuarina Point, China Sea, E. Coast	9 30	6¾	
Cato Bank, Australia, E. Coast	8 0	6	
Cavalli Islands, New Zealand	8 0	7	
Cavern Island, China Sea, E. Coast	9 30	5½	
Centre Id. (Foveaux St.), New Zealand	12 15	8	6
Ceram, Wahaay Harbour, Moluccas	6 0	3	
Chalky Inlet, New Zealand	11 15	8	6
Champion Bay, Australia, W. Coast	9 10	1	
Changchi Id., China, E.C.	9 30	17	
Chapu Road, Hang-chu Bay, China, E. Coast	12 0	25	
Chauan Bay, China, E. Coast	11 0	6½	
Cheduba, Bay of Bengal	11 30	8	
Chee-fow, *see* Chifu.			
Chentabun River, China Sea, W. Coast	10 0	5½	
Cherbaniani Reef, Laccadives, Indian Ocean	10 0	7	4
Chesterfield Islet, Australia, E. Coast	8 30	5	
Chifu, Yellow Sea	10 34	8	6½
Chimmo Bay, China, E. Coast	10 20	16	
Chimney Id., Rees Pass, China, E. Coast	11 30	12	
Chinchu Harbour, China, E. Coast	12 25	17	
Chin-hae, Yung R., China, E. Coast	11 20	12½	
Ching-tau Bay, Yellow Sea	6 0	12	9
Chittagong (Bar), Bay of Bengal, E. Coast	1 15	15	10
Chodo Id., Korea, W.C.	6 20	12	
Choiseul Port, Madagascar, E. Coast	4 0	5	
Chosan Harbour or Tsau-liang-hai, Japan Sea	7 45	7	5
Christmas Island, Indian Ocean	10 0		
Christmas Harbour, Kerguelen Id.	2 0	2	
Chuen-pee Point, Canton River	2 0	7¾	
Chusan Archipelago (Vernon Channel), China, E. Coast	9 40	14	
Chusan Tinghae, China, E. Coast	11 0	12	9
Circular Head, Tasmania	11 40	9	
Cleveland Bay, Australia, E. Coast	7 30	10–12	
Cochin Harb. and Road, Hindostan, W. Coast	1 0	3½	
Cockburn Port, Africa, E. Coast	4 15	12	
——— Sound, Australia, W. Coast	9 0	1–1½	
Collier Bay, Australia, N.W. Coast	11 45	36	
Colombo, Ceylon	1 0	2	
Condore, Cochin China	3 0	4	
Congoon Bay, Persian G.	7 45	9½	
Conway Cape, Australia, E. Coast	11 0	18	
Cooper Port, New Zealand	3 50	7½	5½
Coringa or Cocanada Bay, Bay of Bengal, W. Coast	9 10	4–5	3
Coringa R. (Bar), Bay of Bengal, W. Coast	9 0	5	
Corner Inlet, S. Australia	11 40	8	
Crichton Harbour, Korea, S. Coast	9 50	11½	8¼
Crimon Ids., Java Sea	8 0	6	5
Croisilles Harbour, New Zealand	9 0	12	8
Crowdy Head, Australia, E. Coast	9 15	5	
Cumsingmun Harbour, Canton River, China	12 6	6½	
Cupchi Point, China, E.C.	8 0		
Curieuse, Seychelles, Indian Ocean	5 10	7	
Curtis Port, Australia, E. Coast	9 40	10–12	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps
	H. M.	ft.	ft.
Daggs Sound, New Zealand	11 30	8	6
Dalawan Bay, China Sea, E. Coast	11 0	5	
Dalrymple B., Madagascar, W. Coast	5 0	15	
——— Port, Tasmania	12 5	10	7½
Damaun Bar, Hindostan, W. Coast	1 30	17	
Dampier Strait, Moluccas		11	
Danno R., Hindostan, W. Coast	1 30	17	
Darnley Id., Torres Strait	9 30	12	
Darwin Port, Australia, N. Coast	5 30	17–24	
Dauphin Fort, Madagascar	4 30	7	
Deep Point, Durian Strait	5 0	10	
Delagoa Bay (Port Melville), Africa, S. Coast	4 30	15	
——— (Portuguese Factory), Africa, S. Coast	5 20	12	
———, Shefeen Id., Africa, S. Coast	4 40	12	
Delgado C., Africa, E.C.	4 0	16	11½
Delhi River, Sumatra	4 0	8	
Denham Sound, Sharks Bay, Australia, N.W. Coast	12 5	5	
Denial Bay, Australia, S. Coast	12 15	6	
Denison Port, Australia, E. Coast	9 30	6	
Dewghur Harbour, Hindostan, W. Coast	11 25	9	
Diamond Island, Bay of Bengal	10 30	8	
——— Point, Malacca Strait	12 0	9½	
Diego Garcia Island, Indian Ocean	1 30	6	
Diu Island, Hindostan, W. Coast	2 0	6	
Divy Pt., Bay of Bengal		5	
Dodandowe Bay, Ceylon	1 50	1½	
Douany, Comoro Ids.	4 0	11–12	
Dunbar, Hindostan, W. Coast	10 10	8	
Dunk Island, Australia, E. Coast	9 28	6–10	
Durnford Port, Africa, E. Coast	4 45	12	
Dusky Bay, New Zealand	11 15	10	8
Dyer Id., Africa, S. Cst.	2 50	5	
East Cape, New Zealand	8 55	7	
Eddystone Pt., Australia, E. Coast	9 39	7	
Elizabeth Bay, Africa, S.W. Coast		5–6	
Elliot Port, Australia, S. Coast		5–6	
Encounter Rock, Yellow Sea	10 44	11	8
Endeavour R., Australia, N. Coast	8 0	5–10	
——— Strait, Australia, N. Coast	1 0	9½	
Endermo Harbour, Japan	5 30	6	
English R., Delagoa Bay, Africa, S. Coast	7 30	5	
Enora Bay, Japan Sea		4	
Eran Bay (Palawan), China Sea, E. Coast	10 10	6¼	
Essington Port, Australia, N. Coast	3 24	13	
Eyre Port, Australia, S. Coast	10 30	6	
Fairy Port, Australia, S.C.		4	
False Point, Bay of Bengal, W. Coast	8 0	8	
Fansiak Channel, Canton R., China, E. Coast	1 0	7¼	5
Farewell, Cape, New Zealand	9 20	14	10
Fatsizio, Japan Sea	6 0	5	
Fitz-Roy Id., Australia, E. Coast	9 15	7–12	
Flesh Bay, or Bay St. Bras, Africa, S. Coast	3 30?	6?	
Flinders Group, Australia, E. Coast	9 15	8–12	
Fog Ids., Hang-chu B., China, E. Coast	11 45	17	
Fongwhang Group (Bullock Harbour), China, W. Coast	8 30	17	
Formosa Mt., Malacca Strait	8 0	11	8½
Fowlers B., Australia, S. Coast	10 30	6	
France, Port de, New Caledonia	8 25	4	
Frederick Reef, Australia, E. Coast	8 0	6	
Freycinet Estuary	4 15	3¼	
——— Reach, Sharks Bay, Australia, N.W. Coast	3 0	5	
Galang Bay, Hainan Id., China Sea		4–5	
Galle, Pointe de, Ceylon, S. Coast	2 0	2	
Gambier Ids., Australia, S. Coast	1 50	3	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Geby, Fohou Id., Gilolo Passage, Moluccas .		5	
Geelong Harbour, Australia, S. Coast . .	2 50	2½	
George St., Basin, Australia, N.W. Coast .	12 15	25	
Georges Bay, Tasmania .	9 42	3	2
Ghubbet Ne, Socotra, Indian Ocean . . .	7 0	7	
——— Hashísh, Arabia, S.E. Coast	10 0	10	
Gizree Bunder, Indus, Hindostan, W. Coast	9 50	7	
Glennie Ids., Bass Strait	12 20		
Goa, Hindostan, W. Cst.	11 30	6	
Gollonsir Socotra, Indian Ocean	7 20	8	
Good Hope, Cape of, China, E. Coast . .	9 0		
Goold Island, Australia, E. Coast	6 45	6	
Gooriya Creek (entrance), Hindostan, W. Coast	11 0	9	
Gore Port, New Zealand	9 0	8	6
Goulburn Ids., Australia, N. Coast	6 0		
Grand Port, Mauritius .	1 0	1½	
Great Barrier Id., (Nagle Cove), New Zealand .	6 25	10	7
——— Reef, Australia, E. Coast . .	8 48	7	
Grey Port, Swan River, Australia, W. Coast .	9 0	1–1½	
Guardafui Cape, Africa, E. Coast	6 15	6	
Gundavee R. (entrance), Hindostan, W. Coast	2 0	19	
Gutzlaff Id., China, E.C.	11 30	15	
Haimun Bay, China, E. Coast	9 0		
Haiyun-tau (Thornton Haven), Yellow Sea .	9 30	12	8
Hakodadi Harbour, Yezo Island, Japan . . .	5 0	3	
Hamilton Port (Korea), Yellow Sea	8 30	11	
Hammelin Pool, Sharks Bay, Australia, N.W. Coast	5 0	3½	
Hang-chu Bay (Sesham Ids.), China, E. Coast	11 45	14	
——— (Fog Ids.) .	11 45	17	
——— (Chapoo Rd.)	12 0	25	
——— off Can-pu .		32	
Hardy Port, New Zealand	9 55	8	6
Hastings Harbour, Bay of Bengal, E. Coast . .	10 40	13½	
Hawke B., New Zealand	7 50	3	
Heawandou Pholo Atoll, Maldives	9 30	5	
Heda Bay, Japan Sea .		5½	
Heron Islet, Capricorn Group, Australia, E. Coast	9 0	10	
Hie-chechin Bay, China, E. Coast	7 0		
Hicks Bay, New Zealand	9 0	7	
Hillsborough Island (New Port), Bonin Islands .	11 32	3½	
Hobarton, Tasmania . .	8 15	4½	3½
Hoe-e-tow Bay, China, E. Coast	12 15	16	
Hokianga R. (entrance), New Zealand . . .	9 45	10	
——— (Kokohu), New Zealand . . .	10 15	10	7
Hon-cohe Bay, China Sea, W. Coast	11 30	5	
Honghai B., China, E. Coast	10 0	6½	
Hongkong, China, E. Cst.	10 15	4¾	
Hoogly R. (W. entrance), Bay of Bengal, W. Cst.	10 0	10¾	
Hooper Island, Korea, S. Coast	9 10	11½	8¼
Hope Sound (Mia-u-tau Group), Yellow Sea .	10 24	6¼	
Hout B., Africa, W. Cst.	2 20	5	
Houtman Rocks, Australia, N.W. Coast .	11 30	2½	
Howe, West Cape, Australia, S. Coast . .	9 0	6	
Hu-i-tau Bay, China, E. Coast	12 15	16	
Hukkar R. (entrance), Hindostan, W. Coast	10 30	11	
Hulu Shan B., Yellow Sea	2 30	8	6
Hunter Id., Bass Strait .	11 30	8	
——— Port, Australia, E. Coast	9 45	6–7	
Iki, Japan Sea . . .		8	
Iliolo Port, Filipinas . .	12 0	5½	
Indus (Gizree Bunder), Hindostan, W. Coast	9 50	7	
Inhambane R., Africa, E. Coast	4 15	10	
Investigator Road, Australia, N. Coast . .	8 0	9	
Isolette Cape, Arabia, S.E. Coast	9 0	10	
Jacinto, Port San, Ticao Id., Filipinas . . .	6 30	6	
Jackson Port (N. Head), Australia	8 15		

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Jaffrabat, Hindostan, W. Coast	11 35	9	7½
Jashk Shoal, Persian Gulf	9 30	8	
Jask Cape, Persian Gulf	6 0	6	
Jervis Bay, Australia, E. Coast	6 20	6–9	
Jezírat Arabí, Persian G.	6 30?		
——— Hamar-al-nafur, Arabia, S.E. Coast	9 30	10	
——— Ján, Persian Gulf	11 30	10	
——— Kabr ,,		8½	
——— Kais ,,	0 45	7½	
——— Kharg, or Káreg, Persian Gulf	8 0	6½	
——— Larek, Persian G.	10 15		
——— Tumb, ,,		8	
Jiddah, Red Sea		3	
Johanna Id. (anchorage)	3 40	11	
——— Pomony Harb., Comoro Ids.	4 0	11	9
John St., River, Africa, S. Coast	4 0	5	
Jonquiere Bay, Gulf of Tartary	10 0	6	
Jooria, Hindostan, W.C.	2 0	16	12½
Juan de Nova, Madagascar		5	
Junk Fleet entrance, Canton River, China	11 50	6½	
Junkseylon Id. (E. side), Malacca Strait	10 0	11½	
Kaikora Penin., New Zealand	5 30	8	6
Kaipara Harb. (entrance), New Zealand	10 55	10	8
Kalian Point, Banka Strait	8 17*	12½	
Kapiti Island, N. Zealand	9 0	6	
Karachi Harb. (entrance), Hindostan, W. Coast	10 30	9½	6
Kata, Japan Sea	6 4	6½	
Kawau Id., New Zealand	6 30	10	
Kawhia Harb., New Zealand	9 30	12	
Kedewarry, Hindostan	9 57	9	
Keelacarry, Ceylon	11 0		
Kedgeree, Bay of Bengal	11 30		
Keeling Islands (Port Refuge), Ind. Ocean	5 30	5	
Kelung Harb. (Formosa), China Sea, E. Coast	10 30	3	
Kenn Reef, Australia, E. Coast	8 0	5½	
Kent Island, Bass Strait	11 10		
Keppel Bay, Australia, E. Coast	9 30	9–14	
Kerguelen Island, Indian Ocean	2 0	2	
Kesm, or Kishm, Persian Gulf	11 0	12	
Khór Jerámeh, Arabia, S.E. Coast	9 30	10	
Kijouk Phyou Harbour, Bay of Bengal	10 0	9	6
Kinsiang Point, China, E. Coast	7 0		
Kirindi, Ceylon	3 30		
Kiswara Harb., Africa, E. Coast	4 30	12	
Kitnapatnam, Bay of Bengal, W. Coast	11 0	1¼	
Koepang, Timor	11 0	9	6½
Kokohu, New Zealand	10 15	10	7
Ko-kun-to Group, Korea. W. Coast	2 25	18	10
Kok-si-kon Prt. (Formosa) China Sea, E. Coast	11 30	3	
Koombanah B., Australia, W. Coast	9 0	½–3	
Koree R. (Monda Point), Hindoostan, W. Coast	11 40	11	
Koweït, Persian Gulf	0 15	9	
Krakatoa, Strait of Sunda	7 0	4	
Kuper Harbour, Korea, S. Coast	9 28	11½	8¼
Kuriyán Muriyán Bay and Islands, Arabia, S.E. Coast	8 20	6½	
Kurrachee, *see* Karachi.			
Kweshan Ids., China, E. Coast	9 30	14	
Labuan Id., China Sea, E. Coast	9 45	6	
Lady Bay, Australia, S. Coast		4	
Lady Elliot Islet, Australia, E. Coast	9 0	7–8	
Laguimanoc Port, Luzon	1 30	5½	
Lamo Harbour, Africa, E. Coast	4 6	11	
Langshan Crossing, Yang-tse-Kiang†	1 40	12	8
Lankeet Island, Canton River, China	11 20	6½	
Lansew Bay, China, E.C.	10 0	13	
Latham Id., Africa, E. Cst.	4 0	10	
Lau-mu-ho, Yellow Sea	1 30	5	

* In N.W. Monsoon.

† At the Langshang Crossing the tide rises for 3 hours only, and falls for 9 hours.—H.M.S. *Actæon*, 1861.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Leven Port, Madagascar	3 30	7½	
Liant Cape (G. of Siam), China Sea, W. Coast	5 7	6½	
Liau Ho (Bar), Yellow Sea	4 0	11½	7½
——— (entrance)	5 0	12	
Liau-tung, Chingho, Yellow Sea	1 20	6½	
——— Gulf (Sand Point), Yellow Sea	4 50	7	5¾
——— N.W. Head of Gulf	5 30	10	8¾
Lindy River (entrance), Africa, E. Coast	4 15	12	
Língeh, Persian Gulf	12 0?		
Lintin Island, Canton R., China, E. Coast	12 0	7½	
Lishan Bay, China, E.C.	10 15	16	
Litau Bay, Yellow Sea	3 0	6	4
Lizard Id., Australia, E. Coast	9 15	7–10	
Lloyd Port, Bonin Ids.	6 8	3	
Lobah Point, Banka Strt.*	11 0*	10	
Loheia, Red Sea	1 30	3	
Lombock (Ampanam B.), Java Sea	8 0	6	
Lord Howe Island, S. Pacific	8 30	6	
Lo-shan-kau, Yellow Sea	4 30	11	9
Louis Port, Mauritius	12 30	3	2¼
Luabo River (entrance), Africa, E. Coast		22	
Lucipara Pass, Banka Strait	irr.	10	7½
Lung-mun Harbour, Yellow Sea	10 0	7	
Macao, China, E. Coast	10 0	6½	
Macassar, Celebes	4 40	5½	
McDougall Harb., Africa, S.W. Coast	2 30	5¾	
Macowa, Red Sea	0 30	2	
Macquarie Harbour, Tasmania	7 30	3	
——— Port, Australia, E. Coast	8 56	4–5	
Madame Island, Madagascar	4 0	5	
Madras Road, Coromandel Coast	7 34	3½	
Magadoxa, Africa, E. Cst.	4 30	8	
Mahato Id., Africa, E. Coast	4 30	7	
Majambo B., Madagascar	4 30	16	
Makátein, Arabia, S.E. Coast	9 0	6	
Makalleh, Arabia, S.E. Coast	8 30	7	
Makumba R., Madagascar	4 45	17	
Makung Harbour, Pescadores, China Sea	10 30	9½	7
Malacca Strait (light vessel one fathom bank)	6 0	15	12
——— (off Mount Formosa)	8 0	11	8½
——— Road, Malacca Strait	7 30	11	8½
Malcolm Atoll, Maldives	10 30	3	
Malè, Maldives	12 30	3	
Malludu Bay, Borneo	10 30	6–8	
Mana Island, New Zealand	7 0	8	6
Manama, Persian Gulf	5 20	7	
Manawatu River, New Zealand	10 0	8	6
Mandavee Roads, Hindostan, W. Coast	11 50	15	11
Manila (Luzon Island), China Sea, E. Coast	10 40	2½	
Manning River, Australia, E. Coast	9 15	4	
Manora P., Karachi, Hindostan, W. Coast	10 30	9½	6
Manorah R., Hindostan, W. Coast	1 30	16	
Manukau Harbour (entrance), New Zealand	9 30	13	10
Maria Van Diemen Cape, New Zealand	8 0	7	
Marka, or Muerka, Africa, E. Coast	4 30	8	
Maroni Bay, Comoro Ids.	4 53	10	
Martaban, Bay of Bengal	2 20	21	
Mary, St., Harb., Madagascar, E. Coast	4 0	5	
Mascat, Persian Gulf	11 15	6	
Mason B., New Zealand	11 10	8	6
Massacre Bay (Tasman corner), New Zealand	8 45	13	9
——— Motu Pipi River, New Zealand	9 50	14	10
Massowah, Red Sea	1 0	3	
Maule River, Chile	10 0		
Maulmain, Bay of Bengal	2 0	22	17
Mauritius (Port Louis)	12 30	3	2¼
——— (Grand Port)	1 0	1½	
Mayday Bay, Palawan	9 55	3½	
Mayhé Id., Indian Ocean	4 0	6½	
Mayotta Id., Mozambique	4 10	1¾	
Mazambo Port, Madagascar	4 30	15	

* In S.E. Monsoon.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Meichen Sound, China, E. Coast	12 30	17	
Melbourne, Australia, S. Coast	1 20	3	
Melinda P., Africa, E.C.	4 15	11	
Mellish Reef (Sand Cay), Australia, E. Coast	7 55	5–6	
Menam River (Paknam), China Sea, W. Coast	5 7	9½	
Mensular Id., S.E. end, Sumatra	6 0	4	
Merbát, Arabia, S.E. Cst.	9 0	6¾	
Mercury Bay, New Zealand	7 21	7	5
Mergui, Bay of Bengal, E. Coast	10 30	18	
Merjee R., Hindostan, W. Coast	11 0	7	
Miau-tau (Depôt Bay), Yellow Sea	10 35	6	
Michael Seymour Port, Gulf of Tartary	5 30	3	
Milford Sound, New Zealand, Mid. Island	9 15	8	6
Millman Island, Palawan, W. Coast	10 27	2¾	
Min R. (Temple Point), China, E. Coast	10 45	19	14½
——— (Losing Island), China, E. Coast	12 0		
Mindanao, Filipinas	7 0	6	
Minow Islands, Madagascar, W. Coast	5 0	15	
Mirs Bay (Tide Cove), China, E. Coast	10 0	6½	
Mocha Road, Red Sea, E. Coast	12 0	4¼	
Molyneux Bay, N. Zeald.	3 0	8	6
Mombaza Port, Africa, E. Coast	4 0	11	
Monganui Harbour, New Zealand	8 15	9	7
Moreton Bay, Australia, E. Coast	9 30	3–7	
Mossel B., Africa, S. Cst.	3 30	6	
Mourondava, Madagascar, W. Coast	4 45	12	
Mozambique Har., Africa, E. Coast	4 15	12	
Mungalaum Id., China Sea, E. Coast	11 0	5	
Mungullo or Mongallo R., Africa, E. Coast	4 45	12	
Murdounah Id. (E. Cst.), Red Sea	6 0	3	
Murray Islands, Torres Strait	9 30	10	
Murray Pass, Bass Strait	11 10	8	
Musa Port, Babuyan Ids.		5	
Mutlah River (entrance to Biddah River), Bay of Bengal, W. Coast	10 0	14	
——— (Muda Kali), Bay of Bengal, W. Coast	11 45	15	
Naafe R., Bay of Bengal, E. Coast	10 0		
Nafa-Kiang, Loo Choo Islands	6 23	7	
Nagasaki Bay, Japan Sea	7 15	9	7½
Nagore, Bay of Bengal, W. Coast	8 15		
Namki Ids., China, E. Cst.	8 30	17	
Namoa Island (Clipper Road), China, E. Cst.	11 15	7	
Namquan Harb., China, E. Coast	10 0	17	
Nancowry Harb., Nicobar Islands	9 15	8½	
Nangamessie Harbour, Sumba	11 30	17	13½
Nangka Id., Banka Strait		12	
Nansaree River (Bar), Hindostan, W. Coast	3 0	18	
Napoleon Road, Gulf of Tartary	2 30	2½	
Narrinda Bay, Madagascar, W. Coast	4 30	15	
Naruto (Fukura), Japan Sea	6 17	7	
Natal Port, Africa, S. Cst.	4 30	6	
Naturaliste Channel, Sharks Bay, Australia, N.W. Coast	11 45	6	
Negapatam, B. of Bengal	5 0	3	
Newcastle, Australia, E. Coast	9 45	6–7	
Nhatrang Bay, China, W. Coast	8 30	5½	
Nicholson Port (Lambton Harbour), New Zealand	4 30	5	3
Nicobar Id. (Nancowry Harb.), Indian Ocean	9 15	8½	
Nimrod Sound, China, E. Coast	10 30	20	
Ninepin Group, China, E. Coast	10 0	5	
Ning-hai, Yellow Sea	12 0	6	
Nin-po-fu, Yung River, China, E. Coast	1 0	9	
North Sands, Malacca Strait	5 30	15	12
Noss Island, Madagascar	5 0	15	
Numa-choa, Comoro Ids.	3 0	14	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Nysna Harbour, Africa, S. Coast	3 45	5	
Observatory Id., China Sea, E. Coast	11 0	5¼	
Oelar Cape, Banka Strait	6 30	12	
Oho Sima, Loo Choo Ids.	7 30	5½	
Oibo Harb., Africa, E.C.	4 15	6	
Omaider Island (Gulf of Akabah), Red Sea	6 0	4	
Omersary R., Hindostan, W. Coast	1 45	18	
'Om-rasas-Masírah, Arabia, S.E. Coast	10 0	10	
One Fathom Bank Light, Malacca Strait	6 0	15	12
Ooloogan Bay, China Sea, E. Coast	9 30	5½	
Oonting Port, Loo Choo Islands	6 35	8	
Oösima, Japan Sea	6 50	5	
Osaki, ,,	5 55	6½	
Osprey Reef, Australia, E. Coast	8 36	6	
Otago Har., New Zealand	2 50	7	5
Palliser Cape, ,,	6 0	6	
Palmedo Road, Sumba. Id.		15	
Palmeira Point, Ceylon	9 30	7–11	
Paloan Bay, Mindoro		5	
Pamarung Ids., Borneo, E. Coast		8–10	
Pampang Bay, Java		7–8	
Pancol, China Sea, E.C.	9 40	6	
Parenga-renga Harbour, New Zealand	7 54	7	
Passage Id., Banda Sea	noon	6	
Passandava Bay, Madagascar, W. Coast	5 0	15	
Paterson's Inlet, New Zealand	1 10	5	6
Patta B., Africa, E. Cst.	4 30	10	
Paul, St., Island, Indian Ocean	11 0	3	
Paumben Pass, Bay of Bengal, W. Coast	1 30	2	
Pegasus Port, N. Zealand	11 50	8	6
Peh-tang-ho, Yellow Sea	3 33	10	7½
Pei-ho or Peking River (entrance), Yellow Sea*	3 40	10	7½
——— (Tien-tsin)	7 0	4½	
Pelican Lagoon, Kangaroo Id., Australia	5 0	6	
Pelorus Sound, New Zealand	9 35	11	7
Pemba Channel, Mozambique	4 0	11	
Pemba Id., Mozambique	4 15	12	
Penang, Malacca Strait	12 0	9	7½
Percy Isles, Middle or No. 1 Island	10 30	16	13
——— South or No. 2 Islet, Australia, E. Coast	10 30	14	
Perim Id., Gulf of Aden	12 0	7	
Peros Banhos, Indian Ocean	1 30	5	
Perouse, La, Strait, Japan Sea	10 30	6	
Perron Cape, Sharks Bay, Australia, N.W. Coast	12 45	5½	
Pescadore Ids. (Makung Harbour), China Sea	10 30	9½	7
Petrel Bay, St. Francis Isle, Australia, S. Cst.	12 0	6	
Pheasant Point, Wusung River, China, E. Cst.	0 35	13	8
Philip Port, Capel Bay, Australia, S. Coast	2 30	3–4	
——— (entrance), Australia, S. Coast	1 30	3–4	
———, Queenscliff	1 30	3	
Philip B., Hobson Bay, Australia, S. Coast	3 0	3–4	
Pidioe Bay, Lombock		10–12	
Pierre Island, China Sea, E. Coast		4	
Pigeon Bay, Yellow Sea	11 45	8	
Pihkishan Ids., China, E. Coast	8 30	17	
Pillar Cape, Tasmania	1 0	6	
Pimlea Harbour, Africa, E. Coast	4 30	12	
Pio Quinto Port, Babuyan Islands	6 0	6	
Pitty, Hindostan, W.C.	10 5	9	
Plettenberg Bay, Africa, S. Coast	3 10	6	
Plymouth, New, New Zealand	9 30	12	9
Pomba B., Africa, E. Cst.	4 0	15	11
Pootoo Island, China, E. Coast	8 15	12	
Portland Bay, Australia, S. Coast	Midnight	4	
Possession Cape, Torres Strait	9 0	6	
——— Id., Torres Strait	1 0	9½	
Post-Office Id., Torres Strait	1 0	9½	
Poverty Bay, N. Zealand	6 5	6	

* Time and rise much affected by winds.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Pratas Shoal, China Sea .	4 0	5	
Preservation Inlet, New Zealand	11 20	8	6
Prince Frederick Harbour, Australia, N.W. Coast	12 0	28	
Princess Royal Harbour, Australia, S. Coast .	11 56	1–4	
Pulicat Shoals, Coromandel Coast	9 25	$2\frac{3}{4}$	
Pulo Aor, Sumatra, N.E. Coast		5	
—— Condore, China Sea, W. Coast*	2 30	$6\frac{1}{2}$	
—— Leat, Gaspar Strait	2 30	4	
—— Mendanao, „ .	2 30	4	
—— Panjang, G. of Siam	7 0	2	
—— Timoan (W. side), China Sea, W. Coast	6 0	$7\frac{1}{2}$	
Queda, Malacca Strait .	12 0	$5\frac{1}{2}$	
Queen Charlotte Sound (entrance), New Zealand	8 50	8	6
Quilimane R. (entrance), Africa, E. Coast . .	4 15	16	
Quiloa, Africa, E. Coast .	4 45	12	
Rachada Cape, Malacca Strait	5 30	13	
Radama Port, Madagascar, W. Coast . . .	4 40	13	
Ragged Id., Sumbawa, Java Sea	8 10	3	
——— Point, Borneo, E. Coast		7	
Raine Id., Torres Strait .	8 10	10	
Rajahpoor Harbour, Hindostan, W. Coast . .	11 0	12	
Rajang River, Borneo .	4 45	13	9
Ramree Road, Bay of Bengal, E. Coast . .	10 0	12	
Rangoon, Bay of Bengal, E. Coast	5 30	21	14
——— R. (entrance), Bay of Bengal, E. Cst.	3 15	21	14
Rás Hafún, Africa, E. Coast	6 15	4	
Rás Mahommed (Gulf of Akabah), Red Sea .	6 0	5	
Rás Sharmah, Arabia, S.E. Coast	9 0	8	
Rás-al-Kheimeh, Persian Gulf	11 45	7	
Rás-al-Asídah } Arabia	8 30	$5\frac{1}{2}$	
Rás Shébali } S.E.	10 0	10	
Rás-al-Hed } Coast	9 30	9	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Raujpoor (G. of Cambay), Hindostan, W. Coast	2 15	18	13
Red Bay, Ceylon, S. Coast	2 20	$2\frac{1}{4}$	
Red Island, Durian Strait	5 0	$10\frac{1}{2}$	
Refuge Cove, Bass Strait	12 5		
Rendezvous Id., Borneo, S.W. Coast . . .		8	
Resolution B., Marquesas	2 30	4	
Reunion Id., (St. Pierre)	noon	$3\frac{1}{2}$	
Reunion Id., (St. Denis)	0 22	$2\frac{1}{2}$	
Reunion Id., (St. Gilles)	1 0	$2\frac{1}{2}$	
Indian O. (St. Paul)	1 7	4	
Rhio, Rhio Strait . . .	10 0	7	5
Richmond R., Australia, E. Coast	9 20		
Rivoli B., Australia, S.C.	10 0	4	
Rocky Id., Gulf of Siam	4 0	4	
Rodrigue Id., Ind. Ocean	1 45	6	
Romania Point (Malay Penin.), China Sea, W. Coast	10 30		
Rovama River, Africa, E. Coast	4 0	16	$11\frac{1}{2}$
Royalist Port, Palawan, E. Coast	11 0?	$6\frac{1}{2}$?	
Ruapuke Id. (Foveaux Strait), New Zealand	1 0	8	6
Sabon Id., Durian Strait		10	
Saddle Id., East, China, E. Coast	11 0	14	
Sado (Yebisu), Japan Sea	5 0	2	
Saïgon (C. St. James) .	11 0	8	
——— (Saïgon City), Cochin China	5 30	$9\frac{1}{2}$	
Sale Macowa, Red Sea .	0 30	2	
Sambilangs, Malacca Str.		12	$10\frac{1}{2}$
Sand Point, G. of Liautung, Yellow Sea . .	4 50	7	$5\frac{3}{4}$
Sandy Cape, Australia, E. Coast	7 50	6–8	
——— Id., Madagas. W.C.	5 0	15	
Sang-tau Bay, Yellow Sea	0 55	7	$4\frac{1}{2}$
Sanguir Island, Moluccas		6	
Sanmoon Bay (St. George Island), China, E. Cst.	10 20	15	
San-shui, Si Kiang, China, E. Coast		5–6	
Saparooa Id., Moluccas .		6	
Sapie Bay, Sumbawa . .	1 0	10	
Sarawak R. (Moratabas entrance)	4 0	9	$5\frac{1}{2}$
——— Santubong (entr.)	4 0	10	6
——— Sarawak Junction	5 0	15–18	9
——— City Borneo, W. Coast. . .	5 20	15–18	9

* From a French survey, 1862.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Sau-o Bay, Formosa . .	10 0	3½	
Saugor Id., B. of Bengal		12	
Saumarez Reef, Australia, E. Coast	8 0	6	
Sedashigur Bay,* Hindostan, W. Coast.			
Sedili R., China Sea, W. Coast	9 44	7	
Sesham Islands, Hang-chu Bay, China, E. Coast	11 45	14	
Seychelle Archip. (Mayhé Id.), Indian Ocean .	4 0	6½	
Seypan Id., Ladrone Ids.	6 45	2½	
Sha-lui-tien Banks (W. part), Yellow Sea . .	2 50	10	
Sháb Kadún, Arabia, S.E. Coast	9 20	10	
Sháb'bu-saifeh, Arabia, S.E. Coast	9 45	10	
Shanghai, Yang-tse-Kiang, China, E. Cst.	0 40	10	
Shao-king, Si Kiang, China, E. Coast . .		3	
Sharja, Persian Gulf . .	1 0	6	
Sharks Bay, Naturaliste Channel, Australia, N.W. Coast . . .	11 45	6	
——— Denham Sound	12 5	5	
——— Freycinet Reach	3 0	5	
——— Freycinet Estuary	4 15	3¼	
———Cape Perron	12 45	5½	
———HamelinPool	5 0	3½	
Shefeen Island, Africa, S. Coast	4 40	12	
Shihtau Bay, Yellow Sea	1 30	9	7
Shoal Bay, Australia, N.C.	6 0	18–25	14–20
———, E. Coast . .	8 30		
Shoal Water B., Australia, E. Coast	10 30	12–18	
Si Kiang or West River, China, E. Coast:			
,, (San-shui) .			5–6
,, (Shao-king) .			3
,, (Wuchan) .			1–1½
Siak River, Malacca Strt.	9 0	12	
———, off the town .		11	
Sidmouth Cape, Australia, E. Coast	9 15	10	
Sillebar R. (Bar), Sumatra	6 0	4¼	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Simidsu, Japan Sea . .	7 30	7	
Simoda Port, ,, . .	5 0	3–5	
Simonoseki, ,, . .	8 30	8	6
Simon's Bay, Africa . .	2 44	5¼	3¾
Singapore, New Harbour, Malacca Strait . .	9 45	10	7½
Sir C. Hardy Ids., Torres Strait, E. Coast . .	9 15	10	
Sir E. Pellew Islands, Australia, N. Coast .	7 30	4–7	
Smoky Bay, Australia, S. Coast	12 15	6	
Society Bay (SulivanBay), Yellow Sea . . .	0 15	8	
Socotra Id., Indian Ocean	7 20	8	
Sofala R., Africa, E. Cst.	4 0	19	
South-West Bay, New Providence	7 30	4	
——— Cape, New Zealand	12 0	7	5
Spenser Gulf (Thorny Passage), Australia, S. Coast	12 0	6–8	
——— Point Lowly .	7 0	6–8	
——— Port Augusta†	8 30	9–12	
——— Point Riley .	5 45	4¾	
——— Wallaroo . .	irr.	4–5	
Spider Id., China, E. Cst.	10 0	17	
Staunton Id., Yellow Sea	1 30	8	5½
Stephen Port, Australia, E. Coast	9 0	6	
Streaky Bay (Blancheport), Australia, S.C.	1 0	5	
Suadiva Atoll, Maldives .	1 0	4	
Sual Port, Luzon . . .		6	
Suez Bay (head of Gulf), Red Sea	2 0	6	
Sughrá, Arabia, S.E. Cst.	8 0	6	
Surat, Hindostan, W.C.	4 0	19	
Swain Reefs, Australia, E. Coast	10 25	10	
Swan Island, Bass Strait	9 35	6	
———River, Port Grey, Australia, W. Coast .	9 0	1–1½	
Swift Bay, Australia, N. Coast	12 0	21	
Sydney, Australia, E. Cst.	8 38	4¾	4
Ta-tsing ho, Yellow Sea .	4 10	10½	8
Table Bay, Africa, W. Cst.	2 40	5	
Tahrí, Persian Gulf . .	5 0?		
Tai-cho ho, Yellow Sea .	0 15	6	
Taichow Ids., China, E.C.	9 0	14	

* Spring tides rise A.M. 6 feet, P.M. 7½ feet, from October to March; and the contrary during the rest of the year.

† At Port Augusta, when the wind veers round to W. and S., and blows strong, the rise has been as much as 16 feet.—Commander John Hutchison, R.N., Admiralty Survey, South Australia, 1862.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Tai-Tai Bay, China Sea, E. Coast	9 30	$5\frac{3}{4}$	
Tailung Channel, Canton River, China	1 30	$6\frac{1}{2}$	
Ta-lien-whan Bay, Yellow Sea	10 47	$10\frac{3}{4}$	8
Tama no Ura Harbour, Goto Id., Japan Sea		6–8	4–6
Tam-Sui Harbour, China Sea, E. Coast	11 45	7–12	
Tamar R., George Town, Tasmania	12 5	10	$7\frac{1}{2}$
———, Launceston, Tasmania	1 0	$12\frac{1}{2}$	
Tamatave, Madagascar, E. Coast	4 18	8	
Tanabé, Ki Channel, Japan Sea	6 0	6	$5\frac{1}{4}$
Tangtang Harbour, Madagascar, E. Coast	4 30	6	
Tanjong Api, China Sea		7	
——— Bolus, Malacca Strait	9 30	$10\frac{1}{2}$	$8\frac{1}{2}$
Tanna, New Hebrides	5 35	3	
Tappanooly Harbour, Sumatra	6 10	6	
Taranaki, or New Plymouth, New Zealand	9 30	12	9
Tatiyama Bay, Japan Sea	5 50	5	
Tauranga Harbour, New Zealand	7 10	6	$4\frac{1}{2}$
Tavoy R. (entrance), Bay of Bengal, E. Coast	10 30	20	
Tay-bay-oo-bay, China Sea, E. Coast	10 15	6	
Tebonkos Road, Baly. N. Coast	5 0	$6\frac{1}{2}$	
Thirsty Sound, Australia, E. Coast	10 45	12–18	
Thompson Sound, New Zealand	11 30	8	6
Thorny Passage, Spencer Gulf, Australia, S.Cst.	12 0	6–8	
Three Hummock Island (E. side), Bass Strait	10 30	10	
Three Kings' Islands, New Zealand	8 0	7	
Ticao Island (Port San Jacinto), Filipinas	6 30	6	
Tien-pak Harb., China, E. Coast	12 0	$8\frac{1}{2}$	
Tinghae, Chusan, China, E. Coast	11 0	12	9
Toboe Ali Point, Banka Strait	8 30PM* / 10 0AM†	12	

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Tomo (Seto-uchi), Japan Sea	11 6?		5
Tongsang Harb., China, E. Coast	11 30	12	
Tooniang Id., Bias Bay, China, E. Coast	8 0		
Towan Id., China, E. Cst.	9 20	13	
Tracy Island, Korea, S. Coast	8 58	$11\frac{1}{2}$	$8\frac{1}{4}$
Trincomalie Har., Ceylon, S. Coast	8 18	2	$1\frac{1}{2}$
Tringano R., G. of Siam, China Sea, W. Coast	8 0	7	
Trinity Opening, Great Barrier Reefs	9 15	7–12	
Troubridge Shoals, Australia, S. Coast	3 30	6	
Tsang-chow Id., Bias Bay, China, E. Coast	8 30		
Tsau-liang-hai or Chosan Harbour, Japan Sea	7 45	7	5
Tsu-sima Sound, ,,	8 30	8	6
Tsugar Strait, ,,	5 0	5	
Turon B., Cochin China	3 0	4	
Tuticorin Harbour, G. of Manar, Bay of Bengal, W. Coast	1 15	$2\frac{1}{2}$	$1\frac{3}{4}$
Tutukaka Harbour, New Zealand	7 0	9	7
Tweed River (Danger Point), Australia, E.C.	9 45	5–8	
Twofold Bay, Australia, E. Coast	10 0	7	5
Tylatiap Harbour, Java, S. Coast	8 45	$3\frac{1}{2}$	
Typa Anchorage, China, E. Coast	10 0	7	
Ummen Nakheïlah, Persian Gulf	7 30?	8?	
Underwood Port, New Zealand	6 10	8	6
Unsang, Borneo	8 0	$3\frac{1}{2}$	
Upstart Bay, Australia, E. Coast	9 0	6	
Urakami, Japan Sea	7 30	6	5
Uranouchi, ,,			5
Ursula Id., Palawan, China Sea, E. Coast	11 0	$7\frac{1}{2}$	
Ushruffi Islands, Red Sea	6 14	2	
Vansittart's Saddle, Yellow Sea	4 20	10	$8\frac{1}{2}$
Vao Port, Isle of Pines, New Caledonia	8 6	4	
Venus Harbour, Australia, S. Coast	2 15	6	

* In S.E. Monsoon. † In N.W. Monsoon.

Place.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.
	H. M.	ft.	ft.
Vernon Channel (Chusan Arch.), China, E. Cst.	9 40	14	
Versavah, Hindostan, W. Coast	12 15	16	
Victoria R., Mosquito Flat, Australia, N.W. Coast	12 19	15–24	
——— Sandy Island, Australia, N.W. Cst.	1 17	3–10	
——— Turtle Point, Australia, N.W. Cst.	7 15	7–13	
Vincent, St., Cape, Madagascar, W. Coast	4 45	12	
——— Port St., New Caledonia	5 50	4½	
Vladimir, St., Bay, Gulf of Tartary	irr.	2	
Volcano Ids., China, E. Coast	11 30	15	7½
Wahaay Harb. (Ceram), N. Coast, Moluccas	6 0	3	
Waikato R., New Zealand	9 30	12	9
Wallis Id., Torres Strait	irr.	7	
Wanchu R. (entrance), China, E. Coast	9 0	15½	
——— (City), China, E. Coast	9 30	15½	
Wang-kia Bay, Yellow Sea	2 30	9	7
Wang-kia-tia Bay, Yellow Sea	6 0	12	9
Wanganui R., New Zealand	10 15	8	6
——— Inlet, New Zealand	11 20	7	6
Wangari Harbour, New Zealand	7 0	9	7
Wangaroa Harbour, New Zealand	8 15	7	
Wangaruru Harb., New Zealand	7 10	9	7
Wapitagun Harb., Gulf of St. Lawrence	10 30	5	3
Warnboro' Sound, Australia, W. Coast		3–4	
Warsheek Roads, Africa, E. Coast	4 30	8	
Waterloo B., Africa, S. Coast	4 0	6	
Wei-hai-wei Harb., Yellow Sea	9 30	9	
Wellesley Is., Australia, N. Coast	7 30	8–12	
West Hill, Australia, E. Coast	10 20	24	
West River, China, E. Coast, *see* Si Kiang.			
Western Port, Australia, S. Coast	1 10	8	6
Whampoa (Docks), China	In March 1 40; In April 1 15; In May&June 0 30	7–8	
White Dog Ids., China, E. Coast	9 0	18	
Wide Bay, Australia, E. Coast	9 14	10	7
William Port, New Zealand	12 45	8	6
Willis Islets, Australia, E. Coast	8 0	6	
Willoughby Cape, Kangaroo Id., Australia	4 10	6	
Wilson Promontory, Australia, S. Coast	2 0	10	
Woodlark Id., Louisiade Archip.	7 15	4	
Wreck Reef (Bird Islet), Australia, E. Coast	8 3	6	
Wuchu, Si Kiang, China, E. Coast		1–1½	
Wusung River (entrance), Yang-tse-Kiang, China, E. Coast	0 30	15	10½
——— (Pheasant Point)	0 35	13	8
Wynkoops Bay, Java	5 0	4½	4
Yang ho, Yellow Sea	0 15	6	
Yang-tse Kiang (entr.), China, E. Coast	12 0	15	10
Yedo Bay (Yoku-hama), Japan	6 0	6½	4¾
Yoku-hama, Yedo Bay, Japan Sea	6 0	6½	4¾
York C., Australia, E. Coast	11 15	10	7
Yung R., Chinhae, China, E. Coast	11 20	12½	
——— Ning-po-fu, China, E. Coast	1 0	9	
Yung-hing Bay, Japan Sea	5 20	2½	
Yura Harbour, Japan Sea	6 5	6½	
Zambezi River (Pearl Id.), Africa, E. Coast	4 30	12–15	
Zanzibar, Africa, E. Cst. ——— (Channel), Africa, E. Coast	5 20 / 4 15	10 / 11	
Zaudzi, Mayotta, Comoro Islands	4 10	12	
Zebú Port, Filipinas	12 0	7	
Zeyla, Africa, E. Coast	7 15	8½	

CHAPTER VIII.

CURRENTS IN THE INDIAN OCEAN, CHINA SEA, AND WESTERN PACIFIC.

129. Currents are the channels through which the waters of the ocean circulate, and their strength and direction depend concurrently on the action of a variety of causes, to each of which it would be difficult to assign the exact portion of effect belonging to it. The rotation of the earth on its axis, the difference of temperature between the tropical and polar seas, evaporation, the direction of the wind, whether perennial, periodical, or variable—these are the chief agencies, sometimes and in some places acting together, at other times and in other places opposing each other; hence it is not difficult to understand that some currents must be *warm*, others *cold*; some are *surface*, others *under* currents; while some are *periodical*, and others *variable*, changing with the periodical or variable winds, now flowing to augment the strength and breadth of a *constant* current—now tending to oppose, though unable to counteract it.

Another distinction of an important character in connexion with currents is their classification (according to their apparent origin) into *drift* and *stream*. Every constant or very prevalent wind (such, for example, as the Trades) that sweeps the ocean, drives before it the surface water in the form of a *drift* current; impelled to leeward, it moves on until it meets some obstruction, all the while tending to produce an accumulation of *flowing* water, which eventually gives rise to a *stream* current. The drift current is generally shallow, and its velocity will depend greatly on the force of the wind and its angle of incidence on the surface: the obstacle opposing its onward progress may be land or a stream current already formed. A *stream* current is the flowing off of the accumulated waters of a drift current in the effort to restore the equilibrium of the general surface-level of the ocean, and it may be of any bulk, depth, and velocity. A drift current when opposed by a stream already formed will either fall into and augment the latter, if the angle which its direction makes with that of the stream current be less than a right angle,—or, if it be greater, the drift itself becomes a stream current, and in this case takes a parallel but opposite course to that of the stream by which its progress has been interrupted.

130. Sketch of the General Currents of the Ocean.—Before entering on any details of the currents of the Indian Ocean, it will not be out of place to give a brief sketch of the general circulation of the entire body of waters constituting the three great oceans:—

The Pacific Ocean, owing to its vast extent, allows a fuller sweep to the general currents than either the Atlantic or Indian Ocean. The Antarctic Polar Current, bent eastward by the prevailing winds of those regions, strikes the western coast of America between Lat. 55° and 45° S.; there it divides into two branches, of which one runs southward, doubling Cape Horn, and carrying its waters to the Atlantic;—the second and principal branch passes along the coast of Chili and Peru, cooling the climate of that region by the low temperature of the waters it bears, which are from 18° to 22° Fahr. colder than the neighbouring sea off Lima; this current, to which is given the name of "Humboldt" (who was the first to prove its

origin and abnormal temperature), suddenly quits the coast near Aguja Point, and flows westward to join the great Equatorial Current.

The Equatorial Current in the Pacific occupies a breadth of nearly 50°, and extending on both sides of the Equator, stretches beyond the tropics N. and S.; it follows its peaceful and majestic course unobstructed, with an average speed of from 30 to 35 miles a day, to the chain of islands that fringe the continents of Asia and Australia. On the north it reaches Formosa, and, running upon the coast of China, turns off and passes to the N.E., along the shores of Japan, as the Black Stream—the gulf-stream of the Pacific. On the S., it becomes disturbed by the Monsoons, and loses its way in the labyrinthine mazes of the Indian archipelago, thus producing other and often stronger currents, which add to the dangers of the navigation of those stormy seas.

In the northern part of the Pacific the W. winds reigning there determine a drift current, which advances to the American coast, and conducts the waters southward along the shores of California, whence they doubtless re-enter the Equatorial Current, to commence a new circuit.

The Arctic current seems in the Pacific to be almost nothing. The bank or neck, which connects the neighbouring points of the continents of Asia and America under the water of Behring's strait, hinders the under currents which come from the pole from entering, while the warmer waters of the Pacific pass on the surface unobstructedly into the Frozen Ocean.

In the Indian Ocean, the Equatorial Current, like the Trade-wind, is broken. In the region of the Monsoons, or the northern region, the currents alternate, and follow the direction of the periodical winds, flowing with them six months in one direction, and six months in another. But in the S., where the Trade-wind retains its empire, the normal current holds its way, narrows as it approaches Madagascar, passes north of that island, and, stemmed by the coast of Africa, enters the channel of Mozambique. Jammed into this narrow passage, it acquires the enormous speed of three to five miles an hour, and, reinforced S. of Madagascar by the other branch, it reaches in its rapid course the Cape of Good Hope and the Agulhas bank, the borders of which it follows at a distance from the coast. Here it spreads out and divides; one part encounters the current setting from the Southern Atlantic, and with it re-enters the Indian Ocean; the other branch doubles the Cape, enters the Atlantic, and, flowing at a short distance from the western coast of Africa, proceeds to blend its waters with those of the Equatorial Current of that ocean.

The form of the Atlantic Ocean—the small breadth it presents in the region of the Equator—and the deep windings of the Caribbean Sea and the Gulf of Mexico, in which nearly all the tropical waters of this ocean are accumulated, as in a receptacle having no outlet, give to its currents an aspect peculiarly well marked. The Equatorial Current does not here assume its customary proportions, while the return current—the Gulf Stream—assumes a very striking character.

The Equatorial Current is joined, as we have said, by the current of the Cape of Good Hope issuing from the Indian Ocean: starting from the coast of Southern Africa, it soon extends on both sides of the Equator, widens considerably, and flows across the ocean at the rate of two or three miles an hour. Having reached the coast of America, it divides at Cape St. Roque. One branch flows southward along the coast of Brazil, and, together with the waters of the southern basin, finally takes the route to the eastward. The other and principal branch takes a W.N.W. direc-

tion, sends its waters along the shores of Guayana, enters the Caribbean Sea, penetrates into the Gulf of Mexico, of which it makes the circuit, and passing before the mouths of the Mississippi, arrives at the narrow passage between Florida and the island of Cuba, whence it comes forth under another name: the accumulated and moving waters of the Caribbean Sea and the Gulf of Mexico are thus the inexhaustible source of that current of warm water, which, under the name of the Gulf Stream, makes its way through the Bahamas, flows along the coast of Florida at a rate varying from two to five miles an hour, according to the season, and keeps on its way upon a line parallel to the shore at a short distance from its margin, until it passes beyond Cape Hatteras. The Stream, hitherto narrow, deep, and rapid, meets in this vicinity the cold waters from the N., and more to the N. it encounters the obstruction of the great sand-banks off Newfoundland: repulsed by these, it makes a sudden turn to the E., becomes much broader, spreads over the surface, and goes on with slackened course to the Azores, from whence it bends towards the S., in order to recommence from the coasts of Africa the vast cycle of its never-ending rotation. The warm waters of the tropics conveyed by this current advance northward even beyond the limits just indicated: driven by the S.W. winds prevailing in the North Atlantic, they proceed to bathe the coasts of the N. of Europe, the temperature of which they soften, and often deposit on the lonely shores of Scotland and Norway the plants and seeds of tropical regions,—unanswerable witnesses of their distant course.

On considering the narrow breadth of the Gulf Stream from its origin to Cape Hatteras, one is led to ask how it can be sufficient to cover with warm water the immense surface which it occupies from this point to the Azores. The beautiful observations made under the able direction of Professor Bache give the answer; for numerous thermometrical soundings prove that off that cape the depth of the current is such, that at the depth of 3000 feet it presents nearly the same difference of temperature, compared with the surrounding sea, as it does at the surface. It is evidently these deep waters which appear at the surface when it spreads out; for as it loses in speed, the warm waters are free to ascend and to take the place assigned to them by their less density. The current only changes *form*, and, in advancing, *loses in depth what it gains in width.*

The polar currents of the Atlantic are perceptible chiefly on the coasts of America. Hudson's and Baffin's Bay and the Sea of Greenland pour their waters and their ice along the eastern coast of the American continent, and contribute to lower the temperature of that region.

Such are the most important features presented by the circulation of the waters of the ocean; and as a broad generalization of all atmospheric and oceanic movements, it may be observed that the WINDS (or *aërial* currents), and the CURRENTS of the OCEAN, alike form part of a great system of circulation, the special characteristics of which can be thus expressed:—

1. Between the Tropics, the winds and the oceanic currents have a prevailing direction to the westward.
2. In Middle Latitudes, the prevailing currents of the air and the ocean alike tend towards the eastward.
3. In High Latitudes, the general direction of the winds and of the oceanic currents is from the Poles towards the Equator, *i.e.*, from N. to S. in the Northern Hemisphere, but from S. to N. in the Southern Hemisphere.

The following brief summary of the currents of the ocean—with their mean direction and velocity—will be useful for ready reference:—

North Atlantic Ocean.

Principal Currents.	Mean Direction.	Rate.
Equatorial current	W.	30 to 50m. per day.
Guayana current	N.W.	20 to 30 „
Current of the Caribbean Sea and Gulf of Mexico	—	15 „
Gulf Stream	N.—N.E.—& E.	60, 30, 20 „
Current of North Africa	S.	20 „
Guinea current (along coast)	E.S.E. & E.	20 „
Secondary Currents.		
Current of Bay of Biscay	E.	6 to 10 „
Rennel's current	N.W.	10 to 20 „
Portugal current	S.S.E. & S.E.	16 „
Current at Strait of Gibraltar (entrance)	E.	12 „
Drift of the N.E. Trade-wind	S.W.	10 „
Arctic current (American coast)	S. & S.W.	24 „

South Atlantic Ocean.

Principal Currents.	Mean Direction.	Rate.
Brazil current	S.	20 „
Southern connecting current	E.S.E. & E.	15 „
Current on W. coast of Africa	N.	15 „
Antarctic drift current	E.N.E. & E.	10 to 25 „
Secondary Currents.		
Drift of the S.E. Trade-winds	N.W. & W.N.W.	10 „
Current between the Guinea and Equatorial currents	N.W.	12 „
Cape Horn current	N.E.	18 to 30 „

Indian Ocean.

Principal Currents.	Mean Direction.	Rate.
Equatorial current	W.	12, 16, & 22 „
Mozambique current	S.W.	18 to 28 „
Agulhas current	S.W.	20 to 80 „
Counter current S. of Agulhas current	E.	30 „
Counter current of S. Indian Ocean	E.	very variable
Secondary Currents.		
S.W. branch of Equatorial current	S.W.	30
Current of S. Australia	E.	26 to 14 „
Bay of Bengal and Arabian Sea, variable with the Monsoons	—	—

North Pacific Ocean.

Principal Currents.	Mean Direction.	Rate.
Equatorial current	W.	30m. per day.
Kuro Siwa, or Black Stream	N.E.	30 to 50 „
Californian current	S.E.	16 „
Secondary Currents.		
Kamtschatka current	N.W.	8 „
Behring's current	N.	14 „
Equatorial counter current	E.	18 „

South Pacific Ocean.

Principal Currents.	Mean Direction.	Rate.
Equatorial current	W.	24 „
Current on S.W. coast of Australia	S.	12 „
Counter current of S. Pacific	E.	20 „
Antarctic drift	E.N.E.	very variable
Humboldt or Peru current	N.	15 „
Secondary Currents.		
Mentor's current	N.E.	16 „
Current of Cape Horn	S.E.	18 „

Special Remarks on the Currents of the Indian Ocean.

131. Equatorial Current.—The Equatorial Current in the Indian Ocean is only found S. of the Equator, its northern limit coinciding with the equatorial limit of the S.E. Trade-wind—namely, the parallel of 10° S. On the meridian of 100° E. its southern limit reaches as far as Lat. 25° S., but, as the current advances westward, it inclines to the northward, decreasing in breadth until, on the meridian of Rodrigues, it does not extend beyond the parallel of 20° S. Off this island it separates into two branches—one flowing S.W., and the other N.W. The S.W. branch of the Equatorial Current entirely surrounds Mauritius, and its northern edge, passing S. of Réunion, reaches the S. coast of Madagascar; here its breadth is 450 to 500 miles, and its temperature 76° Fahr. From thence it flows S.W., to form the Agulhas current, which commences S. of Natal: the S.W. current on this parallel is not more than about 70 or 80 miles across, and its temperature has been found as high as 70° or 72°. Off Réunion the velocity of the current varies from 10 to 15 miles a day: off the S. point of Madagascar it has been found to run from 40 to 50 miles.

The western branch of the Equatorial Current runs W.N.W. and N.W., and passing round the N. end of Madagascar, strikes the African coast near Cape Delgado (Lat. 10° 41′ S.); here it divides into two branches—one, during the S.E. Monsoon, flows northward past Zanzibar towards Cape Guardafui, but during the N.W. Monsoon it is deflected to the eastward before reaching the Equator,—the other branch enters the Mozambique Channel, where, as the well-known Mozambique Current, it flows along the E. coast of Africa. The mean breadth of this portion of the Equatorial Current is 360 miles, and off Cape Amber its mean rate is

about 50 miles a day; but it has occasionally been found running from 60 to 70 miles—this strength of the current, however, never extends beyond 50 miles northward of Cape Amber: its temperature is about 78° Fahr.

The velocity of the Equatorial Current in mid-ocean is very variable; sometimes it attains a rate of 20 to 22 miles a day, but its mean is about 12 or 16 miles.

The temperature of this current, from its origin on the eastern side of the ocean until it reaches the meridian of Rodrigues, gradually increases—varying from 72° to 82° Fahr. over that extent.

The following "bottle papers" indicate (approximately) the set of the northern part of the Equatorial Current in the Indian Ocean:—

(1) A bottle thrown from the *Futta Sultan*, June 10th, 1853, in Lat. 6° 10′ S., Long. 90° 40′ E., was picked up at Brava, E. coast of Africa, in Lat. 1° 7′ S., Long. 44° 3′ E., in 1856.

(2) A bottle thrown from the *Panther*, Feb. 3rd, 1857, in Lat. 11° 19′ S., Long. 84° 21′ E., was picked up between Brava and Juba Islands, E. coast of Africa, in July, 1857.

132. Mozambique Current.—The Mozambique Current, as just observed, is derived from the Equatorial Current, and follows the line of the African coast from N.N.W. to S.S.E., until off Cape Padrone it unites with the S.W. branch of the Equatorial Current: off Mozambique this current has been known to set S.E. by E. 4 knots an hour; off Cape Corrientes it has been reported as setting from 70 to 90 and even 120 miles a day; but these are probably extreme cases,—the mean velocity from Cape Delgado to Cape Corrientes may be estimated at from 30 to 40 miles a day; it has been found running 40 miles a day off Natal, at the distance of 20 miles off shore. It is said that this current is stronger during the S.E. than the N.W. Monsoon—owing to the accumulation of water from the Equatorial Current which is at that season forced by the wind towards the African shore; but this is uncertain. The temperature of the Mozambique Current ranges from 70° to 75° Fahr.

133. Counter Currents around Madagascar.—In that part of the ocean comprised between the Agulhas Current, the S.W. branch of the Equatorial Current, and the S.W. coast of Madagascar, the currents are often very variable, sometimes setting E.S.E. and S.E. between Cape Corrientes and Madagascar, but generally N. and N.E. near the eastern edge of the Agulhas Current, between it and the S.W. branch of the Equatorial Current. These counter currents sometimes attain a velocity of 15 to 20 miles a day.

It has been observed that the S.W. branch of the Equatorial Current flows round Rodrigues and Mauritius, yet does not reach Réunion; off this island it appears to send offshoots setting N.W., N.N.W., and N.

In the area comprised between the E. coast of Madagascar and the bifurcation of the Equatorial Current, the set of the waters is not only variable in direction but in strength also—greatly depending on the prevalent wind of the season.

In the vicinity of the Comoro Islands the currents are uncertain both in strength and direction: to the northward of them, however, a north-westerly current running from 12 to 18 miles a day may be expected, while to the southward of them an easterly current is not unfrequent; through the group the current is westerly; but great caution is required hereabouts, as the set may be 2 or 3 knots either way.

On the W. coast of Madagascar a weak northerly current generally prevails, as is also the case in the middle of the Mozambique Channel southward of Lat. 18° S.

134. Agulhas Current.—On a parallel between Port Natal and Cape Padrone the union of the S.W. branch of the Equatorial Current and that through the Mozambique Channel forms the well-known Agulhas Current, flowing at first near the shore, and thence *following the course of the edge of the Agulhas bank*—but *passing over its southern extreme;* near the meridian of 20° E. its velocity is greatly diminished, and it breaks into two branches—one running to the north-westward into the Atlantic, and the other (obstructed by the Antarctic drift) turns to the eastward as the *counter current* of the Indian Ocean.

The breadth of the Agulhas Current is from 30 to 50 miles; but this as well as its velocity greatly depends on the winds and seasons. Off Cape Recife its rate is sometimes 100 miles a day, and frequently 70 or 80 miles, but by the time it has reached the meridian of 23° or 24° E. it has diminished to 50 or 60 miles a day.

A strong gale from the W. or S.W., lasting for some time, may check the velocity of the Agulhas Current by diverting it earlier into the counter current of the Indian Ocean, but it runs all the stronger afterwards; generally, however, it continues its course in the teeth of the gale, producing thereby a dangerous wall-like sea.

The Agulhas Current, although perceptible on the bank, is comparatively feeble; and near the African coast—especially between Capes Hangklip and Agulhas—there is an easterly set.

The temperature of the Agulhas Current is higher than that of the waters on either side of it—N. or S.—so that it may easily be known whether a vessel is in it or not.

Wilkes* remarks that—"On our track from the China seas towards the Cape of Good Hope, we met with but little current until we approached the E. coast of Africa. We had, during this part of our voyage, an opportunity of trying the deep-sea temperature daily, which confirmed the impression that this portion of the ocean is but little liable to submarine streams.

"On approaching the E. coast of Africa, we found ourselves at first influenced by the Polar Stream, then, as we neared the coast, by the Equatorial Stream that sets down the Mozambique Channel. This stream is usually confined to narrow limits, but at some seasons becomes strong enough to throw its waters in a S.W. direction beyond the Agulhas bank. There is little doubt that this Equatorial Stream is superficial, overlying the Southern Polar Stream, a portion of which latter, touching the Agulhas bank, is forced up by that obstruction to the surface. This is evident by its reducing the temperature of the waters, on soundings at the Cape, to 62°. This Polar Stream is divided by the Cape: the eastern part sets along the E. coast of Africa as a submarine stream, and on reaching the island of Madagascar is found to flow N., along its W. shores. The other and larger portion is deflected, and flows to the northward, along the W. coast, and finally forms the Great Equatorial Stream of the South Atlantic."

The following abstract on the currents of the southern extremity of Africa is from

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* "Narrative of the United States' Exploring Expedition, 1838–1842." By Charles Wilkes, U.S.N., Commander of the Expedition, vol. v. p. 477.

Capt. Sir J. C. Ross' "Voyage of Discovery in the Southern and Antarctic Regions, 1839–1843":—

1. With respect to the Polar Current:—March 8th, 1840, in Lat, 32° 21′ S., Long. 17° 6′ E., 45 miles from Paternoster Point, sounded in 127 fathoms; expected to find an *elevation* of temperature both of air and sea on approaching the African coast, by reason of the radiation of heat from its shores; but by 1h. P.M. the temperature of the sea had fallen from 70° to 56·5°—that of the air being 65°. The cause of the depression of temperature became evident on sighting Cape Paternoster, for a current increasing in strength and coldness, as we neared the land, was found to exist. The following is a summary of the experiments on it:—Barely reaching 40 miles from shore, where the sea is more than 300 fathoms deep, this current spreads over double that distance in shallower parts; 45 miles from land, and at a depth of 120 fathoms, the temperature of the water was 40°, that of the surface 56°; and 60 miles off land, at 200 fathoms, the temperature was 43·5°, the surface being 61°. Thus a northerly current of very limited extent, but of considerable force, exists from the Cape of Good Hope along the W. coast of Africa, which in general terms may be represented by a volume of water 60 miles wide and 200 fathoms deep, averaging a velocity of 24 miles a day, and of the mean temperature of the ocean, running between the shores of Africa and the waters of the adjacent sea. The mist which hangs over this stream of cold water is occasioned by the condensation of the vapour of the superincumbent atmosphere, whose temperature is generally so many degrees higher than that of the sea.

2. Next, with respect to the Agulhas and Counter Current of the Indian Ocean:—April 11th, still on the Agulhas bank, the S. limit of which in Long. 21° 20′ E. is between Lat. 36° 37′ and 36° 44′ S., or about 130 miles from Cape Agulhas.

April 13th, 14th. It rained at times 'sheets of water;' violent squalls and momentary calms; rapid changes both in strength and direction of the wind; carried 30 miles S. of our supposed position, and next day 50 miles S.W., by the current, after which it changed to N.W., running at the rate of 68 miles per day, or nearly 3 miles per hour, in direct opposition to the wind.

April 16th, Lat. 41° S., Long. 25° E., another change in the current carried us N. 75° E. 22 miles in 24 hours; we were now S. of that stream which, taking the direction of the Natal coast, is known to extend far out to sea, and got a counter current setting to the eastward at the rate of 1 mile per hour.

135. Counter Current of the Southern Indian Ocean.—This current, so important to vessels bound for Australia, is formed by a S. and S.E. drift from the Equatorial Current of the Indian Ocean uniting with a branch from the Agulhas Current, which is suddenly deflected to the eastward by the cold Antarctic Current flowing towards the Equator, the tendency of which is that it gradually combines northing with easting, so that off Cape Leeuwin it bifurcates; from this point one branch sweeps northward along the W. coast of Australia, and finally rejoins the Equatorial Current near the Tropic of Capricorn,—while the other branch, setting along the S. coast of the same continent—as the Australian Current—eventually passes into the Pacific.

The velocity of this counter current is very variable—depending greatly on the winds; on the meridian of 30° E. it sometimes runs from 30 to 40 miles a day, and

its breadth is often from 200 to 250 miles between the parallels of 38° and 42° S. As it advances eastward it probably spreads out, and thereby diminishes its rate, but it has been found to run with considerable strength between the island of St. Paul and Cape Leeuwin during the Austral summer. The north-easterly current on the S.W. coast of Australia sometimes runs from 20 to 30 miles a day.

The temperature of this current is as variable as its velocity.

The following "bottle papers" indicate (approximately) the general set of the current in Great Southern Ocean, between Cape Horn and Australia:—

(1) A bottle thrown from H.M. Antarctic exploring ship *Erebus* (Capt. James Ross), April 4th, 1842, in Lat. 53° 39′ S., Long. 60° 47′ W., was picked up at Cape Liptrap, S. coast of Australia, Lat. 38° 55′ S., Long. 145° 57′ E., in September, 1845.

(2) A bottle thrown from the *Ambarawa*, August 20th, 1845, in Lat. 38° 31′ S., Long. 27° 36′ E., was picked up 10 miles W. of Cape Bridgewater, S. coast of Australia, Lat. 38° 24′ S., Long. 141° 12′ E., May, 1851.

(3) A bottle thrown from the *Ocean Chief*, Jan. 1st, 1857, in Lat. 42° 40′ S., Long. 42° 32′ W., was picked up at sea by the *Gideon Howland*, in Lat. 39° 50′ S., Long. 36° 35′ E., Dec. 16th, 1857.

Maury,* speaking of the *S. and S.E. drift current of the Indian Ocean*, says that "it seems to be an overflow of the great intertropical cauldron of India; seeking to escape thence, it works its way polarward more as a drift than as a current. It is to the Mozambique Current what the northern flow of warm waters in the Atlantic is to the Gulf Stream. This Indian overflow is very large, and finds its way S., midway between Africa and Australia, and appears to lose itself in passing round a sort of Sargasso Sea, thinly strewed with patches of weed. We need not be surprised at such a vast flow of warm water as the currents in the S.W. area of the Indian Ocean indicate, when we recollect that this ocean is land-locked on the N., and that the temperature of its waters is frequently as high as 80° Fahr." He has also marked on his "Chart of Sea Drift" an area extending from Lat. 40° to 50° S., and between Long. 15° and 107° E., indicating the flow of this warm water from the middle of the Indian Ocean. But whether the weed is derived exclusively from that ocean, or whether (as appears most probable) it may not be the result of the two currents—one from the Indian and the other from the Antarctic Ocean—bearing their united drift eastward, is not well-established; certain it is, however, that seaweed is found thereabouts in large quantities. The same authority says that on the polar side of 35° S. "146 log-books make mention of it between the meridians of 40° and 120° E.; but it *most* abounds along *this* line between the meridians of 45° and 65° E., and between the parallels of 42° and 48° S.

Abstracts of the log-books of the following vessels show where this seaweed has been passed by our own Australian traders:—

1853—*Lord Auckland*—Capt. Thompson.

Jan.	2nd—Lat.	44°	4′ S.	Long.	45°	52′ E.	}	Water discoloured—seaweed.
„	3rd ...	44	53	.....	49	4		
„	4th ...	45	0	.....	52	4		

* See "The Physical Geography of the Sea, and its Meteorology."

1853—*Fly Away*—Capt. M. Sewall.

Oct.	22nd—Lat.	43°	46′	S. Long.	56°	7′	E.	Saw patches of rockweed and kelp.
„	26th ...	42	45	.....	79	56		Saw quantities of rockweed and kelp.
„	27th ...	42	21	.....	82	40		Saw patches of rockweed.

1853—*Malay*—Capt. S. Hutchinson.

Dec.	24th—Lat.	48°	59′	S. Long.	52°	9′	E.	Passed kelp, and saw a diving water-fowl.

1854—*Parana*—Capt. F. Langston.

Jan.	8th—Lat.	44°	36′	S. Long.	43°	30′	E.	
„	9th ...	44	58	.....	48	36		
„	10th ...	45	9	.....	52	53		

Between Jan. 7th and 15th, seaweed, birds, and whales reported.

1854—*Kent*—Captain Coleman.

Sept.	27th—Lat.	43°	33′	S. Long.	46°	14′	E.	Saw seaweed.
„	28th ...	43	26	.....	51	5		
„	29th ...	43	57	.....	56	11		

1854—*Gertrude*—Capt. W. Phinney.

Oct.	2nd—Lat.	47°	2′	S. Long.	70°	3′	E.	Water discoloured.

1855—*Kent*—Capt. Coleman.

July	4th—Lat.	43°	46′	S. Long.	48°	26′	E.	Water green—seaweed.
„	5th ...	43	16	.....	53	53		
„	6th ...	43	27	.....	59	37		

1855—*Lady Hodgkinson*—Capt. Wilson.

Sept.	22nd—Lat.	42°	53′	S. Long.	52°	34′	E.	
„	23rd ...	43	6	.....	54	27		Birds numerous
„	26th ...	45	10	.....	70	37		Much seaweed about.
„	27th ...	45	29	.....	76	15		Much seaweed.

1856—*Sir Ralph Abercrombie*—Capt. Boyd.

Aug.	17th—Lat.	44°	21′	S. Long.	45°	31′	E.	Penguins—sea greenish.
„	18th ...	43	46	.....	51	12		
„	19th ...	43	34	.....	56	56		

1856—*Maid of Judah*—Capt. Marchant.

Aug.	30th—Lat.	42°	18′	S. Long.	78°	0′	E.	Seaweed.

1857—*Norfolk*—Captain Coleman.

May	9th—Lat.	44°	11′	S. Long.	44°	13′	E.	Seaweed.
„	10th ...	44	0	.....	49	4		
„	11th ...	44	4	.....	54	16		

1859—*Essex*—Capt. J. S. Atwood.

Jan.	15th—Lat.	43°	5′	S. Long.	81°	27′	E.	Seaweed.
„	16th ...	43	25	.....	87	49		
„	17th ...	43	36	.....	91	10		
„	18th ...	43	21	.....	94	35		

1860—*Norfolk*—Capt. J. S. Atwood.

May	2nd—Lat.	42°	55′	S. Long.	52°	57′	E.	Seaweed.
„	3rd ...	42	56	.....	59	44		

1861—*Norfolk*—Capt. J. S. Atwood.

Dec.	20th—Lat.	45°	48′	S. Long.	57°	40′	E.	Seaweed.
„	21st ...	45	25	.....	59	44		
„	22nd ...	45	35	.....	65	42		
„	23rd ...	45	11	.....	71	24		
„	24th ...	45	7	.....	78	27		
„	25th ...	45	9	.....	84	27		
„	26th ...	45	19	.....	90	3		

1863—*Essex*—Capt. J. S. Atwood.

Oct.	23rd—Lat.	43°	59′	S. Long.	44°	58′	E.	Seaweed.
„	24th ...	43	59	.....	49	50		

The frequent occurrence of seaweed and birds hereabouts has often led seamen to think there are more islands scattered on this route than are already laid down on the chart, but this is not probable. Capt. J. Fawcett, of the *Harriet Humble*, says:—10th Nov. 1853, being in Lat. 43° 44′ S., Long. 40° 47′ E., the sea became very dark, being green and deeply discoloured, as if we were on soundings; and the following day a piece of tangle was picked up, which, from the freshness of its stem, appeared to have been recently broken off. This discoloration of water continued until we had reached the meridian of 53° 30′ E., and it then rather suddenly resumed its natural colour. The temperature of the water when discovered was 44° in 45° E., and in 53° E. 46·5°, air being between 47° and 49°, and the wind from W. to N.N.E.; in 54° E. Long. the temperature of the water suddenly rose to 55°; and this circumstance, coupled with the appearance of soundings and floating tangle, induced me to believe in the existence of a very considerable bank hereabouts. Had we been becalmed, I should certainly have tried for bottom; on a former voyage I noticed a similar discoloration of water hereabouts, but then, as now, had plenty of wind propelling us along, thus preventing me trying a cast for soundings, and a person is loth to heave-to in a fair wind, merely to satisfy his curiosity as to bottom or no bottom; though bottom I have no doubt could be obtained, and that at no very great depth.

"We sailed on nearly an E. course at least 550 miles from the time discoloured water was first discovered, and its temperature fell, until it regained its natural deep blue again and a higher temperature."

We could produce additional testimony, all tending to the same effect—viz., that over a linear distance of 30 to 50 degrees of Long. seaweed and birds are frequently seen, that the water has a discoloured appearance as if in soundings, and that fogs

are very prevalent: we have also three records of earthquake shocks. Captains not unfrequently enter in their logs, when noticing the discoloured water, that they should like to try a cast for soundings, "but the wind being fair, they are unwilling to heave-to." If an opportunity offers for taking a cast of the lead, they would do well to try.

We would also call attention to Capt. Sir J. C. Ross's experience in this part of the ocean when on his Antarctic cruise:—

Nearing the 40th parallel, and to the eastward of the meridian of Cape Agulhas, he was carried 30 miles to the southward of his supposed position, and on the next day 50 miles to the S.W.,—he next encountered a N.W. current. May 3rd, in Lat. 47° 17′ S., Long. 58° 30′ E., he passed seaweed, and was accompanied on his course by an albatross, a large dark petrel, speckled cape-pigeon, stormy petrel, &c. Visiting Kerguelen Island, he spent 68 days in Christmas Harbour, on 45 of which it blew a gale, and there were only three days on which neither snow nor rain fell (June, July): thence proceeding to the eastward, towards Tasmania (July 21–24), he found "seaweed in abundance, current strong, a general tendency of the surface waters to the *eastward*, occasioned probably by the westerly winds, which, at this season at least, prevail almost as steadily as do the Trade-winds in equatorial regions: several kinds of petrel, the only birds seen: the temperature of the sea rose suddenly from 37° to 46° Fahr., extending over a space of 86 miles; it had previously been at 35°."

136. Australian Current.—This current flows to the eastward along the S. coast of Australia, being strongest between Point d'Entrecasteaux and King George Sound, where its velocity is sometimes from 24 to 36 miles a day: in the bight it is comparatively weak, but generally strong at some distance from the land. Towards Bass Straits the easterly set is from 26 to 24 miles a day, and then it turns to the southward along the W. coast of Tasmania: finally passing the S. point of that island, and running E. and N.E., it loses itself in the Pacific. In Bass Strait the current is greatly complicated by the tides. The breadth of this current is generally less in summer than in winter, especially after strong southerly gales have sent up large masses of ice and icebergs to the parallel of 45° S.: again, after strong westerly winds have blown continuously for weeks in succession, its velocity is considerably augmented.

137. In the northern part of the Indian Ocean the currents and surface-drifts are complicated by the Monsoons, and vary with the seasons; as a consequence they are very irregular, and often change in a very capricious manner.

138. Currents in the Arabian Sea.—As already observed (p. 210), the northern part of the Equatorial Current of the Indian Ocean from the meridian of Rodriguez turns to the N.W.-ward, and, as two of the "bottle papers" (p. 211) show, this northerly direction continues for at least a part of the year—probably during the period of the S.W. Monsoon. But between the parallels of 5° N. and 5° S., and between the meridians of 50° and 80° E., it may be said that good observations on the direction of the currents in this area at the different seasons of the year are so few that nothing is known for certainty of their general set; they pro-

bably depend on the Monsoon and its strength. Be this as it may, however, there is always, on the northern edge of the Equatorial Current, an easterly set varying from 18 to 30 miles a day.

During the S.W. Monsoon the current N. of the Equator sets N.N.E. along the African coast, at the rate of 40 to 60 miles a day, spreading out to the eastward as it advances, and consequently losing in velocity; it passes through the channel between Cape Guardafui and Socotra at the rate of 30 to 50 miles a day, and continuing its N.E.-ly course reaches the Arabian coast near Kosair, and so flows onward to the head of the bay at the rate of 20 to 30 miles a day. In the middle of the bay the current is more or less easterly, inclining to S.E. as it approaches the western coast of Hindostan, and its velocity varies from 12 to 30 miles a day.

The island of Socotra (and perhaps a plateau surrounding it) offers an obstruction to the direct progress of the N.E.-ly current, and the consequence is that to the southward of this island, to the distance of 150 miles, there is a great whirl of the stream; it strikes off eastward on the parallel of Rás Hafún, but near the meridian of 55° E. it turns to southward as far as Lat. 5° N., when it curves to the westward and finally completes the whirl by flowing N. On the northern edge of this large eddy the velocity is often 4 or 5 miles an hour, but rarely more than 1 or 1½ miles on its southern edge. On the northern side of Socotra it is supposed that a similar whirl on a smaller scale exists; but this is uncertain. Horsburgh says that the currents run with the prevalent winds to the N.E., and that when these abate in strength, an equally rapid current sets in the opposite direction,—such may be the case near the land.

During the N.E. Monsoon, especially when it is strongest, the current sets with the wind to the southward and eastward, from Rás Jezírat to the Straits of Bab-el-Mandeb, but soon changes its course to E. and N.E. when southerly winds are prevalent.

On the E. coast of Arabia, during this period, the currents are very irregular and variable, changing from one direction to another without any apparent cause. From Rás Jezírat to Rás-al-Hed a N.E.-ly current sets at the rate of 18 to 24 miles a day, and is only checked when the Monsoon is very strong from the northward. During January and February a weak current, variable in direction, is felt along the coast; and late in February a strong northerly set, 20 to 35 miles a day, has been found running between Rás Madraka and Rás-al-'Awáni. In March the N.E. current is comparatively weak, but in April it is again strong along the whole coast.

Commander J. P. Saunders, who was surveying here in the brig *Palinurus*, says that, "as early as the 9th February the winds set in from the southward, and with the southerly winds an easterly current from Ras Seger to Ras Risút.

"As we approached Ras Seger the currents became stronger, running constantly from half a knot to 2 knots per hour to the eastward, with light S.S.W. winds lasting for a few hours during the day, and then succeeded by calms which lasted the remainder of the 24 hours. The currents are not so strong, and the winds are more favourable to the W.S.W. of Ràs Farták."

139. Currents of the Gulf of Aden.—As is the case in the vicinity of Socotra, so the current in the Gulf is in a continual state of whirl or eddy *during the S.W. Monsoon*. On the Arabian side it runs to the eastward as far as Rás Rehmat, whence it strikes off in a S.E.-ly direction towards Cape Guardafui, then turning west-

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ward along the African coast as far as the meridian of 47° E., it curves to the N.W.-ward. On the same meridian the current from the Straits of Bab-el-Mandeb, which has heretofore been running to the eastward, also curves up N. and N.W.—so completing and augmenting the eddy. The velocity of this current varies throughout the Gulf from 12 to 24 miles a day.

During the N.E. Monsoon the currents have been found so irregular that they baffle all accurate description; they appear, however, to be greatly under the control of the wind which, when it blows strong, drives the water before it; but the whirl is always more or less present in the centre of the Gulf.

On the Arabian shore the set is generally southward and westward unless checked by a southerly wind, when it changes its direction to E. and N.E. On the African (or Somáli) coast it frequently runs to the eastward, but may set in the opposite direction without any apparent cause.

140. Currents of the Red Sea.—The currents of the Red Sea are almost entirely regulated by the winds. When a southerly wind prevails, the current flows to the Northward; and with a northerly wind, it sets to the Southward,—its strength also depending on that of the wind; during the change of the Monsoons there is scarcely any current.

Off Jiddah, in different seasons, the current attains a velocity of 1 or 1½ miles an hour. North of Jiddah it varies greatly throughout the whole year; but a strong wind may give it a velocity of 20 or even 40 miles per day.

From May to October, in the *northern part* of the Red Sea, the level of the water is nearly 2 feet lower than during the other months of the year—the effect of strong northerly winds prevalent during that season over the whole area of the sea; the result is a continual current flowing through the Strait of Bab-el-Mandeb into the Gulf of Aden, which is so rapid that even with a stiff breeze from S.W., a vessel is sometimes unable to make head against it.

From October to May, when southerly winds prevail in the lower part of the Red Sea, the current changes and sets rapidly to the northward; the mass of water having no outlet, now accumulates in the northern part of this sea, and attains a greater elevation than during the northerly Monsoon.

The temperature of the water of the Red Sea has been found at 86° Fahr. in the strait of Bab-el-Mandeb; 85° off Mocha; 84° to 82° south of Jiddah; 77° in the North part of the Red Sea; and 71° at its extremity.

Captains Moresby and Elwon, in the "Red Sea Pilot," observe that the currents seem to be entirely governed by the winds; during the prevalence of southerly breezes, they run to the N., and with northerly winds to the southward. It is also probable that they increase according to the strength of either, as there was little or none at all during the prevalence of light variable airs previous to the setting in of the S. winds.

1829. In November, the current during a strong S. wind set to the N.W., about 1 mile per hour off Jiddah harbour.

1830. In December, lat. 21° N., on the Arabian side, it set to the N. 1½ mile per hour.

1831. In November, off the Outer Reefs on the Arabian side, it set along them N.N.W. 1 mile per hour.

1832. In February there appeared to be no current in the neighbourhood of Jibbel

Teer during light winds. In August of the same year, the current in the S. part of the sea set to the S. 1 mile per hour.

1832. In the beginning of October there seemed to be no current; and afterwards, on the N. part of the Farsan banks, it was setting to the N. about $\frac{1}{3}$ of a mile per hour amongst the banks and islands on the Outer reefs. With the exception of those already mentioned there was an imperceptible and irregular flow of tide and current through the several deep-water channels, but intermixed so much with eddies from the numerous islands and shallows, that it was quite impossible to ascertain it with any correctness.

Captain Moresby further remarks that "the currents in the Red Sea, from Jiddah to Ras Mohammed, are various all the year; no particular direction can be assigned to them. It may be generally remarked, they set with the prevailing winds, which, when strong, cause a current of sometimes 20 and 40 miles a day. If the wind continues long in the same quarter, they sometimes set against it, which can be seen by the short, deep swell, in a N.W. wind, against which the best sailing vessels make nothing for the first and second days, when all at once they unexpectedly get to windward. Southerly winds, which sometimes prevail from October to May, generally bring a current from 20 to 30 miles a day with them. After a north-wester has been blowing, and light winds prevail, a current generally sets to the northward, more especially on the Arabian coast; on which account the Arabian side, with the northerly winds, is the best to work on, and not the Egyptian coast, which the old navigators preferred on account of its being more clear of shoals. On the Arabian coast a vessel will be able to take advantage of the winds, if she is near the reefs and coast, which winds almost always bear several points more from the land as the night advances, and particularly in the early part of the morning, and are well open to seaward during the day. This is not the case on the Egyptian coast, when northerly, N.E., and easterly winds prevail; at times, from November to March, they cause a strong current to the westward, and as the wind becomes light, it sets back again to the eastward."

141. The following additional remarks on the Currents in the Red Sea, in the Gulf of Aden, and on the Arabian Coast, are by Captain S. B. Haines, I.N., who was engaged for a considerable time surveying those parts:*

"It is an established fact that the water is raised to a higher level in the northern parts of the Red Sea during December, January, February, and March, from the force of the strong southerly winds that then blow up that sea; and that in July, August, and September, it is several feet lower from the force of the strong N.N.W. winds blowing down towards the Straits. This fact is proved by the 'Durable' shoal, which, though situated in the middle of the sea, is at one time sufficiently dry to have a tent pitched upon it, and at another season is covered with water. The same difference of elevation may be also observed on the coral reefs near Jiddah.

"On the Arabian coast, from Ras Isolette to the Straits of Bab-el-Mandeb, in shore, during the strength of the N.E. Monsoon, the current runs with the wind. In March and April (and sometimes as early as February) this current changes, and it flows towards Isolette during the S.W. Monsoon. In April, I have measured the

* "Jour. Roy. Geographical Society," 1845, p. 150.

current with the patent log, and the vessel at anchor, and found it setting up the coast at the rate of 2 miles per hour, and much faster off the Palinurus shoal. In May, June, and July, I have also measured the current at different stations on the Arabian side between Aden and the Straits, when at anchor, in from 6 to 10 fathoms, and found it 2 and 2½ miles E.N.E., varying in rapidity with the strength of the wind. During the N.E. Monsoon it sets with equal velocity into the Red Sea. This would materially tend to prove the effect of pressure; but strange as it appears, though the wind is the same on the Sómálí* coast, or the S. side of the Gulf of Aden, during the N.E. Monsoon, the currents are sometimes running in a precisely contrary direction without any apparent cause. This led me, at one time, to imagine that the narrow entrance to the large body of water within the Red Sea (which is, moreover, reduced by the islands called the Brothers) forms a kind of barrier or point of deflection; that the current from the Mozambique channel rushing past Ras 'Aseïr at 3 or 4 miles per hour, bifurcates at that point, one branch going northwards, while the other, diminished in rapidity by the absence of the strong southerly wind, sweeps along westward as far as the Straits, when being influenced by the current out of the Red Sea, it turns up eastwards, gradually recovering its former velocity, as it again comes under the influence of the Monsoon. While the two coasts forming the Gulf of 'Aden have their own currents, the central part of the sea has others running in every direction, except during strong breezes, when pressure undoubtedly influences the whole. Thus, for instance, a vessel in July, crossing over from Burnt Island with a strong westerly breeze, will find the current change from W. to N.W., N., N.E., E.N.E., increasing in strength as she approaches the Arabian coast, and will probably be prevented from fetching it within twenty miles of 'Aden under a press of canvas. During the N.E. Monsoon, of course, a contrary rule prevails; and a vessel leaving Berberah for 'Aden will work up some 15 or 20 miles E. of Siyárah before she ventures to stretch across to the Arabian coast.

"A vessel running up her northing on the east side of the African coast during the S.W. Monsoon, and wishing to stand for Aden or the Red Sea, should be very careful for the last two or three degrees, as N.N.E. and N.E. currents will be met with. I have found a current of three or four miles an hour, which, as you round the Cape, sweeps more eastward towards Socotra; in a sailing vessel, therefore, the Cape should be rounded close, otherwise she may lose her passage, as I have known to be done by a fast-sailing vessel.

"Northwards of Tahl Far'ún and the Brothers, from June to September, I have always experienced a strong N. or N.E. current, which renders it difficult to fetch the anchorages on the north side of Socotra. In July, when in the latitude of the north side of Socotra, and only 1½ degrees west of Rás 'Aseïr, I have had light airs and calms, with a current 58 miles due S., while in previous years, and in almost the same position, I have found a N. current, which gradually drew eastward as the vessel stood to the S.E.

"On the north side of Socotra in March and April, I invariably found a strong W.

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* This current on the Sómálí coast in the N.E. Monsoon is very uncertain. The natives say, that when the current on the Arabian coast is running one way, that on the Sómálí coast is generally opposite. In the N.E. Monsoon vessels have met strong northerly currents when to the northward, or rather when Rás Aseïr was open, which, as soon as the cape was shut in, changed to the westward. Again, currents frequently set to the eastward, between Zeïla and Berberah, during the N.E. Monsoon.

current, so much so that I have known a fast 10-gun brig take twenty days to make Tamarídah from Kolonsír, and she then succeeded only by standing over to the Arabian coast, and working up along it eastwards before she stood across; and I was obliged to anchor my vessel at the first place where I could obtain anchorage ground, and proceed in one of my boats to Tamarídah, throughout March, owing to the light airs and strong currents.

"The true cause, therefore, of these currents appears to me to be principally the pressure occasioned by the prevailing monsoons, increasing and decreasing in the same ratio as the winds, and influenced in some degree by the moon's age, and consequent change of the tides, which are by no means regular."

142. Currents of the Persian Gulf.—From May to September a current flows into the Persian Gulf, and from September to May it sets outwards. In March and April, during the little *shemal*, when a northerly set prevails, a vessel working to windward may make good 20 or 25 miles in twenty-four hours.

From September to April the current sets southward in the space between the Persian coast off Ras Task and the opposite coast of Arabia; and it is very seldom at this period that the current is found setting towards the Persian Gulf.

From March to September, though northerly winds prevail in the gulf, the current in the strait of Oman sets against the wind with so much strength that a vessel might make 20 miles a day to windward.

In October, on the coast of Persia, with the N.E. Monsoon, the current flows Southward till March; in April it changes with the S.W. Monsoon, and then flows Northward. When the S.W. Monsoon is at its height the current sets rapidly to the Eastward along the Persian coast.

Capt. C. G. Constable and Lieut. A. W. Stiffe, I.N., in the Persian Gulf Pilot, observe that—

"The greater part of the currents supposed to exist in the gulf are probably tides; a vessel crossing the gulf in six or eighteen hours would, of course, attribute the error in her position to a current. Currents, which are always very weak, are probably confined to the northern end of the gulf, where the tides are less strong than near the entrance, and during a north-wester or south-easter, are replaced by a slight current setting with the wind; after the strength of the north-wester is over, a slight counter-current may be experienced.

"McCluer states, and others have repeated after him, that on the fourth day of a shemál a current will be found setting 1 knot per hour against the wind, so that a vessel will be able to make good way to windward; but this statement requires further corroboration, at any rate asserting it as an invariable occurrence.

"On the Bátneh coast, particularly near Muskat, where the tide stream is imperceptible, there is, during the summer months (when the S.W. Monsoon prevails outside), a set towards the N.W. not exceeding 1 knot per hour. Ships coming out of the gulf should not then attempt to work down close to this coast. During the winter months, when north-westers prevail in the gulf, there is an almost continual set from ½ to 1 knot per hour, or even more, to the south-eastward, so that a ship would find it very difficult to beat up to Muskat near the coast."*

* These remarks on the currents are written with a full knowledge of the Wind and Current Charts published in 1856 by the E.I.C., from which they differ widely.

143. Currents on the West Coast of Hindostan.—From November to March—*the period of the N.E. Monsoon*—the currents along the northern portion of this coast are generally weak and variable, but from Calicut to Cape Comorin they set to the S.E.-ward with a velocity of 20 to 30 miles a day.

In March and April, when strong N.W. winds are prevalent, a S.E.-ly current runs along the entire coast. A northerly current is not unfrequent between Cape Comorin and Anjenga during January.

During the S.W. Monsoon a southerly current is generally experienced, varying from 5 to 10 miles a day on the northern part of the coast, and increasing to 20 or 30 miles a day along the southern part from Cochin to Cape Comorin; off Bombay this southerly current is rarely found, and to the northward of this port, when the wind is strong from the southward, a northerly current may be expected. The set of the stream from the overflow of the large rivers is first from the coast, and then to the southward.

The Indus discharges an immense volume of water into the Arabian Sea during the flood season—between July and September; the current, which is at first south, diverges to the S.S.W. and S.S.E., and attains a breadth of 250 miles, but it is not wholly lost in the general oceanic set until its seaward course has reached 300 miles.

144. Near the **Laccadives,** during the S.W. Monsoon, S.-ly and S.W.-ly currents are found, particularly in March. Among the islands the direction of the current is S.S.W.; in the channel separating them from the Malabar coast the set is about S.S.E.

In the Nine Degree Channel the current generally runs S.W., and rarely to the northward. In February, March, and April, its direction may be S.S.E.

The velocity of the current during this season between the Laccadives and the coast varies from 20 to 26 miles a day; amongst the islands it is from 18 to 24 miles a day.

From 40 to 60 leagues westward of these islands, W. and W.S.W. currents are prevalent, flowing at the rate of 8 to 12 miles a day. However, between the islands, a northerly current is occasionally found flowing at the rate of 8 or 10 miles a day.

145. About the **Maldeeves** the current more generally sets to the eastward than in any other direction, but modified by local causes.

When the S.W. Monsoon blows in its strength—during June, July, and August—the current sets easterly in the vicinity of the North Atoll; while at the same time, but generally in July and August, the set is W.N.W. near the southern part of the group—in the Equatorial Channel and about the South Atoll.

To the eastward of the North Atoll, generally in March and April, it runs W.; and on the contrary, near the South Atoll, between the Equator and the parallel of 4° or 5° S. Lat., it sets E.N.E.; this current has often a velocity of 50 to 65 miles a day, but sometimes it is weak and variable. In May it runs strong to the eastward near the Equator, sometimes setting at the rate of 50 to 70 miles a day near the South Atoll, between the parallels of 2° N. and 2° S.

In the Equatorial Channel and in the latitude of the South Atoll, from October to January, the current flows to the eastward; while between the parallels of 3° and 5° N., and between the Maldeeves and Ceylon, it sets westward with great strength.

Among the islands N. of the Equator the current runs S.W., and among those situated S. of the Equator it runs S. and S.S.E. at this season of the year.

During the N.E. Monsoon, but especially in November and December, on the meridian of Point de Galle, the current sets at the rate of 30 to 35 miles a day, decreasing in strength on its Equatorial edge.

146. Currents in the Gulf of Manaar.—Throughout the Gulf of Manaar and off Colombo the currents are uncertain *during the N.E. Monsoon;* sometimes, however, they have been found setting to the S.W. at a rate of 18 or 20 miles a day. *During the S.W. Monsoon* a current runs into the gulf at the rate of 8 miles a day, and setting northward, follows the direction of the coasts into Palk Bay. Generally there is the greatest variation in the strength and direction of the currents during the change of the Monsoons.

147. Currents round Ceylon.—On the E. coast of Ceylon, *during the N.E. Monsoon,* but especially in October and November, a strong current sets to the southward along the coast; rounding the S. coast it takes a westerly direction as far as Point de Galle, and sometimes as far as Colombo. Its velocity has been estimated to average 40 to 48 miles a day; and on rare occasions it has been found to amount to 94 miles.

On the W. coast of Ceylon during the same season the currents are very variable. Sometimes a fresh N.N.E. wind blowing for several days will produce a moderately strong current setting northward along the coast; this is probably a continuation of that which on the E. coast takes a southerly direction, and on the S. coast of the island flows to the westward.

During the S.W. Monsoon the current flows to the eastward on the S. coast of Ceylon, and northward on its eastern coast: its velocity is never so great as during the N.E. Monsoon—at least near the coast of the island—and it is less in proportion as it approaches the shore; off the N.E. part of the island it has been estimated to run from 10 to 20 miles a day. From May to September no current is found on the E. coast of the island; while out at sea the set may be strong to N.N.E. and N.N.W. When the westerly winds are in full force, there is little or no current within 15 or 18 miles of the land.

Capt. W. J. S. Pullen, when surveying the dangers on the S.E. coast of Ceylon (in May, June, and July, 1860), found "the currents in the vicinity of the Great and Little Bassas Reefs alike remarkable for their rapidity and eccentricity. In the line of and between the two reefs, that is, about 6 miles off shore, during the S.W. Monsoon, the current sets along the coast to the N.E. at the rate of 1 to 2 miles per hour, only diverging from this, its apparently natural course, when within the influence of the broken ground of the reefs. The rate appears to be influenced by the strength of the wind, and is, consequently, most irregular.

"Towards the close of July, when running a meridian distance to the Great Bassas from Galle, notwithstanding that he had allowed fully 10 miles easterly current, he found that he had drifted outside the line of the Bassas Reefs; and at daylight, instead of having them in sight, was at least 10 miles to the S.E. of them—no bottom with 100 fathoms of line; set by a current 26½ miles in 14 hours, or 1·85 the hour, on about a S. by E. course. Nor was this the strongest current

experienced, nor in the only place. About half-way between the two reefs a current of 2½ knots, on an E. by N. course, was found.

"Midway between the line of the reefs and the shore the direction of the current assumes a more northerly trend, and the rate is reduced, until it at length becomes absorbed in an in-shore eddy, which was almost invariably found setting along the coast to the S.W. at the rate of half a mile per hour.

"Between Point de Galle and the Bassas the current sets along the line of coast, the rates varying at different times, without any apparent cause, from 1 to 2 miles per hour, but said at times to attain the rate of even 4 knots. To the northward of the Little Bassas, close in on the eastern shore, a decided southerly set was experienced at the rate of nearly a mile an hour, which increased to a velocity of 2 knots near Trincomalie."

From September to March the southerly current is generally strong off Trincomalie, but especially so during October and November, when it sometimes runs from 50 to 70 miles a day.

148. Currents in the Bay of Bengal.—According to D'Apres de Mannevillette, the currents depend entirely on the Monsoons; *during the N.E. Monsoon* flowing S. and S.W., but to the N. *during the S.W. Monsoon.*

In April the general movement of the waters is to the N. and N.E., the current attaining its greatest strength (varying from 10 to 20 miles a day) in April and May.

In the middle of the gulf, during March and April, the current is weak and variable; between the Coromandel coast and the Nicobars, as well as at the entrance of the Strait of Malacca, it frequently sets S.W.; in the northern part of the bay it often flows southerly in March, and northerly in April.

During the S.W. Monsoon, in the eastern part of the bay and near the Strait of Malacca, the current often has a southerly set, like that near the Malabar coast.

At the distance of 40 or 50 leagues from the coasts, in the middle of the Bay of Bengal, the S.W.-erly current begins regularly about the middle of October or beginning of November—the time *when the N.E. Monsoon is well established:* before this the current is variable, setting S.S.W. and even N.W., or to some point between these two directions.

In January the S.W.-erly current loses its strength; and in February ceases in the middle of the bay, and perhaps on the coasts also, where, however, if there be any set, it runs towards the N. and N.W.

149. West Coast of the Bay of Bengal.—The current generally sets to the northward about the end of March, its velocity increasing in April and May, during which southerly winds prevail with great regularity. After May it generally slackens or ceases, and during the subsequent months generally runs southerly, though not always. At the beginning and during the strength of the N.E. Monsoon the current has been known to run 2½ and 3 knots an hour to the southward along the Coromandel coast, abating, however, in January. The northerly current along the coast of Coromandel and all the eastern coast of Hindostan from Ceylon to Balasore, varies in direction between N. and N.E.—sometimes even E.N.E. In August, the current from the swollen waters of the Ganges is strong and extends far to seaward, contributing to modify the northerly set, and partially arresting it.

During September to November a current setting W.N.W. or W.S.W. frequently prevails on the coast of Bengal. In March, the current along the entire coast most frequently flows to the southward—rarely to the northward. In the middle of the bay, during March and April, the current is very weak and variable.

150. Currents on the East Coast of the Bay of Bengal.—On the eastern side of the Bay of Bengal, and near the Strait of Malacca *during the S. W. Monsoon*, the current sometimes sets to the southward.

During the N.E. Monsoon, near the Nicobar Islands, and also between them and the island of Junkseylon, a strong N.W. current is found, which sometimes, however, sets N. Between Cape Negrais and Chittagong, the current is seldom strong at any season, but from the middle of December to May a southerly current is occasionally experienced there, and from June to September a northerly set.

Throughout the bay, in the month of December, there are no currents but those produced by the tides.

151. Currents in Malacca Strait.—The general current in Malacca Strait is to the northward all the year round, especially in the middle of the channel. *During the N.E. Monsoon*, while it is running northward from Arroa island to Junkseylon and Pulokondo, it occasionally sets to the southward, along the Malay coast, where it is always more or less complicated by the tidal stream.

During the S. W. Monsoon the set of the current along the coast of Pedir, and thence out of the Strait, is to the westward; whilst at the same time, on the opposite side, between Pulokondo and Junkseylon, it runs to the northward.

152. Currents on the West Coast of Sumatra.—On the west coast of Sumatra the current is seldom strong, generally not more than 12 to 18 miles a day.

The Monsoons are so variable on this coast that they seldom influence the current to any great extent, still the general prevalence of westerly winds is such as to drive a considerable body of water towards the west coast of Sumatra, whence it sets to the S.E. along the coast; it very rarely runs N. In June and July, between Analaboe and Acheen Head, a N.W. current, running 20 or 30 miles a day, has been experienced.

After the month of August, near Acheen, and thence along the S.W. coast of Sumatra, as well as on the south coast of Java, the current sets strongly to the eastward. A portion of the westerly current from Malacca Strait very frequently turns the N.W. point of Sumatra, and sets southward along the coast.

153. In Sunda Strait, from January to April, the current sets to the eastward, and during the rest of the year it has a westerly direction. The velocity of these currents is sometimes as much as 3 and $3\frac{1}{2}$ knots an hour.

154. Throughout the Bay of Bengal the currents are rarely, if ever, as strong as in the Arabian Sea; and they are always influenced by tidal currents near the coast. Owing to the difference in the set of the currents in the Northern Indian Ocean during the two Monsoons, two Charts of that part have been compiled, illustrating the general set during the prevalence of each periodical wind.

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Most of the foregoing observations on the Bay of Bengal are from D'Apres de Mannevillette, who has been, more or less, followed by all subsequent writers. It remains to draw the attention of the navigator to a paper* on the Currents of the Bay of Bengal during the S.W. Monsoon, by J. A. Heathcote, Esq., I.N.:—

"Ceylon.—From the S.W. corner of the peninsula of India, the current of the S.W. Monsoon runs in a direction varying from S.E. to S.S.E., according to the distance from the land, and at the rate of ½ to 1½ mile per hour, until about the latitude of Point de Galle, it is diverted into a more easterly course. On the line between Cape Comorin and Point de Galle, there is a strong set into the Gulf of Manaar, which begins from 30 to 35 miles outside this line, and may prove a source of danger. Vessels from Bombay to the eastward should therefore be careful to keep within the limits of the favourable S.E.-ly current. South of Ceylon, within 30 miles of the coast, the current runs strongly to the eastward from ¾ to 2 miles an hour; but farther south, that is, between the parallels of 4° and 5°, its direction is more southerly, or about E.S.E. On the east coast of Ceylon a strong current exists to S.S.E. and S., taking more or less the direction of the land, and running at the rate of ½ to 1½ mile an hour, or as much as 40 miles a day.

"The inaccuracy of a deduction of Horsburgh is here apparent. He states the current at this season to be here running in an entirely opposite direction, that is, to the northward; for he argues that, as it runs to the southward in the N.E. Monsoon, it may most probably run in a contrary direction in the opposite Monsoon. Such, however, is not the case. The southerly current is well established;† not only are numerous instances of its effects on record, but the result of my own investigations has also been confirmed by the observations of officers very recently employed on the survey of the east coast of Ceylon. This current is felt not farther than from 40 to 50 miles off shore, and from its eastern limits a N.E.-ly set begins. I think it very possible that future observations may prove that this current is a return of that which flows with great velocity round the S.E. corner of Ceylon to the N.E.-ward, a portion of which may be found to bend to the northward; for, under circumstances somewhat analogous, a return current of this description *is* found off Cape Guardafui in Africa. At the Bassas rocks it is met by that already described as setting eastward off the S. coast of the island; and they both together then take a N.E.-erly, and afterwards an E.N.E.-erly direction across the bay; except that in the vicinity of the parallel of 5° N. the set is less northerly, while S. of that parallel it becomes E.S.E.-erly.

"Coromandel.—On the coast of Coromandel a northerly set prevails within 30 miles of the shore, as far N. as the parallel of 15°; outside these limits it turns to the north-eastward. North of the parallel of 15° it takes the direction of the land as far as Gordeware Point, and thence trends in an easterly and afterwards a north-easterly direction across the bay. From False Point nearly to Vizagapatam we have a strong S.E. current of ¾ to 1½ mile per hour, within 30 miles of the coast; but, farther to the eastward, it gradually succumbs to the influence of the wind, and joins the general set, first in a north-easterly and then in an easterly direction across the bay.

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* "Jour. Roy. Geographical Society, 1862," p. 234.

† Logs of the *London*, July, 1830, of the *Warren Hastings*, and of the *Kellie Castle*, May and June, 1833, and of H.M.S. *Cambrian*, July, 1850, &c. &c.

"Aracan.—On approaching the coast of Aracan the current becomes more northerly, and finally is governed by the form of that land, and runs strongly to the N.N.W-ward. It thus becomes a very dangerous current for vessels making Akyab during the S.W. Monsoon. In such cases it is frequently necessary to heave-to off the port during the night; and if the existence of this current be not known, and proper precaution be not taken to keep to the southward, the vessel may be drifted into dangerous proximity to the reefs to the eastward of the harbour. In some of the works on this subject, all mention of this current is omitted, in others it is represented as running in a contrary direction; it is therefore the more necessary to call attention to it, as either the want of information on the one hand, or the existence of erroneous information on the other, may lead to injury to the greatly increasing trade of Akyab.

"Circulation of Currents and Tidal Waves.—This northerly current along the coast of Aracan may probably have a very intimate connection with the southerly current on the coast of Ganjam. They may both belong to the same system of circulation, the Aracan current finding its way to the westward along the sea-face of the Sunderbunds, and becoming the southerly current at False Point, and being again thrown on the coast of Aracan, as before described. But, if this be the case, any positive trace of the westerly movement is not to be discerned, or at least is most difficult to recognise in the peculiar rotatory tides which are found to seaward of the Sunderbunds. These tides set, at different periods of each tide, towards every point of the compass. The flood begins at W., at the first quarter it flows W.N.W., at half-flood it is about N., the last quarter being to E.N.E. The ebb begins at E., half-ebb runs about S., and the last quarter ebb W.S.W., thus forming a complete rotation. But although these rotatory tides go far to hide the current itself, its effects while working its way to the westward are observable in the configuration of the sand-banks off the mouths of the Ganges. The current would here exert its greatest force, and these sands are curved to the westward in a remarkable manner, their very form proving that they are under an influence stronger than that which bends the banks off the mouth of the Hoogly into their S.S.E.-erly position; the latter being due to the S.W. Monsoon itself, while the former is the effect of the current of the same Monsoon concentrated, as it were in a funnel, by the shores of Aracan. That the position of the banks off the mouths of the Ganges is *not* caused by the N.E. Monsoon, admits of but little doubt; for this portion of the sea is peculiarly sheltered from the N.E. winds, and they cannot be supposed to exert a force sufficient to affect the position of these sand-banks, as, were it so, the effects of this force would be apparent in a much greater degree to the westward; and the sands at the entrance to the Hoogly would lie in a south-westerly direction instead of their present south-easterly one.

"The S.E. Current.—A strong current to the south-eastward at the rate of $\frac{3}{4}$ to $1\frac{3}{4}$ mile per hour begins about Lat. 18° and Long. 90°, flows down towards Preparis Island, and then turns more easterly into the Gulf of Martaban. There is, no doubt, an accumulation of waters in the N.E. portion of the bay caused by the steady blowing of the S.W. Monsoon across the whole breadth of the sea; and this current seems to be the result of these waters attempting to find an exit. It may be of important advantage to ships from Calcutta bound to ports to the eastward, for it will materially help them in getting to the southward against the wind. From its eastern edge the currents turn off to the N.E.-ward, until near the coast of Pegu

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they become governed by the form of the land, and take a course to the N.N.W., joining those on the coast of Aracan already described.

"ANDAMAN ISLANDS.—The Andaman Islands play an important part in the system of currents of the S.W. Monsoon. They present an obstruction to the general set of the waters in the middle of the sea; and the same phenomena are observable in their vicinity as are to be seen wherever fluids in motion meet with an impediment under similar conditions. The currents rushing to the eastward round the N. and S. extremes of the islands meet at a short distance beyond them, become confused and irregular, and throw up high ripplings; while immediately under the shelter of the islands an eddy is found, running to the northward from ½ to 1 mile per hour. That portion of the sea to the westward of the Andaman Islands is wisely avoided during the S.W. Monsoon, the reefs lying to windward of the islands presenting dangers to which every prudent mariner would gladly give a wide berth; and I have therefore been unable to find examples of actual experience of the currents to the west of the Andamans. But it is more than probable that the north-easterly set extends close up to the islands; the waters becoming, in a certain measure, heaped up on their west side, and making their way through them and round them wherever they find an opening. Evidence of this action is particularly observable at the eastern mouth of the narrow strait which separates the South and Middle Andaman. This strait was closely examined on the occasion of the expedition—of which DR. MOUAT was the head—appointed, towards the close of the Indian mutinies, to select a site for a penal settlement in these islands. I may remark, *en passant*, that the manuscript of the original survey of the Great Andaman by LIEUT. BLAIR, executed at different periods between 1788 and 1796, and drawn on a large scale, was in the hands of the expedition, and was found to be beautifully accurate in all its details. It was our sure guide in the intricacies of channels of which no other knowledge but that afforded by this chart was to be obtained; and in those few places where it is deficient in the representation of details, we found that they had not been passed over until it had been ascertained that they could be of no practical utility. The geographical position of these islands has also been determined so far satisfactorily, that though it may not be incapable of a still nearer approach to exact truth, yet it has, I believe, attained already to a higher degree of accuracy than can be claimed for the positions at present assigned to many places of far higher commercial importance.

"MIDDLE STRAIT, GREAT ANDAMAN.—The strait between the Middle and South Andaman is one of peculiar formation; it is for the most part a narrow deep crevice, between the mountains by which it is bounded on both sides, and which are in no part distant from it much more than 300 yards, while at places the rocks completely overhang it. The channel is thus narrowed at one or two points to about 80 yards, its general breadth being from 400 to 500 yards. Its depth varies, but it is mostly deepest where it is narrowest, 25 fathoms being found where the rocks abut immediately upon the channel, and 6 fathoms where they are more distant; a depth of from 12 to 14 fathoms is, however, very generally found throughout the narrow part of the strait—its western portion, where it runs north and south, being both broader and shallower. Its western entrance from the sea has now a depth of from 4 to 6 fathoms, it having been filled up to some extent during the last seventy years, while the interior of the strait has suffered scarcely any perceptible change. We found no variation in the depth nor in the contour of the shore; even small islets of less than 50 yards in length appearing in precisely the same state as to size, eleva-

tion, and position, as represented by the first surveyor. But while the depths before mentioned are found in the strait itself, its eastern mouth is almost closed by a bank of sand and mud, which has but from 6 to 10 feet water on it; and this, I believe, may be looked upon as the effect of the current of the S.W. Monsoon, which being driven, as before described, upon the west coast of the island, finds its way through this narrow strait, and deposits at its exit the sediment which it had taken up or set in motion on its passage. The area of drainage of this strait, though small, is sufficient to throw into it a considerable quantity of silt and sand; and the very form of this bank indicates that it has come out *from* the strait, and not that it has been thrown *into* the strait by any effort of the winds and currents of the N.E. Monsoon; and, moreover, were this latter the case, some corresponding effects would surely be observable at some of the other openings on the same side of the island, such as Port Cornwallis, the entrances north and south of Sound Island, and Port Blair, at all which places instead of shoals we find deep water. The strait between North and Middle Andaman is completely closed; it is now no longer a strait, if it ever was one; and this is not at all certain, for BLAIR had not the opportunity of surveying it. He probably found it impossible to enter even in a boat, as we did.

"In the open sea between the Mergui Archipelago and the Andamans, the influence of the prevailing wind again shows itself in a north-easterly set of $\frac{1}{2}$ to $1\frac{1}{2}$ mile per hour.

"A S.E.-ly and S.S.E.-ly current sets with considerable force down through the Mergui Archipelago and past the Seyer Islands; and from lat. 10° N. and long. 95° E., a strong current in the same direction sets, at the rate of $\frac{3}{4}$ to $1\frac{3}{4}$ mile per hour, into the entrance of the Malacca Strait. This current may probably be found some degrees farther to the eastward; but I have been unable to gather any facts in support of such a theory, though I know of nothing in opposition to it.

"The Ten-Degree Channel, between the Little Andaman and Car-Nicobar island, is so seldom made use of as a passage for ships during the S.W. Monsoon, that I have not been able to gather a sufficient number of facts to establish the existing current.

"SUMATRA.—On the north coast of Sumatra the current of the S.W. Monsoon follows the form of the land to the westward; but this portion of the sea is sheltered from the influence of the wind. A slight return current to the eastward may be experienced in about lat. $6\frac{1}{2}$° N.

"Between Acheen Head and the Great Nicobar an extraordinary current is found running to the south-westward in the teeth of the Monsoon at the rate of $\frac{3}{4}$ to $1\frac{1}{2}$ mile per hour; it extends to the parallel of 5° N., and nearly to long. 92° E., when it turns to the S. and S.E. Where this current meets the ordinary N.E.-ly set, strong ripplings are observed. It may be taken advantage of by ships bound westward from the Straits of Malacca, and though it is at present but little known, its existence is well substantiated by the experiences of the *Herefordshire* in August, 1825; the *Orwell* in July, 1832; the *Marquis Huntley* in August, 1831; H.M.S. *The Royalist* in June, 1845; the *Cambrian* in July and August, 1844; the *Serpent* in 1845, and again 1851; and others."

155. Currents in the Indian Archipelago—S. of the Equator.—Among the **Islands of the Indian Archipelago,** the waters of the ocean being subdivided into a number of comparatively limited areas, there is no space for the development of the Equatorial Current; hence whatever currents prevail are under the control of the prevalent wind of the season, being westerly with northing during the E. and S.E. Monsoon—easterly with southing during the W. and N.W. Monsoon—modified at all times by the tidal streams.

As before observed (p. 226), the current is easterly in the **Strait of Sunda** from January to April, and westerly during the remainder of the year—setting sometimes at the rate of 60 or 80 miles a day.

In the **Java Sea,** both the easterly and westerly current is influenced by the set of those in the straits of Sunda, Banka, and Gaspar. JANSEN, speaking of the currents in this region, says:—"It is sufficiently important to fix the attention, seeing that these circumstances have great influence upon the winds in the many straits of the Archipelago, in which strong currents run most of the time. Especially in the straits to the east of Java these currents are very strong. I have been unable to stem the current with eight-mile speed. However, they do not always flow equally strong, nor always in the same direction. They are probably the strongest when the tidal current and the Equatorial Current meet together. It is said that the currents in the straits during the E. Monsoon run eighteen hours to the N. and six hours to the S., and the reverse during the W. Monsoon. The passing of the meridian by the moon appears to be the fixed point of time for the turning of the currents. It is probable that the heated water of the Archipelago is discharged to the N. during the E. Monsoon, and to the S. during the W. Monsoon."

In the **Gaspar, Carimata,** and other straits in this part of the Archipelago, the currents set southerly with the N.E. Monsoon, and northerly with the S.W. Monsoon, but their direction greatly depends on the lay of the land and on the tidal stream; in fact, the latter are very strong throughout the whole Archipelago and in the China Sea, where the in-draughts between the islands produce strong eddies, and overfalls—resulting from the meeting of the streams over an uneven bottom—are very common. It should also be remembered that the time of high water at F. and C. varies in the two Monsoons, not being a *constant* as in other parts of the ocean.

In the Strait of **Macassar** the current is more frequently southerly than northerly throughout the year; it is always strong during the N.E. Monsoon, but especially so in December, January, and February; during the S.W. Monsoon if there is any current it as often sets gently to the S. as to the N.

Into the **Sea of Celebes** and the **Sulu Sea** there is generally a weak W. or S.W. current from the Pacific in both Monsoons, subject, however, at times, to a strong easterly set along the north shore of Celebes and the south shore of Mindanao. Hereabouts the currents are always remarkable for their variability—for from this part of the sea originates the Easterly Counter Current of the Pacific Ocean.

The currents are very rapid at all times in the narrow channels separating the chain of islands extending from Java to Timor.

In the **Arafura Sea** the set is still with the prevalent Monsoon, and its velocity depends on the force of the wind—seldom, however, exceeding 20 or 30 miles a day.

In the **Banda Sea and Molucca Channels** the strength of the current is greater during the N.W. Monsoon than when the S.E. Monsoon is prevalent; but

as the direction of the wind is less regular here than in the neighbouring seas, so is the direction of the current.

On the **N.W. Coast of Australia** a north-easterly current prevails, derived from the northerly current which, from Cape Leeuwin, sets along the west coast of the continent to join the Equatorial Current of the Indian Ocean. It is met with all the year round, but its velocity is very uncertain—probably never more than 12 to 18 miles a day, except in the Westerly Monsoon, when a strong easterly current sets through that part of the ocean southward of Java and the Sunda islands, and with this unites, to pass into the Arafura Sea. It may be also a prolongation of this north-easterly current which, on the north side of the Serwatty islands, sets to the eastward during the S.E. Monsoon, where, in the Arafura Sea, the current is westerly.

156. The Currents of the China Sea.—The currents of the China Sea are uncertain, depending for direction and velocity on the general prevalence and strength of the Monsoons—varying as these vary.

1. *During the N.E. Monsoon :—*

In the south-western part of the China Sea, along the east side of Malacca and the south coast of Cochin China, the current generally sets to the southward about the middle of October, and continues in that direction till the month of April. In March it sets constantly southward between the Anamba Islands and Singapore, with the light easterly winds and calms prevalent during that month.

On the **east coast of Cochin China,** and near the island of Hainan, the current, variable between S. and S.W., commences about the middle of September ; it is strongest near the coast from 15° to 11° N. Lat., and becomes weaker in proportion as it flows to the southward.

During the strength of the N.E. Monsoon, from the parallel of 14° N. to Cape Padaran, the current near the coast frequently runs at the rate of 40, 50, and even 60 miles a day. This velocity, however, is not persistent, and it is certainly weaker near Cape Padaran, as well as across the entrance of the Gulf of Siam, where its direction is S.W.

Near the south coast of China, at this season, the current generally takes a W.S.W. direction, nearly parallel with the coast, and it is especially rapid after strong winds or a typhoon. At about 25 leagues from the land it is never so strong as in shore and between the islands; it is also stronger in shoal water than where the soundings are 30 or 40 fathoms.

In the **Formosa Channel**—between the island and the main—the current sets south. When the wind is strong, it takes a S.W. or southerly direction in the strait between the **south end of Formosa** and the north side of Luzon ; here, however, when the wind is variable, the set is often northerly.

On the **west coast of Luzon** the current is very variable — sometimes southerly and sometimes northerly, as is the case on the **coast of Palawan,** where it depends entirely on the wind, and only becomes strong in proportion as it is driven by the gale.

2. *During the S.W. Monsoon :—*

In the **middle of the China Sea** a northerly set begins in May, or sometimes

at the end of April. When the S.W. Monsoon is strong, the current sometimes maintains a northerly and N.E. set until September; but when the Monsoon is light or moderate, the current is variable: thus there is no constancy during this season, and after the first burst is over, if there is any set it is as likely to be to the S. as to the N.E.

Off the **coast of Cochin China,** north of Cape Padaran, the current is always weak during the S.W. Monsoon; and between this cape and the Gulf of Tonquin it sometimes sets to the northward and sometimes to the southward.

With a N.W. gale prevailing in the Gulf of Tonquin, as well as to seaward, the current near the **Paracels** (and in that part of the sea over which these winds extend) generally sets S.W. or S., producing a high sea, for the direction of the currents in that case is oblique to that of the wind.

On the **south coast of China,** the current, during strong S.W. winds, sets to the eastward with the trend of the coast. The freshes generally produce a westerly current, and its rate between Macao and the island of St. John is from 1 to 2 miles an hour—its direction varying between W.S.W. and W.N.W.; this is but a temporary set, not lasting throughout the Monsoon.

Off the **coasts of Luzon and Palawan** the current sets to the northward during the whole of the S.W. Monsoon; but close in shore it is weak and scarcely felt.

Strong westerly winds near the **Bashee Isles** produce an easterly current; the set is more frequently, however, to the northward, varying at times from N.N.W. to N.E., and strong.

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157. The late Commander W. T. Bate, R.N., referring to the vicinity of Palawan, where he had been employed surveying, says:—

"In the **Palawan Passage,** or **Balabac Strait,** the currents are influenced by the prevailing winds, the set being found to be in the direction in which it is blowing, with a velocity proportionate to the wind's force. Westerly winds are remarked as forcing through the strait a *strong* current to the eastward.

"In the **North Balabac Strait,** the current also depends greatly on the prevailing winds. It has been observed in both straits, that in the months of November and December, after a succession of westerly winds, the current sets constantly to the eastward, slackening only on the ebb tide; while in July, after a continuance of unusually fine weather, with light E. and S.E. winds, it sets with the same velocity, —viz., from $\frac{3}{4}$ to $2\frac{1}{2}$ knots in the opposite direction. The mean velocity observed for thirteen consecutive hours was $1\frac{3}{4}$ mile.

"In **Ologan Bay,** no perceptible current has been observed, except after heavy rains, or when westerly winds have prevailed, when there is a slight out-draught.

"On **East Coast of Palawan,** the currents appear to depend chiefly on the prevailing wind. In the Pasco Channel, in the month of June, the current was observed running at the rate of $3\frac{1}{2}$ knots an hour to the northward."

158. Gulf of Siam.—In both Monsoons, the China Sea current barely enters the Gulf of Siam, but rather sets across its entrance between Pulo Obi and the Redang islands. At the head of the gulf, during the N.E. Monsoon, a strong westerly current is frequently found, against which it is necessary to guard when making the

Bangkok River, to avoid being set to leeward. From Cape Chong P'ra to Cui (or Sano-roi-yot) Point a northerly current may be expected during the S.W. Monsoon. Generally, near the land, the set is with the prevalent Monsoon, and strong in proportion to the force of the wind; but in the middle of the gulf the current is weak and variable.

Along the **East Coast of China** the current is northerly during the S.W. Monsoon, and southerly during the N.E. Monsoon; varying in velocity from 1 to 3 or 4 knots an hour, according to the strength and duration of the wind, and frequently throwing ships out of their reckoning.

Off the **Pescadores,** a northerly set of four knots an hour has been experienced during the Southerly Monsoon, with the flood to the northward, slacking, however, with the ebb, but not ceasing entirely: the "China Pilot" says that navigators "may safely allow that the effect of the current and tidal stream together, will set a ship, according to the prevailing Monsoon, seventeen miles in one tide."

To the eastward of Formosa, about **Botel-tobago,** the currents are also changeable with the Monsoons.

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159. Currents of the Western Pacific.—The **Great Equatorial Current** of the Pacific flows steadily from the American Continent towards the Islands of the Indian Archipelago, at the average rate of from 30 to 24 miles a day; slightly stronger, however, in its northern than in its southern area, and on the western side of this ocean presenting many anomalies.

The **Equatorial Counter Current** in the Pacific sets to the eastward, between the parallel of 6° north and the Equator, separating the Great Equatorial Current into two distinct bodies of water; it is probably due, in the first instance, to the *drift* of the Monsoon, and then augmented by a set from the North and South Equatorial Currents, as they are turned aside by the opposing shores of New Guinea and the Filippines; it sometimes attains a velocity of 48 to 60 miles a day, at other times it does not exceed 12 or 13 miles, perhaps less. This easterly current in the Pacific, near the Equator, has been recognised by all navigators, and is well known to all whalers, but the limits of its extension are by no means certain; Captain Wilkes attributes its origin to the set from the Indian Ocean along the north-west coast of Australia, but this is more than doubtful.

The **South Equatorial Current** flows to the westward, between the Equator and Lat. 26° S.; but near the meridian of 175° W. it probably begins to feel the effect of the obstructions to its westerly progress, and a branch, under the name of the **Rossel Current**, takes a N.N.W. direction, passing between the New Hebrides and Solomon's Group, and thence by the south coast of New Guinea towards Torres' Straits. Its average velocity is 8 or 10 miles a day. Within the Barrier reefs it is not so much the current as the tidal streams which require attention.

About the meridian of 170° E. another branch declines to the southward, and on the parallel of Sandy Cape is well marked as the **Current of the East Coast of Australia.** Its course is successively W.S.W., S.W., and S.S.W., and finally becomes south, running along the eastern coast of Tasmania. Its velocity is very irregular, varying from 24 to 60 miles a day, and is persistent in its southerly course all the year round off the Australian coast, often strongest during S.E.-ly gales, when it takes a westerly direction towards the land; close in shore and in the bights there

is generally an eddy current setting to the northward at the rate of 10 or 20 miles a day.

The **North Equatorial Current,** in the vicinity of the Caroline Archipelago, is partially under the influence of the Monsoons which prevail there; from May till October, the westerly set is greatly diminished, and during the strength of the S.W. Monsoon the current occasionally flows very slowly (six miles a day) to the E.N.E. and N.E.; from October to May, the general westerly set of the equatorial current is prevalent, but it inclines to W.S.W. and even S.W., and probably at this season a portion of it may be deflected into the easterly counter current. To the northward and westward of the Ladrones, the Equatorial stream pursues its course steadily towards W.N.W., becoming more and more northerly as it approaches the opposing shores of Luzon and Formosa; decreasing in breadth, but at the same time acquiring increased velocity; eventually it curves to the N. and N.E., and passes the Loo-Choo group and the Japan Islands as the **Japan Current,** or **Kuro Siwo**—a considerable body of warm water resembling in many respects the Gulf Stream of the Atlantic.

160. The following remarks on the Japan current are from the observations of Lieut. Silas Bent, U.S.N., made during the period of the American expedition to Japan in 1852–54:—

"The existence of a N.E. current on the coast of Japan was noticed by Cook, Kruzenstern, and other explorers, and has, of course, not escaped the attention of more recent intelligent navigators; but I believe no systematic series of observations upon it have hitherto been made.

"The Japanese are well aware of its existence, and have given it the name of 'Kuro-Siwo,' or Black Stream, which is undoubtedly derived from the deep blue colour of its water when compared with that of the adjacent ocean.

"The fountain from which this stream springs is the great equatorial current of the Pacific, which, in magnitude, is in proportion to the vast extent of that ocean when compared with the Atlantic.

"Extending from the Tropic of Cancer, on the north, to Capricorn, in all probability, on the south; it has a width of near three thousand miles, and with a velocity of from 20 to 60 miles per day, it sweeps to the westward in uninterrupted grandeur, around three-eighths of the circumference of the globe, until diverted by the continent of Asia, and split into innumerable streams by the Polynesian Islands; it spreads the genial influence of its warmth over regions of the earth, some of which—now teeming in prolific abundance—would otherwise be but barren wastes.

"One of the most remarkable of these offshoots is this **Kuro-Siwo, or Japan Stream,** which, separated from the parent current by the Bashee islands, and south end of Formosa, in latitude 22° N., longitude 122° E., is deflected to the northward along the coast of Formosa, where its strength and character are as decidedly marked as those of the Gulf stream on the coast of Florida. This northwardly course continues to the parallel of 26° N., when it bears off to the northward and eastward, washing the whole S.E. coast of Japan, as far as the Straits of Tsugar, and increasing in strength as it advances, until reaching the chain of islands to the southward of the Gulf of Yedo, about the meridian of 140° E., where its maximum velocity, as shown by our observations on one occasion, was 72, 74, and 80 miles respectively per day. Its average strength from the south end of Formosa to the Straits of

Tsugar is found to be from 35 to 40 miles per twenty-four hours, at all seasons that we traversed it.

"Near its origin, the Kuro-Siwo, like the Gulf stream, is contracted, and is usually confined between Formosa and the Majico-sima group, with a width of one hundred miles. But to the northward of this group it rapidly expands on its southern limits, and reaches the Loo Choo and Bonin Islands, giving it a width to the northward of the latter of about five hundred miles.

"To the eastward of the meridian of 143° E., in latitude 40° N., the stream takes a more easterly direction, allowing a cold current to intervene between it and the southern coast of Yesso, where the thermal change in the water on leaving the stream is from 16° to 20°. But from the harassing prevalence of fogs during the limited stay of the squadron in that vicinity, the reports and tables do not furnish sufficient data to prove *conclusively* the predominant direction of the cold current through the Straits of Tsugar, particularly as the tide ebbs and flows through them with great rapidity. Yet from what we have, I am inclined to believe that it is a current from the Arctic ocean, running counter to the Kuro-Siwo, and which passes to the westward through the Straits of Tsugar, down through the Japan Sea, between Corea and the Japanese islands, and forms the hyperborean current on the east coast of China, which is known to flow to the southward, through the Formosa Channel into the China Sea. For to the westward of a line, connecting the north end of Formosa and the south-western extremity of Japan, there is no flow of tropical waters to the northward; but, on the contrary, a cold counter current filling the space between the Kuro-Siwo and the coast of China. As far as this cold water extends off the coast, the soundings are regular, and increase gradually in depth; but simultaneous with the increase of temperature in the water, the plummet falls into a trough similar to the bed of the Gulf stream, as ascertained by the United States' Coast Survey.

"The surface of this counter current is, no doubt, influenced in some measure by the S.W. Monsoon, and during the season of that wind a portion of it is forced out between Formosa and Japan, to mingle its waters with the Kuro-Siwo; but so well is its existence known to vessels trading on the coast of China, that they very rarely, if ever, attempt to *beat* to the northward through the Formosa channel, but almost invariably make the passage to the eastward of Formosa during the prevalence of adverse winds, though those winds may be stronger there than in the Formosa channel.

"Of the power of these two currents I can speak from experience, in addition to the facts disclosed by the observations now under consideration; for in the winter of 1848, when attached to the U.S. ship *Preble*, commander James Glynn, and bound from Hong Kong to Japan, we struggled for three days, after leaving the port, against this south-west current, setting down through the Formosa channel, without making a single mile on our course to the eastward, and were compelled to resort to the expedient of working along in-shore, and anchoring whenever the tide was combined with the current against us. A number of days were thus toilsomely spent before reaching Breaker Point, on the coast of China. We then stretched across the channel, in the middle of which we felt the full strength of the south-west or counter current. But on doubling the south end of Formosa, we immediately fell into the Kuro-Siwo, and were borne by it ninety-two miles, dead to windward, in less than three days, whilst lying-to, under storm-sails, in a stiff gale from the northward and eastward.

"There is an increased temperature of both the air and the water the moment this stream is entered, but a predominant thermal change in the water, which almost invariably continues superior in temperature to that of the air until leaving the stream again. On the north-western edge of the stream the transitions are sudden and extreme, varying, according to the latitude, from 10° to 20°. On the south-eastern side, the change is less abrupt, and from the gradual approximation of the thermal ranges of the air and water, its outline is rendered less distinct and definite.

"Along the borders of the stream where it chafes against the torpid waters of the ocean and counter currents, as also in its midst, where whirls and eddies are produced by islands and the inequalities in its bed, strong tide-rips are constantly encountered which often resemble heavy breakers on shoals and reefs, and become finger-boards, as it were, to warn the seaman of the otherwise unseen influence which may be bearing his ship far from the intended track, and, perchance, upon some of the many fearful dangers that sprinkle that region of the sea.

"The Gulf Stream, as delineated in the Coast Survey Report of Professor A. D. Bache, for 1854, has a striking resemblance to the Kuro-Siwo. The thermal changes in the Kuro-Siwo indicate a depression of only a few degrees in the water thermometer, and should more properly, perhaps, be termed *cool* strata, as compared with the rest of the stream, for in all instances these strata maintain a superior temperature to the atmosphere above them; and if the hyperborean current is, as I have supposed, entirely separated from the Kuro-Siwo by its passage through the Straits of Tsugar to the westward of Japan, I am inclined to think that there is no counter-current *underlying* the Kuro-Siwo, as is the case with the Gulf Stream. This, however, can be determined only by experiments with the deep-sea thermometer, and the usual apparatus for determining sub-surface currents, none of which were made by the expedition, as its special object was of primary importance, and all other subjects within the field of our observations were necessarily of subordinate consideration, and were obliged to be made as opportunity and the ordinary facilities of our situation would permit.

"Lieut. M. F. Maury says, that 'the maximum temperature of the Gulf Stream is 86°, or about 9° above the ocean temperature due to the latitude.' This maximum temperature coincides pretty nearly with that of the Kuro-Siwo, as shown by the daily means of our observations; but the difference between the temperature of the Kuro-Siwo and the 'ocean temperature due to the latitude' is, by the same observations, shown to be greater than that of the Gulf Stream, amounting on an average to about 12°.

"There is a floating sea-weed found in the Kuro-Siwo, similar in appearance to the *fucus natans* of the Gulf Stream; but the specimens collected by the expedition were unfortunately lost before being submitted to botanists for examination, and it is therefore yet undetermined whether they are identical or not.

"It may not be uninteresting to state, that Lieut. W. L. Maury found sprigs of coral while surveying off the harbour of Simoda, in latitude 35° N.

"There is a striking coincidence not only in the *recurvation* of these oceanic streams, but of the general coincidence in *their* recurvation with that of the storms of the Northern Hemisphere. Mr. Redfield is of the opinion that the recurvation of storms between the parallels of 20° and 30° north and south latitude, in all parts of the world, as shown by observations, is but partially dependent upon the influence of land, and is 'to be ascribed mainly to the mechanical gravitation of the

atmospheric strata as connected with the rotative and orbital movements of the different parts of the earth's surface.'

"These atmospheric meteors, originating generally about the tenth parallels of latitude, north and south, are impelled by this influence directly towards the poles, but are at the same time borne to the westward by the Trade winds. This compound force gives them an oblique direction to the north-west and south-west, until arriving at the outer limits of these winds, about the parallels of 25° or 30°, where the storms become released from their influence, and continuing their course to the north and south towards portions of the earth's surface, having less rotative velocity than that from whence they came, they gradually *recurve*, and soon assume a path to the north-east and south-east, which they pursue until dissipated by expansion, or have fulfilled their mission by a restoration of the atmospheric equilibrium, a disturbance of which had probably given rise to them. The converse of this rotatory influence of the earth is thus described by Dr. Hadley and Dr. Franklin:—'The air under the Equator and between the tropics being constantly heated and rarefied by the sun, rises; its place is supplied by air from the higher and polar latitudes, which, coming from parts of the earth that had less motion, and not suddenly acquiring the quicker motion of the equatorial earth, becomes an east wind blowing westward, the earth moving from west to east and *slipping under* the air.' This general law of nature operates in the same manner upon the waters of the ocean as upon the atmosphere, when, by any disturbing cause, portions of the former are set in motion from about the Equator, modified, of course, by such local obstructions of continents, islands, &c., as may be encountered in their path.

"Redfield furthermore says:—'The Gulf Stream from Florida to Newfoundland is for the most part imbedded or stratified upon a current which is setting in the opposite direction in its progress from the polar regions. By this action the great stream of drift ice from the polar basin is brought within the dissolving influence of the Gulf Stream; and the Grand Bank itself, perhaps, owes its origin to the deposits which have resulted from this process during a long course of ages. The icebergs being carried southward by the deeper Polar Current, their rapid destruction is here effected by the tepid water of the Gulf Stream. These two streams of current, like other currents, both atmospheric and aqueous, pursue each its determinate course, the Gulf Stream being thrown eastward by the greater rotative velocity which it acquired in latitudes nearest the Equator, and the Polar Current being thrown westward along the shores and soundings of the American continent and its contiguous ocean-depths by the tardy rotation which it derived in higher latitudes. Were the influence of winds wholly unfelt upon the ocean, it is probable that the same system would still be maintained in all its essential features by the mechanical influence of the earth's rotation, combined with an unstable state of equilibrium.'

"Maury, in a paper 'On the Gulf Stream and Currents of the Sea,' read before the National Institute (U.S.), April, 1844, says:—'A geodetic examination as to the course of the Gulf Stream does not render it by any means certain that it is turned aside by the Grand Banks of Newfoundland at all, but that in its route from the coast of Georgia, as far towards the shores of Europe as its path has been distinctly ascertained, it describes the arc of a great circle as nearly as may be. Following the line of direction given to it after clearing the straits of Florida, its course would be nearly on a great circle, passing through the poles of the earth. That it

should be turned from this, and forced along one inclining more to the east, requires after it leaves these straits the presence of a new force to give it this eastward tendency. And have we not precisely such a force in the rate at which different parallels perform their daily rounds about their axis? In consequence of this the stream, when it first enters the Atlantic from the Gulf, is carried with the earth around its axis at the rate of about two miles and a half a minute faster towards the east than it is when it sweeps by the Grand Banks of Newfoundland.

"'That this explanation as to its eastward tendency should hold good, a current setting from the north towards the south should have a westward tendency. Accordingly, and in obedience to the propelling power derived from the rate at which different parallels are whirled around in diurnal motion, we find the current from the north which meets the Gulf Stream on the Grand Banks taking a south-westerly direction, as already described. It runs down to the Tropics by the side of the Gulf Stream, and stretches as far to the west as our shores will allow.'

"That this theory of rotative influence may or may not be correct, it is not my province to discuss; but I was forcibly struck with these coincidences of recurvation when the tracks of the Gulf Stream and Kuro-Siwo, together with the paths of the hurricanes, were traced upon the same chart; and I have made these quotations to show what hypotheses are entertained by some of the eminent men who have given much attention and study to the subject, and from a conviction that they are in some measure, at least, sustained by the results of our observations upon the Kuro-Siwo; for, notwithstanding the configuration of the eastern shores of the continents of America and Asia are undoubtedly the original cause of the deflection to the northward of the whole of the Equatorial Current of the Atlantic by the Gulf Stream, and of a portion of that of the Pacific by the Kuro-Siwo, or Japan Stream, yet were no influences, such as Mr. Redfield and Lieutenant Maury refer to, operating upon these streams, would not their natural inclination from the inertia of their westward flow be to hug the coast and wash their whole length to the Arctic Sea, or until that inertia was overcome by their friction against the continents? Yet this is not the case in either instance, for it has been well established by Mr. Bache that a counter current flowing to the southward and westward intervenes between the Gulf Stream and the coast of the United States as far as the peninsula of Florida; and, as I have before stated, as far as our observations extend, they prove conclusively that there is a very important counter current intervening between the Kuro-Siwo and the main coast of Asia.

"The influence of the Kuro-Siwo upon the climate of Japan and the west coast of North America is, as might be expected, as striking as that of the Gulf Stream on the coasts bordering the North Atlantic. From the insular position of Japan, with the intervening sea between it and the continent of Asia, it has a more equable climate than we enjoy in the United States; and since the counter current of the Kuro-Siwo does not make its appearance on the eastern shores of the islands south of the straits of Sangar, and as these islands, in their geographical position, have a more eastwardly direction than our coast, the Kuro-Siwo, unlike the Gulf Stream, sweeps close along this shore, giving a milder climate to that portion of the empire than is enjoyed in corresponding latitudes in the United States.

"The softening influence of the Kuro-Siwo is felt on the coasts of Oregon and California, but in a less degree, perhaps, than that of the Gulf Stream on the coasts of Europe, owing to the greater width of the Pacific Ocean over the Atlantic.

"Still, the winters are so mild in Puget's Sound, in latitude 48° N., that snow rarely falls there, and the inhabitants are never enabled to fill their ice-houses for the summer; and vessels trading to Petropaulowski and the coast of Kamtschatka, when becoming unwieldy from accumulation of ice on their hulls and rigging, run over to a higher latitude on the American coast and thaw out, in the same manner that vessels frozen up on our own coast retreat again into the Gulf Stream until favoured by an easterly wind.

"And in a late address before the American Geographical Society, by Dr. Hawks, when speaking of the routes for a railroad to connect the Atlantic States with the Pacific coast, he cites the remarks of Mr. Johnson and other eminent surveyors, to show that the precipitation of moisture to the westward of the Rocky Mountains, in Oregon territory, is, with rare exceptions, in the form of rain throughout the year, and seldom as snow; and as the prevailing winds on that coast are from the westward, they are unquestionably ameliorated by the warm waters of the Kuro-Siwo, which, impinging upon the Aleutian islands, are thence thrown against the shores of Oregon and California, and form the southerly current on those coasts, to again fall into the great equatorial current of the Pacific.

"The whole of the Kuro-Siwo is not, however, obstructed by the Aleutian islands, for experience shows that there is a current flowing to the northward through Behring's Straits, which is no doubt derived from this stream. This is, perhaps, underlaid by an arctic current flowing to the southward, which, rising to the surface after passing the narrow defile of the Straits, supplies the counter current to the Kuro-Siwo before spoken of.

"In studying this subject, in connexion with others having a bearing upon it, the hypothesis has forced itself upon my mind that that portion of the Kuro-Siwo which finds an outlet into the Arctic Ocean through Behring's Straits, continues its course to the northward and eastward, after clearing Icy Cape, and is the cause of that open sea, with its high temperature, seen to the northward of Greenland by Dr. Kane; and from the *unity* of its flow in a given path, it leaves the vast fields of ice lying to the southward and eastward, between that path and the north coast of America and west coast of Melville Island, in a great measure unaffected by its dissolving influence; for it is in that direction that our enterprising whalemen who resort to those seas find their most open cruising-ground, and I have heard of no instance in which that open water has been explored to its limits in a north-east direction from Behring's Straits. The same physical laws operating upon the Gulf Stream produce similar results upon it after passing Spitzbergen, and the mass of water from these two streams thus accumulated about the pole (after parting with their warmth) find no outlets except those to the southward, between Spitzbergen and the east coast of Greenland, and through the passages among the islands leading into Baffin's Bay, and thus form the streams known as the Greenland and Labrador currents; these, uniting in the North Atlantic, become the counter-current to the Gulf Stream after passing Newfoundland.

"In the passage of the United States' steam frigate *Mississippi* from Simoda, Japan, to the Sandwich Islands, in October, 1854, the thermometer manifested a cold aqueous space between the meridians of 155° E. and 170° W., and the parallels of 30° and 35° N., which bears a general correspondence in the Pacific Ocean to the position of the Sargossa Sea in the Atlantic."

Commander Chas. Bullock, R.N., says that "in June, 1861, the Japan current

ran steadily at the rate of 70 miles a day from Cape Chichakoff towards the gulf of Yedo; but on approaching the great chain of islands south of the gulf it diminished in velocity and curved to the southward."

The general direction of the Currents in the Indian Ocean is shown on *four* Charts which accompany this work.

In the northern part of this ocean—north of the parallel of 10° S. and thence to the Asiatic continent—it is well known that the currents are under the influence of the Monsoons; hence the general Chart, entitled "CURRENTS OF THE INDIAN OCEAN," gives the direction of the main streams for the whole year, *only* to the south of the parallel of 10° S. Between Lat. 6° S. and 4° N. the currents for three or four months set strongly to the westward, and then (after a brief interval) for the same number of months the general westerly set receives a great check, with perhaps a tendency to the eastward—according to the Monsoons—but always subject to deviations from variable winds; and these currents are often *very strong in the vicinity of the islands, atolls, and banks of this region.*

Special CURRENT CHARTS are given for the ARABIAN SEA and the BAY of BENGAL. The materials for the former sea were taken from the Chart and Memoir of Lieut. A. D. Taylor, and appertain to the S.W. Monsoon. For the latter (the Bay of Bengal), and for the same season, the paper of Mr. J. A. Heathcote, I.N. (*see* p. 227-230) furnished some of the detail, the rest being obtained from log-books and other observations; the "Currents in the Bay of Bengal, during the N.E. Monsoon," were compiled from various authorities.

Note.—COAST OF COROMANDEL.—COMMANDER R. HOBSON, of H.M.S. *Vigilant*, reports in a letter from Madras, dated August, 1864, that, during a passage from Cuddalore to that place, an unusually strong north-easterly current of at least 3 knots an hour was experienced. Mariners are hereby warned of the uncertainty of the currents in this vicinity.

CHAPTER IX.

ICE AND ICEBERGS IN THE SOUTHERN INDIAN OCEAN.

INTIMATELY connected with the currents and S.W. winds of the Great Southern Ocean is the flotation of Ice and Icebergs within the range of the ordinary tracks of vessels bound to Australia, India, and China; and a few remarks, showing where these dangers to navigation may be generally expected in the greatest numbers, will appropriately find a place in this work.

It is a recognised fact, that the bergs of the Southern hemisphere are more stupendous, larger, and far more lofty than those commonly met with in the Northern hemisphere — at least, on the track of an ordinary commercial voyage. The researches of COOKE, D'URVILLE, WEDDELL, WILKES, and ROSS, sufficiently explain how the enormous solid masses of ice, detached from the shores of an Antarctic conti-

nent, drift for months to lower latitudes, melting by degrees, and crumbling to pieces, and yet appear between certain meridians on the parallels of 40° to 37°, of sufficient size to crush all before them.

Heavy drifts of ice and icebergs along the ordinary route of passenger-ships to Australia and India *are not of annual occurrence*, though icebergs are constantly reported by vessels on the return voyage from Australia *via* Cape Horn; they are also more frequently encountered in the South Atlantic than in the Southern Indian Ocean—though, in rare instances, they have been reported off the Cape of Good Hope—it is, therefore, necessary to be vigilant, and keep a sharp look-out for them.

In the South Atlantic, the area included between the parallels of 40° and 50° S., and the meridians of 30° and 5° W., is especially notorious for ice, and emigrant ships have frequently been in great jeopardy thereabouts. More to the eastward, the Spanish ship *Constancia*, and the French ship *Harmonie*, reported icebergs in Lat. 35° 50′ S., Long. 17° 50′ E., in April, 1828; and, three weeks later, ice islands were seen by the *Eliza*, in Lat. 37° 31′ S., Long. 18° 17′ E.; these bergs were all of very large size, but fast thawing and tumbling to pieces. The *Constant*, September 13th, 1844, sailing E.S.E., near the parallel of 38° 10′ S., when on the meridian of 24° E., fell in with a large cluster of ice-islands, and was not entirely clear of them until she had sailed 180 miles. H.M.S. *Guardian*, December, 1789, was nearly lost by striking on a berg, in Lat. 44½° S., Long. 41½° E. These are instances sufficient to indicate the necessity of a good look-out.

By far the greater number of icebergs may be expected in the Southern hemisphere during the months of September, October, November, December, January, February, March, and April; they are of rarer occurrence from May to August, but still sufficiently often reported during these months as to require incessant vigilance. On the route to the colonies, the chance of meeting ice from September to May is three times as great as during June, July, and August. It is possible that some of the bergs seen in very low latitudes may have taken more than one season to find their way thither.

Looking at the distribution of icebergs over the *whole* of the Southern ocean,*—"one thing is quite evident, that there is far greater danger from ice during the summer months, in the southern hemisphere, than during the winter. Of about 550 reports of ice sighted, nearly half occurred in November, December, and January—while there are only five reports of ice having been seen in June, and only three in July. One-fifth of the reports relates to ice sighted in December, and the ice seen in June and July together is to that met with in December alone rather less than 1:13. The decrease from January to April is less rapid than the increase from August to November, and the probability of falling in with ice in the autumn months of March and April is as 5:3 nearly, compared with the chance of sighting it during the spring months of September and October, although more ice has been seen in December than in any other one month.

"The temperature of the water does not seem to be an *infallible* guide as to the vicinity of ice, although *generally* on approaching ice there is a marked diminution in the temperature of air and water—but especially the latter."

The *lowest latitudes* in which Icebergs have been found in the Southern Indian Ocean are—

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* Meteorological Paper, No. 12, Art. "Icebergs in the Southern Ocean."—Board of Trade.

		° ′	
October	in Lat.	41	0 S.
November	„	39	50
December	„	39	24
January	„	34	0
February	„	47	13
March	„	42	30
April	„	36	0
May	„	45	0
June	„	43	38
July	„	45	0
August	„	40	25
September	„	37	8

The following catalogue is a record of ice-positions, obtained from the log-books of Colonial and Indian traders;—a portion of it was originally published in the *Mercantile Marine Magazine* for 1858, and has been collated with the *Catalogue of Ice* in the twelfth number of the *Meteorological Papers* published by the Board of Trade.

Date.	Lat. S.			Long. E.			Description.
	°	′		°	′		
1840 October	37	0	...	12	0		Five icebergs.
to	38	0		to 14	0		
...	36	57	...	13	47		Two large icebergs.
...	36	10	...	16	1		Two icebergs.
1853 ...	53	0	...	19	0		An iceberg.
...	53	12	...	21	23		Three icebergs and field ice.
...	55	20	...	28	10		An iceberg.
1854 ...	51	10	...	26	20		An iceberg.
...	50	9	...	29	26		A large iceberg.
...	50	39	...	40	10		A large iceberg?
...	50	39	...	46	10		A large iceberg?
1855 ...	54	31	...	126	0		Fifteen icebergs, some a mile long.
...	54	0	...	131	0		Numerous icebergs on all sides.
...	55	54	...	138	23		About twenty large icebergs.
1856 ...	41	47	...	36	21		Iceberg 200 feet high, and ice island 400 feet high.
...	42	45	...	39	52		Three icebergs.
...	48	17	...	41	49		A small piece of ice.
...	41	0	...	42	0		An iceberg 70 feet high.
...	47	42	...	69	56		A large iceberg.
...	47	38	...	73	0		Two icebergs. No change in the temperature of the water.
1858 ...	44	50	...	9	34		Small iceberg.
...	47	26	...	10	34		Iceberg 300 ft. high, 600 ft. long.
1839 November	44	0	...	87	30		Numerous icebergs, 400 feet
to	45	0		to 100	0		high.
1840 ...	39	50	...	33	40		An iceberg.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1853 November	52	26	...	19	42	An iceberg, 1500 feet long.
...	52	20	...	27	47	3 icebergs.
...	51	3	...	32	21	Numerous icebergs.
...	51	20	...	37	6	
...	52	0	...	53	0	An iceberg.
...	53	20	...	74	19	"Saw land"? ice.
...	53	51	...	86	40	An iceberg.
1854 ...	43	18	...	8	15	Four large icebergs.
...	49	0	...	22	30	Several icebergs.
...	52	0	...	25	0	Thirty-three icebergs.
	to 53	0		to 45	0	
...	50	10	...	29	26	A large iceberg.
...	50	0	...	30	0	An iceberg.
...	51	0	...	32	0	Three icebergs.
	to 52	0				
...	52	0	...	32	0	About thirty icebergs.
	to 53	0		to 45	0	
...	51	0	...	41	0	Numerous icebergs.
	to 52	0		to 45	0	
...	50	39	...	46	10	Large iceberg breaking up.
...	53	0	...	88	0	Fifty-seven icebergs.
				to 102	0	
1855 ...	47	50	...	2	0	A very large iceberg.
...	49	45	...	13	42	Four small icebergs.
...	49	0	...	39	0	One large and 3 small icebergs.
1856 ...	49	19	...	7	30	Two icebergs.
...	49	30	...	10	45	Six small icebergs.
...	50	50	...	15	0	"Plenty of ice about."
...	41	0	...	42	0	Three large icebergs.
...	40	51	...	43	27	Four large icebergs 500 ft. high.
...	41	46	...	44	0	Iceberg 172 ft. high.
...	41	23	...	46	28	An iceberg.
...	46	30	...	49	20	Passed close to ice.
...	48	0	...	52	0	An iceberg.
...	41	0	...	52	48	An iceberg.
...	52	0	...	53	0	An iceberg.
1857 ...	48	55	...	32	18	Four small icebergs, much loose ice.
1858 ...	47	51	...	36	33	A large iceberg.
1859 ...	51	0	...	55	0	Struck some ice.
...	44	45	...	56	10	Many large icebergs.
...	44	0	...	68	0	Much ice.
1772 December	49	46	...	19	58	Numerous icebergs.
...	54	55	...	21	44	
1789 ...	44	30	...	44	30	An iceberg—vessel struck and nearly lost.

Date.	Lat. S.		Long. E.		Description.
	°	′	°	′	
1832 December	54	20	5	24	Immense number of icebergs.
...	60	11	10	23	Surrounded by ice and icebergs.
1840 ...	40	24	29	0	A large iceberg.
...	39	24	39	0	An iceberg.
...	57	30	147	0	An iceberg.
1853 ...	49	0	28	37	An iceberg.
...	48	30	35	20	An iceberg.
...	53	0	95	20	An iceberg.
1854 ...	50	0	2	30	Two icebergs.
...	50	0	3	0	Numerous icebergs.
	to 53	0	to 22	0	
...	51	17	6	1	Four large icebergs.
...	52	0	9	52	Nine icebergs.
...	52	29	15	23	Four icebergs.
...	52	12	15	24	Eight icebergs.
...	50	0	15	25	Four icebergs.
...	47	33	18	10	Two icebergs.
...	50	30	19	30	Icebergs.
...	49	26	22	24	An iceberg.
...	53	0	23	0	Forty icebergs.
	to 54	0	to 25	0	
...	47	30	23	30	Icebergs.
...	50	26	29	13	An iceberg.
...	49	50	34	0	An iceberg.
...	49	40	34	30	Icebergs.
...	48	0	35	30	An iceberg.
...	49	0	36	0	Icebergs.
...	48	0	41	0	Two icebergs.
...	44	0	46	0	Numerous icebergs.
	to 45	0	to 51	0	
...	52	53	73	50	"Saw land." ? ice.
...	53	0	85	0	Numerous icebergs.
			to 99	0	
...	52	30	84	0	Numerous icebergs.
			to 102	0	
...	56	30	90	0	Icebergs.
1855 ...	49	20	2	30	Several icebergs.
...	47	10	4	38	A small iceberg.
...	49	30	6	0	Ice and icebergs.
...	47	22	6	6	Two icebergs.
...	49	43	6	18	Many icebergs.
...	48	51	9	26	Eighty icebergs, and much drift ice.
...	47	40	9	55	A small iceberg.
...	47	43	10	59	A large iceberg.
...	47	30	11	0	Twelve icebergs.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1855 December	47	50	...	11	26	Seventeen icebergs, during the day; air 55°; water 45°.
...	48	0	...	13	21	An iceberg.
...	48	0	...	15	0	Thirty-three icebergs.
...	48	2	...	15	39	Twelve icebergs.
...	43	33	...	18	10	Two large icebergs.
...	49	15	...	23	43	A small iceberg; air 54°; water 41°.
...	49	30	...	24	0	Ice.
...	48	13	...	24	47	One large and many small icebergs.
...	48	0	...	26	10	Two icebergs.
...	48	40	...	26	17	Two large icebergs.
...	49	43	...	26	49	An iceberg.
...	48	12	...	30	0	Four icebergs.
...	49	50	...	31	27	A large iceberg.
...	48	48	...	31	40	A large iceberg.
...	50	0	...	32	0	Three icebergs.
...	48	19	...	34	21	Many icebergs.
...	49	9	...	37	14	Two icebergs.
...	50	39	...	37	34	Three large icebergs.
...	48	11	...	37	43	A large iceberg.
...	50	48	...	40	43	Three large icebergs.
...	48	21	...	43	31	Two icebergs.
...	48	30	...	45	0	Three large icebergs.
...	51	0	...	46	14	A large iceberg.
...	48	35	...	48	28	A large iceberg.
...	49	30	...	49	5	Two small icebergs.
...	48	14	...	50	56	Two large icebergs.
...	48	22	...	54	41	An iceberg 200 ft. high.
...	50	30	...	60	0	A large iceberg.
...	51	39	...	61	34	A large iceberg.
...	52	0	...	62	30	An iceberg.
...	51	43	...	64	2	A large iceberg.
...	47	40	...	74	22	A piece of ice.
1856 ...	50	14	...	42	54	Four large icebergs; one 700 ft. high.
...	51	0	...	43	44	A large iceberg.
1859 ...	46	0	...	47	0	A large iceberg.
1773 January	51	0	...	59	0	Icebergs.
1841 ...	65	40	...	173	6	A stream of ice, S. by E. and N. by W.
1850 ...	34	50	...	18	30	A piece of ice, very flat, 30 ft. long, 100 ft. thick, in sight of Cape of Good Hope.
...	34	0	...	20	20	An iceberg seen from the Cape of Good Hope.

Date.	Lat. S.		Long. E.		Description.
	°	′	°	′	
1851 January	51	27	26	37	An ice island much decayed; large fields of ice to the southward.
...	51	33	31	47	Much ice.
...	52	32	37	7	Much ice.
...	52	50	43	3	Much ice.
...	53	10	46	46	Much ice.
...	53	30	54	45	A large tabular-shaped ice island.
...	56	48	83	16	Much broken ice; many tabular ice islands all high and large, and fresh from the barrier; immense fields of ice to the southward.
...	56	35	88	42	Much ice, in large fields.
1855 ...	45	33	15	33	Three icebergs, 100 ft. long, 150 ft. high.
...	45	45	21	0	Icebergs.
...	47	0	37	46	Icebergs.
...	47	15	38	14	An iceberg, 200 ft. high.
...	50	0	41	0	Icebergs.
...	47	20	41	10	Numerous icebergs.
1856 ...	48	15	10 to 15	0 0	Thirteen large icebergs.
...	49	10	14	0	Icebergs.
...	48	30	15	27	A large iceberg.
...	49	0	17	0	Three icebergs.
...	44	25	18	14	A large iceberg, surrounded by large pieces.
...	49	4	19	20	A large iceberg.
...	45	31	21	6	Seven icebergs.
...	48	50	21 to 24	0 0	Six icebergs.
...	49	10	25 to 27	0 0	A large iceberg, and some loose ice.
...	49	10	29 to 31	0 0	Several small icebergs, one very large one; much loose ice.
...	50	5	37	35	A large iceberg.
...	49	41	40	29	A very large iceberg.
...	45	30	45	30	Numerous icebergs.
...	45	26	46	3	One large iceberg, and a large piece.
...	47	48	49	28	A large iceberg.
...	50	20	113	0	Fifty-five icebergs.
...	50	11	113 to 118	0 0	Eleven icebergs, and some loose ice.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1857 January	50	52	...	17	39	A large iceberg, drifting northward. Temperature of air, 47°; water, 37°.
...	52	15	...	23	40	Two large icebergs.
...	50	30	...	32	4	A small iceberg.
...	50	18	...	36	0	A small iceberg.
...	50	10	...	39	15	An iceberg.
...	50	36	...	51	40	A small iceberg, which separated into several pieces.
1859 ...	45	8	...	11	54	An iceberg, bearing E.N.E. about 20 m. Temperature of air and water, 46°.
1774 February	53	30	...	6	35	Three icebergs.
1775 ...	57	20	...	4	0	An iceberg.
...	54	26	...	24	21	Numerous icebergs.
...	52	50	...	26	30	Two icebergs.
1840 ...	50	0	...	120	25	Icebergs.
...	55	30	...	145	30	Icebergs.
1848 ...	48	0	...	37	30	An iceberg, 6 to 7 miles in extent.
...	49	30	...	41	0	An iceberg.
...	50	0	...	107	0	An iceberg.
...	46	0	...	134	0	Icebergs.
1849 ...	49	10	...	30	15	A large iceberg.
1855 ...	47	13	...	20	0	Several icebergs.
...	50	0	...	107	0	An iceberg.
...	46	0	...	134	0	Icebergs.
1856 ...	46	59	...	12	15	An iceberg.
1774 March	53	17	...	11	50	Icebergs.
...	48	30	...	14	30	Two icebergs.
1839 ...	66	0	...	98	0	Numerous icebergs.
	to 67	0		to 102	0	
1840 ...	50	0	...	140	0	Icebergs.
...	47	3	...	10	51	An iceberg.
1849 ...	49	54	...	35	15	Many icebergs and kelp.
...	50	44	...	39	28	An iceberg.
...	52	18	...	110	9	Iceberg, very high.
1855 ...	52	39	...	5	4	Many ice islands.
...	53	14	...	14	41	An iceberg, 960 feet high.
...	52	0	...	0	0	Numerous icebergs.
	to 53	20		to 23	0	
...	53	14	...	20	44	Nearly beset in the ice.
...	53	0	...	28	0	A few pieces of ice.
1856 ...	46	50	...	3	11	Icebergs.
...	48	12	...	24	0	Five very large icebergs.
...	48	15	...	25	23	Seven icebergs.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1856 March	48	4	...	29	22	Several icebergs.
...	46	0	...	37	30	Icebergs.
...	49	21	...	37	35	One very large iceberg.
...	51	0	...	51	0	A very large iceberg; much loose ice.
...	47	26	...	54	38	Three icebergs. Air, 51°; water, 38°.
...	47	20	...	55	0	Three icebergs, 100 ft. high.
1857 ...	42	30	...	66	0	Two large pieces of ice.
1828 April	35	50	...	18	50	A cluster of icebergs.
...	37	31	...	18	17	Five very large icebergs.
1853 ...	36	0	...	20	0	Numerous icebergs.
1854 ...	51	0	...	26	0	An iceberg.
...	53	0	...	80	0	Two icebergs.
1855 ...	48½	0	...	6	0	Numerous icebergs.
to	49	0	... to	12	0	
...	48	44	...	6	43	An ice island, 300 ft. high, and many ice fields; and in the evening passed numerous icebergs and pieces.
...	48	43	...	11	45	A large iceberg, 400 ft. high; and much broken ice.
...	43	30	...	13	0	Numerous icebergs.
...	48	57	...	22	30	Several large icebergs.
...	49	59	...	24	55	A large iceberg.
...	46	0	...	27	0	Numerous icebergs.
1856 ...	49	59	...	0	30	Steering N.N.W., parallel with a line of 47 icebergs.
...	49	30	...	5	0	Several large icebergs and much loose ice.
...	49	32	...	8	30	Field ice and icebergs.
...	49	30	...	9	0	Iceberg and drift ice.
...	48	35	...	11	0	Forty icebergs.
...	47	15	...	16	33	Thirty icebergs.
...	46	50	...	20	23	Two icebergs.
...	48	30	...	22	0	Large iceberg.
...	47	30	...	29	25	An iceberg.
...	48	0	...	37	45	An iceberg.
...	46	0	...	39	30	An iceberg.
...	50	0	...	42	0	Several icebergs.
...	48	44	...	43	0	An iceberg.
...	45	0	...	52	40	Several icebergs.
...	47	0	...	53	0	Several icebergs.
...	47	20	...	58	0	An iceberg.
...	47	53	...	58	30	A small iceberg.
...	47	53	...	59	8	A small iceberg.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1839 May	39	30	...	16	41	An iceberg.
1840 ...	47	17	...	58	50	Small iceberg.
1855 ...	49	0	...	11 to 31	0 0	Numerous icebergs.
...	48	0	...	18	0	Several icebergs, one covered with snow and broken ice.
...	47	48	...	28	26	A small piece of ice. Temperature of air, 47°; water, 40°.
...	49	0	...	37	0	Several icebergs.
...	45	0	...	37	40	A very large iceberg.
...	48	0	...	38	0	An iceberg.
...	47	0	...	38	0	A large iceberg near Prince Edward's islands.
1856 June	45	10	...	48	43	Two large icebergs.
...	43	38	...	50	48	A large iceberg. Air, 39°; water, 39°.
1857 ...	61	41	...	48 to 44	0 0	Pack ice.
1840 July	48	41	...	69	6	Saw a broken-up iceberg in the N.W. bay, Christmas harbour.
1853 ...	49	0	...	50	0	An iceberg.
1856 ...	45	0	...	59	30	An iceberg.
1863 ...	50	45	...	53	20	Two rocks (?) Icebergs.
1840 August	38	9	...	0	1	Many icebergs, and fields.
...	38	30	...	1	0	Icebergs and loose ice.
...	36	38	...	13	15	Two ice islands.
...	36	10	...	13	40	Two icebergs.
...	41	30	...	14	10	An iceberg, 400 ft. high, and 1000 ft. long.
...	37	30	...	14	40	An iceberg—reported 1000 feet high.
...	40	25	...	19	0	An iceberg, 300 ft. high, and 400 feet long.
1863 ...	52	1	...	67	51	A large iceberg.
...	52	12	...	71	1	An iceberg.
1840 September	37	30	...	10	0	An iceberg.
...	38	0	...	12	0	An iceberg.
...	37	0	...	13	0	An iceberg.
...	41	30	...	14	10	An iceberg, 1000 feet long and 400 feet high.
...	37	45	...	14	50	An iceberg.
...	37	0	...	15	0	An iceberg.
...	37	0	...	15	0	An iceberg, 1000 feet long and 400 feet high.
...	40	30	...	19	0	An iceberg, 400 feet long and 300 feet high.

Date.	Lat. S.			Long. E.		Description.
	°	′		°	′	
1840 September	40	20	...	26	0	One large iceberg, and four small icebergs.
...	37 to 38	30 to 47	...	36	19	Icebergs.
1844 ...	37	8	...	24	0	Four icebergs, 100 to 200 ft. high.
...	38	10	...	24	0	Many large icebergs on a surface of 180 miles, S.E. and N.W.
... to	38 39	0 15	... to	24 27	0 0	Numerous icebergs.
...	39	4	...	25	50	Numerous icebergs around.
1853 ...	52	10	...	37	7	Two large icebergs.
...	49	0	...	43	0	An iceberg, 500 feet high.
1854 ...	49	40	...	0	20	Icebergs.
...	48	0	...	45	0	An iceberg.
1855 ...	48	15	...	41	54	An iceberg. Temperature of water, 42°; air, 35°.

The approximate northern limit of icebergs in the Southern Indian Ocean is shown on the Wind Charts which accompany this work.

These remarks may be aptly closed with some observations by Dr. Scoresby, F.R.S., for many years an active whaling captain, and well acquainted with ice and icebergs; they were made during his passage in the *Royal Charter* to Australia.*

March 31st, 1856; at noon, Lat. 47° 30′ S., Long. 52° 43′ E., wind W. increasing in the afternoon to a hard gale, and ultimately in squalls with showers of rain and sleet, it blew fiercely. An object of some alarm and much excitement, to be met with at night, in a heavy sea and gale, and showery weather, was announced at 7·30 P.M., as being seen. Two icebergs, indeed, showing ominously in the showery sky, were then on the port beam; and soon afterwards a third appeared on the port bow.

April 1. For convenience of description, I have deferred the account of the icebergs and the storm—as just noticed under the previous day's remarks—to the present period, when an iceberg clearly within view, and a sea at its most majestic attainment of grandeur, afforded more precise means of attempting the description satisfactorily; that is, if any description suggested by personal contemplations could accurately convey a picture of one of the sublimest operations of "the stormy wind and tempest," with the exciting and solemnising incident of the dangers of our progress in the period of darkness amid the mighty icebergs of Antarctic forma-

* Journal of a Voyage to Australia and Round the World for Magnetical Research, by Rev. W Scoresby, D.D., F R.S., &c. p. 118.

tion. These topics lead us backward a few hours in time to the evening of 31st March.

Though the line of track up to or beyond the latitude of 46° S. had led us within a well-known range of icebergs, yet, when we had advanced so far to the eastward as the 59th degree of longitude, beyond which it appears icebergs are but rarely seen in our parallel, we were led to hope, and earnestly to hope, as the evening closed in with a heavy gale, hard squalls, and perplexing showers of sleet or hail, and a greatly rising sea, that the risk of falling in with icebergs had happily been passed. But we were disappointed. The "look-out," stimulated by promise of reward from the captain, reported at 7.30 P.M. an iceberg on the port-bow. All was now excitement—a mixture of curiosity and apprehension—and the forepart of the poop became speedily crowded with the passengers from below. The object of interest and peril could only be recognised, however, as it gradually came nearer on the port-beam, by that characteristic luminosity by which this peril to the navigator is happily, and, I may add, providentially indicated. But the disappointing indistinctness in this case—or, as some might have thought, the doubtfulness of the reality—were very soon superseded by another announcement from the chief officer, that he thought we were coming to another iceberg ahead of the ship, or a little on the port-bow. The ominous luminosity now left no doubt of our nearer approach towards another of these formidable incumbrances and perils belonging to this track of navigation. The ship's course being altered somewhat to starboard, brought us sufficiently far clear of it; but as it approached the beam of the ship in direction it became sufficiently conspicuous, shining out of a dense black shower in that quarter, to enable us to judge both of its general form and magnitude. Its form was in a waving outline of considerable breadth, it might be two hundred to three hundred yards, with a height possibly of one hundred feet, or more. It was a white luminosity on a dark or almost black background of a rain or snow-shower.

Altogether, three icebergs were discerned through the darkness and haze; but whilst CAPTAIN BOYCE pursued his course amongst them, some reduction of the sails was judiciously made, and for a time the maintop-gallant sail, mizentop sails, and fore course, were taken in. At 10 P.M., however, the weather being clearer—the sky, indeed, by no means so dark as usual in the absence of the moon, with a slight Aurora Australis yielding us obvious advantage—the foresail was again set, and throughout the night our course, E. ½ N. (true), was pursued, mercifully, without interruption either from the icebergs or the extremely heavy sea, which had been greatly augmented under the continuance and violence of the storm.

A fair estimate of our danger from the icebergs could not be easily made. In a gale so heavy, with the occurrence of ice in uncertain and undeterminable quantity and distribution, no considerate person could be free from solemn thought or apprehension; but the regulation of these feelings under such circumstances is a matter of much importance to personal comfort, and with the Christian matter for peculiar submission to, and repose on, the Divine providential will and guidance. Rationally considered, the special dangers on the one side are meeting with a succession of icebergs after shifting the course or partially hauling to, so as to render the *weathering* of a second or third iceberg, or the getting a large ship of the clipper class sufficiently off the wind in time to wear clear of the danger, impracticable—besides the possibility of another of these formidable enemies to security appearing in the line selected for escape. Over and above this must be noted the special and

even more formidable danger of falling in with detached fragments of ice, lumps from fractured and wasting bergs lying low in the water, and without the provision of luminosity for making themselves visible, yet in masses sufficiently great to stave in the bows or utterly destroy the strongest existing ship. Such dangers encountered in darkness, aggravated by showers, or haze or fog, are not to be rationally contemplated without some serious or anxious thought.

But, on the other hand, the question of danger ought to embrace the probable extent, number, magnitude, and frequency of icebergs on any given track, in comparison with the magnitude or width of the spaces amongst them. To the proportion in favour of safety must be added the effects of watchfulness on the part of the navigator, forming some previous estimate of his position of danger; the chances of the icebergs being passed in daylight, moonlight, or in moderate weather, or revealed when in the way by their luminosity; and, finally, the results of experience in the comparative fewness of the accidents demonstrated by the small additional premium, and the moderateness of the premium generally demanded by Underwriters for the insurance of ships voyaging to Australia or New Zealand. So estimated, the result comes out there is risk, and considerable risk, to ships voyaging through seas liable to the danger of icebergs; yet the risk, taken on an average, and in a merely intellectual or commercial point of view, is but small. In our particular case, the risk from separated fragments of the bergs we passed was lessened by the course we pursued and the steady direction of the gale, as fragments in a gale and heavy sea will always be found nearly astream of the iceberg—that is, in the line of the wind from the berg—to windward or to leeward; but we, in keeping far on one side, did not intersect or come near this usual line of icy débris and fragments. Hence, as a cautionary rule for sailing among icebergs at night, I would recommend the passing them, if possible, well on one side, in respect to the direction of the wind, and not to intersect the stream-line of the ice.

Not seeing more of icebergs during the night, it was hoped that we had passed beyond their region into an entirely free sea. But about 7.30 A.M. I was called by the Captain with the announcement that there was another large iceberg on the port bow. So far as the sight only was concerned, this was an announcement of considerable interest, as I naturally felt it, in the opportunity of comparing these mighty *flotations* of the Antarctic with the familiar ices of the Arctic regions. Hastily equipping myself for the exposure to the gale—for the thermometer was at 39°, and the decks sprinkled with hail, and the wind blowing violently—I arrived on the poop in good time to see the berg in its best approach and nearest position. It was already nearly on the port beam, and, although perhaps a mile to a mile and a half off, was abundantly conspicuous, and, as viewed with an opera glass, discernible in its particular features.

Of the mass, when covered, as sometimes it nearly was, with the broken, dashing waters of a heavy sea, it was difficult to judge. Probably it would be hardly less than 300 yards to a quarter of a mile in its greatest width, and possibly 150 to 200 feet high in its loftiest peaks; for it had two pointed peaks rising up like spires out of the solid mass, with one or more smaller elevations of a like kind betwixt or annexed to them. Pictured as it happened to us, on the dark storm-like face of a snow shower, its native whiteness shone out with characteristic conspicuousness, though no longer displaying the luminosity of those seen in the darkness of night. The spectacle of this floating ice-island in the assault and burst of the white waters

of an incidental highest wave—a wave, probably, of 40 feet altitude, and much breadth and massiveness of water—striking its steep or vertical face towards the west, and flying upward, and throwing a splendid white canopy over the greatest part of the windward elevations—was magnificent.

CHAPTER X.

ON THE SPECIFIC GRAVITY AND TEMPERATURE OF THE WATER OF THE INDIAN OCEAN.

Indian Ocean and Adjacent Seas.—In the Indian Ocean, including under that head the sea as far as 50° S. and 140° E., the region (or line) of lowest specific gravity appears to be near the equator or a little to the south of it, whereas in both the Atlantic and Pacific the line of least density is to the north of the equator in the belt of equatorial rains and calms. There is a marked decrease in density towards the east in the bay of Bengal and towards Sumatra, occasioned no doubt by the accession of the fresh water from the rivers Ganges, Mahanuddy, and Irawaddy; but taking the means of zones of 10 degrees there is but little difference in either the specific gravity or temperature from 20° N. to 20° S.

In the neighbourhood of Sumatra and Java, in Banca, Sunda, and Gaspar straits the specific gravity is exceedingly variable.

Though the specific gravity of the South Indian ocean is less on the whole than that either of the South Atlantic or the South Pacific, some of the highest densities on record have been found in the South Indian. Captain Heddle of the *Calliance*, when going from Melbourne to Calcutta, between Lat. 30° and 10° S., Long. 100° and 90° E., found two of 1·0349 and 1·0362 respectively. The last is the highest observation (well authenticated) on record, with the exception of Captain Harrington's 1·0442 to the southward of Australia; but Captain Heddle is a careful observer and there is no reason to doubt his accuracy.

Sea of Japan, Yellow Sea, &c.—The density of the water (at surface) in the neighbourhood of the Japan islands and near the east coast of China and Chinese Tartary is somewhat variable. The greatest recorded in these seas is 1·0354, found in Lat. 40° 40′ N., Long. 138° 6′ E. by H.M.S. *Pique*. 1·0320 (and over) has been not unfrequently recorded, but upon the whole the mean specific gravity is not high; and near the mouths of the larger rivers, especially the Yang-tse Kiang, it is very low indeed. Near the mouth of the Peiho also it was on one occasion found to be as low as 1·0053.

The sea-water temperatures generally appear rather high for the latitudes. The range of temperature, especially near the coast, is considerable. In the gulf of Pe-Chili a *range* of 52° has been observed; 82° being the highest and 30° the lowest temperature recorded. The occasionally very low temperatures in this locality seem to be caused by the ice brought down by the Peiho river.

Red Sea.—The mean of some 200 observations gives 1·0286 as the mean density of the Red Sea.

The density seems to be greatest in the northern parts of the sea, and to decrease gradually southwards towards Aden. The maximum observed is 1·0321, in the bay of Suez, by H.M.S. *Cyclops*. The minimum 1·0252 by the steamer *European*, near Aden.

Dividing the sea into two parts, north and south of latitude 20°, we have the following result:—

Mean density of the whole	1·0286
„ Northern half . . .	1·0297
„ Southern half . . .	1·0272

being an excess of ·0025 on the side of the Northern half.

The mean temperature of the Red Sea is 79°·3. Above latitude 20° it is 77°·4, and (the mean of the observations) below that latitude it is 81°·5.

The highest temperature recorded is 94°.* Temperatures as high as 90° occur not unfrequently. The lowest temperature reported is 64°.†

Of the three oceans *South of the Equator*—the Atlantic, the Pacific, and the Indian—the Atlantic is the heaviest and the coldest; while the Indian is the lightest and the warmest; and the Pacific is between the two; as below:—

South Atlantic .	Specific gravity . .	1·02676
	Temperature . . .	66°·66
South Pacific . .	Specific gravity . .	1·02658
	Temperature . . .	67°·70
South Indian .	Specific gravity . .	1·02630
	Temperature . . .	69°·28

In conclusion, the result of the whole inquiry serves to show that the *chief* differences in oceanic specific gravity arise from local or special circumstances. It is high in regions where evaporation is rapid, as in the trade winds, and low in those parts of the ocean where much rain falls. It is the highest of all (on the average) in arms of the sea, such as the Red Sea, where there are no rivers and but little rain; and lowest near the mouths of great rivers, such as the St. Lawrence or the Plate, or in seas like the Black Sea and the Baltic, where the accession of fresh water is great. It is low also in high latitudes in the vicinity of ice.

The highest surface temperature anywhere recorded is 94° in the Red Sea near Aden. The highest temperatures recorded elsewhere‡ are 88° and 89°. These have been found not unfrequently in the Indian Ocean near the equator. Captain Maury speaks of a temperature of 95° as being not uncommon in the Red Sea, but there is no record here of any temperature above 94°.

Changes of temperature in sea water are frequently abrupt, and in studying the temperatures (p. 256—260) as given, it should be borne in mind that it is the fact of these temperatures being the means of all observations within squares of ten degrees that causes the transitions to appear gradual.

In the neighbourhood of the Cape of Good Hope the changes of temperature are, as is well known, both sudden and frequent.

The register of H.M.S. *Encounter* states, that when in Lat. 39° 30′ S., Long.

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* Steamer *European*, at Aden, 2nd September, 1857. † H.M.S *Cyclops*.

‡ With the exception of a temperature of 91°.

15° E. in February 1860,—"At 6 A.M. upon drawing water from alongside it appeared quite warm to the hand," and the temperature was found to be 72°, which was 17° higher than it had been the previous day at noon, when the ship was in the same latitude, but 1° 53′ further to the westward. The specific gravity (*uncorrected* for temperature) continued unchanged at 1·0285, and a northerly current of 19 miles had been experienced.

The *Sebastian Cabot*, CAPTAIN QUIRK, in very nearly the same position and in the same month found the surface temperature at 6 A.M. to be 57°, at noon 73°, and at 6 P.M. the same day 76°. This was in Lat. 39° 25′ S., and Long. 16° 30′ E. to 18° 30′ E., current E.N.E. about 12 miles per 24 hours.

Farther to the southward, the *Pomona*, CAPTAIN BERGEN, Lat. 41° to 43° S., Long. 15° to 25° E., found the temperature of the water varying from 48° to 64°, changing frequently; though no great difference was observed in the specific gravity (uncorrected.)

In illustration of the effect of heavy rains, in at least temporarily diminishing the specific gravity of the surface, a most remarkable instance was observed by DR. C. K. ORD, of H.M.S. *Hermes*, when that ship was lying in Simon's bay in August 1859. On the 4th of that month at 9 A.M. the specific gravity was 1·0266, and in one hour it was reduced by the heavy rain that fell to 1·0193, the water becoming "brown in colour, merely brackish in taste, and its current setting distinctly outwards." By noon the density had increased to 1·0253, and at 3 P.M. the surface had recovered its former density of 1·0266. The next day the specific gravity was again reduced by heavy rain and again rose.

The *temperature* of the surface was also temporarily lowered from 58° to 55°, the temperature of the rain being 50°.

SPECIFIC GRAVITY AND TEMPERATURE OF EACH SQUARE OF TEN DEGREES IN THE INDIAN OCEAN:—

Between the parallels of 30° and 20° N.*:—

1.	Long.	50°	to	60°	E.	temp.	78·0°;	sp. gr. 1·0283
2.	„	60	to	70	E.	„	77·3	„ 1·0259
3.	„	70	to	75	E.	„	79·0	„ 1·0261
4.	„	85	to	90	E.	„	80·3	„ 1·0212
5.	„	90	to	95	E.	„	76·7	„ 1·0238

Between the parallels of 20° and 10 N.:—

	Long.	40°	to	50°	E.	temp.	81·1°;	sp. gr. 1·0270
8.	„	50	to	60	E.	„	77·9	„ 1·0275
9.	„	60	to	70	E.	„	80·9	„ 1·0284
10.	„	70	to	80	E.	„	82·4	„ 1·0270
11.	„	80	to	90	E.	„	81·5	„ 1·0249
12.	„	90	to	100	E.	„	81·1	„ 1·0242

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* The numbers *before* the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

Between the parallel of 10° N. and the Equator :—

	Long.	40°	to	50° E.	temp.	80°5 ;	sp. gr. 1·0264
15.*	„	50	to	60 E.	„	80·9	„ 1·0270
16.	„	60	to	70 E.	„	82·9	„ 1·0269
17.	„	70	to	80 E.	„	82·6	„ 1·0267
18.	„	80	to	90 E.	„	82·5	„ 1·0260
19.	„	90	to	100 E.	„	83·0	„ 1·0251

Between the Equator and the parallel of 10° S. :—

23.	Long.	40°	to	50° E.	temp.	79°6 ;	sp. gr. 1·0226
24.	„	50	to	60 E.	„	81·4	„ 1·0266
25.	„	60	to	70 E.	„	82·0	„ 1·0270
26.	„	70	to	80 E.	„	82·2	„ 1·0270
27.	„	80	to	90 E.	„	82·3	„ 1·0262
28.	„	90	to	100 E.	„	82·3	„ 1·0259
29.	„	100	to	110 E.	„	83·0	„ 1·0250
	„	110	to	120 E.	„	82·7	„ 1·0256
	„	120	to	130 E.	„	82·8	„ 1·0265

Between the parallels of 10° and 20° S. :—

30.	Long.	30°	to	40° E.	temp.	80°8 ;	sp. gr. 1·0261
31.	„	40	to	50 E.	„	81·1	„ 1·0267
32.	„	50	to	60 E.	„	79·4	„ 1·0265
33.	„	60	to	70 E.	„	77·5	„ 1·0266
34.	„	70	to	80 E.	„	78·5	„ 1·0263
35.	„	80	to	90 E.	„	79·1	„ 1·0263
36.	„	90	to	100 E.	„	78·6	„ 1·0266
37.	„	100	to	110 E.	„	78·7	„ 1·0266
	„	110	to	120 E.	„	81·7	„ 1·0264
	„	120	to	130 E.	„	82·7	„ 1·0259
	„	130	to	140 E.	„	79·5	„ 1·0256

Between the parallels of 20° and 30° S. :—

38.	Long.	30°	to	40° E.	temp.	74°1 ;	sp. gr. 1·0265
39.	„	40	to	50 E.	„	73·6	„ 1·0266
40.	„	50	to	60 E.	„	75·1	„ 1·0265
41.	„	60	to	70 E.	„	75·0	„ 1·0268
42.	„	70	to	80 E.	„	74·2	„ 1·0268
43.	„	80	to	90 E.	„	70·8	„ 1·0269
44.	„	90	to	100 E.	„	69·6	„ 1·0269
45.	„	100	to	110 E.	„	69·7	„ 1·0271
	„	110	to	115 E.	„	72·6	„ 1·0271

* The numbers *before* the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

Between the parallels of 30° and 40° S.:—

47.*	Long.	20° to	30° E.	temp.	69°·0;	sp. gr.	1·0270
48.	„	30 to	40 E.	„	69·3	„	1·0267
49.	„	40 to	50 E.	„	66 3	„	1·0268
50.	„	50 to	60 E.	„	62 4	„	1·0269
51.	„	60 to	70 E.	„	60·7	„	1·0266
52.	„	70 to	80 E.	„	60·6	„	1·0268
53.	„	80 to	90 E.	„	59·3	„	1·0264
54.	„	90 to	100 E.	„	59·2	„	1·0263
55.	„	100 to	110 E.	„	62·4	„	1·0270
	„	110 to	120 E.	„	61·8	„	1·0269
	„	120 to	130 E.	„	58·7	„	1·0267
	„	130 to	140 E.	„	58·4	„	1·0267
	„	140 to	150 E.	„	58·7	„	1·0262

Between the parallels of 40° and 50° S.:—

57.	Long.	20° to	30° E.	temp.	52°·9;	sp. gr.	1·0261
58.	„	30 to	40 E.	„	50·4	„	1·0260
59.	„	40 to	50 E.	„	48·4	„	1·0256
60.	„	50 to	60 E.	„	49·3	„	1·0257
61.	„	60 to	70 E.	„	51·2	„	1·0259
62.	„	70 to	80 E.	„	49·4	„	1·0256
63.	„	80 to	90 E.	„	48·5	„	1·0258
64.	„	90 to	100 E.	„	47·4	„	1·0259
65.	„	100 to	110 E.	„	48·7	„	1·0259
	„	110 to	120 E.	„	49·9	„	1·0261
	„	120 to	130 E.	„	51·2	„	1·0260
	„	130 to	140 E.	„	53·0	„	1·0260
	„	140 to	150 E.	„	56·0	„	1·0264

Between the parallels of 50° and 60° S.:—

	Long.	20° to	30° E.	temp.	36°·0;	sp. gr.	1·0263
	„	30 to	40 E.	„	35·5	„	1·0257
	„	40 to	50 E.	„	35·2	„	1·0260
	„	50 to	60 E.	„	36·5	„	1·0261
	„	60 to	70 E.	„	36·1	„	1·0259
	„	70 to	80 E.	„	35·1	„	1·0259
	„	80 to	90 E.	„	36·9	„	1·0256
	„	90 to	100 E.	„	39·0	„	1·0257
	„	100 to	110 E.	„	38·0	„	1·0259
	„	110 to	120 E.	„	37·8	„	1·0255
	„	120 to	130 E.	„	40·0	„	1·0254
	„	130 to	140 E.	„	43·0	„	1·0252
	„	140 to	150 E.	„	45·0	„	1·0245

* The numbers *before* the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

SUMMARY:—INDIAN OCEAN AND CHINA SEA, &c., as far as 140° E.

Lat. 20° North to 50° South.

ZONES.	MEANS.		MAXIMA.				MINIMA.				EXTREME RANGE.		Approximate Number of Observations.
	Specific Gravity at 62° F.	Temperature.	Specific Gravity.	No. of Square on Chart.	Temperature.	No. of Square on Chart.	Specific Gravity.	No. of Square on Chart.	Temperature.	No. of Square on Chart.	Specific Gravity.	Temperature.	
North.		°			°				°			°	
20° to 10°	1·0261	81·2	1·0326*	14	91	13	1·0091†	12	62	"	0235	29	1800
10° „ 0°	1·0259	82·4	1·0301	17	88	18, 19, 20	1·0198	21	76	18, 20	0103	12	2100
South.													
0° to 10°	1·0258	82·0	1·0304	25	89	23	1·0127‡	29	69	23	0177	20	2040
10° „ 20°	1·0263	79·8	1·0362	36	87	37*a*	1.0230	33	67	33	0132	20	1700
20° „ 30°	1·0268	72·3	1·0349	44	82	38, 40, 41	1·0220	41	58	42	0129	24	2200
30° „ 40°	1·0267	62·3	1·0333§	55	80	48, 49	1·0204	47	52	17, 52, 53	0129	28	3600
40° „ 50°	1·0259	50·0	1·0303	57	68	59	1·0225	60	34	62	0078	34	2800

* The *Harkaway* from Shanghai found the specific gravity at the surface 1·0326 (nearly) on three successive days; Lat. 19° N. to 14° 40′ N., Long. 117° 30′ to 114° E. No current was perceptible, except on the third day, when a N. 34° E. 21 m. current was experienced.

† The ship *Jessie Boyle*, from Bombay to Moulmain, 15° 17′ N., 96° 52′ E. The water was of a dull muddy green, "almost drinkable," and the density continued diminishing as the ship approached Moulmain.

‡ The *Cambalu*, close to the land on the east coast of Sumatra. Captain Fawcett remarks that the "water is remarkably fresh."

§ Two *greater* densities in these latitudes have been *recorded*, both by Captain Harrington of the *Castilian*. The first was in 39° 15′ S., 134° 5′ E., where Captain Harrington entered in his register and has noted as "extraordinary but correct" a density of 1·0442 (corrected); and again in 38° 7′ S., 109° 56′ E., he reports that he found the specific gravity to be as much as 1·0348.

In higher Latitudes than 50° S. :—

Lat. 50° to 60° S., Long. 20° to 140° E. ; mean sp. gr. 1·0258 ; mean temp. of water, 37°·4.
Max. sp. gr. 1·0283 in Long. 60° to 70° E.
Min. sp. gr. 1·0234 in Long. 130° to 140° E.
Max. temp. of water 45° in Long. 130° to 140° E.
Min. temp. of water 34° in Long. 110° to 120° E.

SPECIFIC GRAVITY AND TEMPERATURE OF EACH SQUARE OF TEN DEGREES IN THE CHINA SEA.

Between the parallels of 40° and 30° N. :—

Long. 115° to 120° E.	temp.	64°·0;	sp. gr.	1·0173
„ 120 to 130 E.	„	60·0	„	1·0222
„ 130 to 140 E.	„	66·2	„	1·0239

Between the parallels of 30° and 20° N. :—

Long. 110° to 120° E.	temp.	74°·4;	sp. gr.	1·0249
„ 120 to 130 E.	„	72·4	„	1·0255
„ 130 to 140 E.	„	78·8	„	1·0266

Between the parallels of 20° and 10° N. :—

Long. 100° to 110° E.	temp.	82°·2;	sp. gr.	1·0244
„ 110 to 120 E.	„	81·0	„	1·0254
„ 120 to 130 E.	„	80·6	„	1·0256
„ 130 to 140 E.	„	82·1	„	1·0262

Between the parallel of 10° N. and the Equator :—

Long. 100° to 110° E.	temp.	83°·0;	sp. gr.	1·0247
„ 110 to 120 E.	„	82·4	„	1·0249
„ 120 to 130 E.	„	83·4	„	1·0250
„ 130 to 140 E.	„	83·6	„	1·0259

These observations (pp. 254–260) are selected and condensed from the Twelfth Number of Meteorological Papers published by the Board of Trade in 1865.

Twenty-five different elements have been observed in the water of the ocean, or in plants and animals of the sea: *oxygen*, *hydrogen*, *chlorine*, *bromine*, iodine, fluorine, *sulphur*, phosphorus, *carbon*, nitrogen, silicon, iron, manganese, *magnesium*, *calcium*, strontium, barium, *sodium*, *potassium*, silver, copper, lead, zinc, cobalt, nickel; but only those printed in *italic* are predominant. Of these, chlorine, sulphuric acid, lime, and magnesia may be determined with great exactitude.

Saltness of the Ocean.—The mean result of several analyses by REGNAULT gives:—

WATER		96·470
SALINE INGREDIENTS—3·505.	Chloride of Sodium	2·700
	„ Magnesium	0·360
	„ Potassium	0·070
	Sulphate of Lime	0·140
	„ Magnesia	0·230
	Carbonate of Lime	0·003
	Bromide of Magnesium	0·002
Loss, including Iodides, Silica, &c.		0·025
		100·000

According to FORCHHAMMER,* the mean of 140 complete analyses gives 3·430 of salt in *one hundred* parts of water, unequally distributed over 16 regions; but the specimens being principally taken at low latitudes, he regards this mean as too high.

The mean saltness of the Atlantic is 3·577; of the Californian Pacific 3·522; of the Japanese Pacific 3·443; and of the Indian Ocean 3·413.

CHAPTER XI.

DEEP-SEA SOUNDINGS IN THE INDIAN OCEAN.

Deep-Sea soundings have not been tried for to the same extent in the Indian as in the Atlantic Ocean; those for the laying down of the Red Sea and India Telegraph are the principal. The following were made by CAPTAIN W. J. S. PULLEN, R.N., in H.M.S. *Cyclops*, on the voyage to Aden in 1857, previous to his sounding the Red Sea; this is an important paper, as the observations and remarks tend to clear the chart of many *vigiäs* to the southward and north-eastward of Madagascar.

"Between the parallels of 35° and 40° S. many doubtful dangers are marked on the charts; and on nearing them, the lead was brought into play. Two of these, I think, may be fairly expunged from the position they have so long held.

"The first was the Brunswick, on which is marked 85 fathoms,—deep enough, certainly, for any ship that floats; but to remove all doubt, I had two casts not far from it of 1410 and 1102 fathoms without reaching bottom.

"The next was the Atalanta shoal, seen by two ships, an American and a Dutchman; both give the position different. I therefore laid it down on our chart in three several places. I passed from the westward between the most northern position and the first of the southern ones, and got four deep casts, besides several of 50 and 80 fathoms in their vicinity. The first was down (by intervals of time noted) to 1110 fathoms. I felt doubtful about the cast, and as there was no time to get another cast before dark, lanterns were placed, and the lead was let go, getting as good a series of intervals as with many soundings we have made by daylight;

* The full detail of the analyses is:—Videnskabernes Selskabs Skrifter.—V. RŒKKE, 1860.

moreover, proving that our first cast was right, for this time the lead was down at 1120 fathoms; and, as a further satisfaction, the valve bringing up a specimen of the bottom, appearing to be fine, light-coloured sand, over a hard bottom. The next morning, having laid by nearly all night with 800 fathoms, I found no bottom; and a little further N.E. the lead was down at 900 fathoms. Here the valve brought up a specimen again similar to that which we had the preceding night, with a small pebble on it; and when a portion of this specimen was placed under the microscope, it proved to be some of the most beautiful species of the *Diatomaceæ* that can be imagined.

"From this last sounding the course was more northerly, and considering what could have given rise to the report of pointed rocks, and how to account for finding such shoal water so far from any land, six and eight hundred miles—the Crozets on the one hand, and south point of Madagascar on the other—thought it possible that a less depth might be met with, and further, that this vicinity ought to have a closer examination. However, looking to the westward, something like a break caught my eye, but being the only person who could see it, I thought I was deceived by the *mirage*, and perhaps imagination, from dwelling so long on the subject of rocks, and went below.

"In the course of half an hour the officer of the watch reports passing broken water to the S.E., just in the opposite direction to where I had seen a like object, but this time there was certainly no deception; the description given was, that it had the appearance of water rushing and foaming over broken ground, like a mill-stream. From the distance, with a glass, it most decidedly looked like breakers; and being under steam, almost a dead calm, I bore away for it; nearing it, it lost the appearance of *break*, but showed a white milky substance, in large patches, spread over a considerable surface, with strips of dark water between, showing as the deepest water; this, together with the long undulating motion from the S.W. swell, had caused it to appear from a distance, as if breaking. I steamed through, and with 145 fathoms found no bottom.

"This appearance, I have no doubt, without examination, has given rise to the reports of so many dangers seen between these parallels; and one circumstance which took place with us will, I think, show how one may be deceived. The captain of the forecastle, not knowing that the course had been altered, or that anything unusual was going on, suddenly looked out ahead, and shouted most lustily, 'Broken water ahead, sir!' This, too, when we were close to it.

"About the Brunswick shoal, also, for two days we were passing through what at a distance might be taken for sand-spits, which on examination proved to be a small gelatinous polypi, with a small crustacea in the head of a yellow and brownish appearance, which, seen in such immense quantities, might easily deceive at a distance, especially in former days. What to call the white substance I do not know; there were infusoriæ and small crustaceæ found amongst it.

"Steering now to pass to the westward of Mauritius, a little south of the parallel of 20°, distant from the land 90 miles, I could not get bottom with 1375 fathoms of line. This first showed me the improbability of the Indian Ocean being of less depth than the Atlantic. Proceeding northward, I passed up to the westward of Cargados Garajos, Saya de Malha, east of Seychelles, and crossed the Equator in 58° 20′ E., getting a cast 9 miles south of it, with 2380 fathoms; no bottom.

"Between 40 and 50 miles west of the northern part of the Cargados got bottom with 1400 fathoms of line. In Lat. 14° 41′ S., and Long. 58° 43′ E., no bottom

with 1570 fathoms. In Lat. 10° 30′ S., and Long. 58° 52′ E., no bottom with 1320 fathoms; here the ship was passing through strong tide-rips looking like breakers, or rather a rush of water over uneven bottom; in fact, it was one of the first overfalls that we had met; on first view it appeared as if numbers of fish at the distance were swimming about just under the surface, or the albicore in chase of the flying fish. Passing near where 185 fathoms are marked on the chart N.W. of the Saya de Malha, no bottom with 200 fathoms.

"Wind now light from northward; when I was close to the doubtful George island, and about ¾ of a mile west of its southern part, 2000 fathoms of line would not reach bottom; temp. of surface 81°·5, at the greatest depth 38°·2. Passed over this island nearly a mile within its southern point, and not finding the ship on shore, conclude that such an island never existed here. Steaming to pass near Rose Galley rocks, the next morning, 5 miles south of the most western one, found bottom with 2254 fathoms of line, the valve bringing in plentiful specimens from that depth; and the thermometer sent down showed a minimum temperature of 35°. The thermometers are hardly to be depended on, for up to this time I have invariably found that on their return the tell-tale in the maximum column has shown very different from what it did on starting—viz., the surface-temperature, from which we may conclude that the minimum tell-tale has moved also. Mr. McLear, the astronomer at the Cape, also spoke of it taking up one of our deep-sea thermometers when he was on board, and quite altering the indices with a very little motion, less than the line is likely to give it on its passage up and down.

"After this sounding near the Rose Galley rocks I passed about 1 mile west of the westernmost one, and could not detect the slightest break or disturbance in the sea anywhere. Approaching Swift bank, I commenced sounding with 150 fathoms only, and carried a line of that depth over the bank without reaching bottom."

CHAPTER XII.

WHALING-GROUNDS IN THE PACIFIC, ATLANTIC, AND INDIAN OCEANS.

The following observations are extracted from Commander Wilkes' "Narrative of the United States' Exploring Expedition, 1838–1842."

The principal whaling-grounds in the Pacific are indicated below; they are confined particularly to spaces which have been known in the Pacific Ocean by names well understood among the whalers, such as the "on-shore ground," and the "off-shore ground," "middle ground," &c. These spaces, however, have wide limits; thus, for instance, the "on-shore ground" embraces the whole extent of ocean along the coasts of Chili and Peru, from the island of Juan Fernandez to the Galapagos islands; and the "off-shore ground" the space between Lat. 5° and 10° S., Lon. 90° and 120° W.

The following list embraces all the different grounds in the Pacific visited by whalers:—

1. The on-shore ground.
2. „ off-shore ground.
3. In the neighbourhood of the Hawaiian islands.

4. In the neighbourhood of the Society islands.
5. „ „ Samoan group.
6. „ „ Feejee group.
7. „ „ Kingsmill group.
8. Along and to the south of the equator, from the coast of South America to the Kingsmill group.
9. Across the South Pacific, between the parallels of 21° and 27° S.
10. „ North „ „ „ 27° and 35° N.
11. In the neighbourhood of the east coast of New Zealand.
12. The Middle Ground, between New Holland and New Zealand.
13. The coast of Japan, and between it and the Bonin islands.
14. The N.W. coast of America.
15. Coast of California.

These, it will be seen, embrace a large field, and it might be supposed that a ship could hardly miss finding the animals. Such, however, is not the case. A vessel may visit all these places, and yet return home a "clean ship," if she happened to be out of season. It appears from experience that whales in their migrations congregate in the above-named places at certain times of the year, and those who are acquainted with the business endeavour to be early on the cruising-grounds. I shall now point out the times, according to the best information, at which the whales visit the several grounds, and although not a whaler, I hope to give such information as may be useful to this adventurous class of my countrymen.

For convenience of description, the cruising-grounds may be considered as included within four distinct sections or belts.

These belts are from twenty to twenty-five degrees of latitude in width.

The first of which I shall speak is that between the equator and the northern tropic; the second, between the tropic and latitude 50° N.; the third, between the equator and the southern tropic; and the fourth, between the southern tropic and Lat. 50° S.

Within the tropics, whales are almost always to be met with. There are, however, particular places within this zone where they chiefly congregate. Whales are found in the first belt on the north side of the equator, to the southward of the Sandwich islands, and thence westward as far as the Mulgrave islands, for the greater part of the year; but the only spot or space they are known to abound at any particular season within this belt, is to the westward of the Galapagos; they pass and repass over the rest of this space in their migrations, and may generally be found near to, or around the small islands.

In the second belt, they range from the coast of Japan to the north-west coast of America, and California; this they frequent from May till November. In the month of July they are found off the Bonin islands, and between them and the coast of Japan. They frequent the space lying to the northward of the Hawaiian islands, and comprehended between the parallels of 28° and 35° N., and within the meridians of 145° and 165° W., from June to October; and resort to the north-west coast of America in August and September; and to that of California in November and January.

The third belt comprises the ocean from the coast of South America to the Kingsmill group, including the Marquesas, Society, and Friendly islands, the Samoan and Feejee groups. Within these are the spaces known as the "on-shore and off-shore

grounds." The latter the whalers frequent from November to February, and along this third belt they are found until the months of July and August, by which time they reach the Kingsmill and Feejee groups. There are, however, stragglers to be met with in this space during all seasons.

The fourth belt extends from the southern tropic to the latitude of 50° S. The most profitable time for cruising within it is in the months of March, April, and May, to the eastward of New Zealand. After that date, along and between the parallels of 22° and 28° S., from the coast of New Holland to that of South America. The portion of sea between New Holland and New Zealand is called the "middle ground," and is frequently found very profitable.

From an examination of the particular localities in which whales are found most numerous at certain seasons, and connecting these with my own observations on currents, I am induced to believe the places of their resort will point more correctly to the neutral points, or spaces of no current, than any other data that we yet possess.

These must naturally become the rendezvous or feeding-places of these animals. The determination of these points will therefore throw additional light on the system of currents in the ocean, by pointing out the neutral spaces. When the chief resorts of whales are connected with the currents shown to exist by the observations of the Expedition and others, they will be found to correspond in a remarkable manner with the neutral spaces.

I have myself paid much attention to acquiring information in relation to the position of these grounds, from the masters of whale-ships, but have usually found their reports at variance one with another, and they have sometimes differed as much as five degrees in assigning their limits. Their position, no doubt, varies much in different years; but even this will not explain all the discrepancies of the statements.

If we examine the seasons of the appearance of whales at certain islands, they will generally be found to be between the beginning and the end of the summer of the climate, during which time animal life is most prolific, and the food of the whale consequently abounds near the particular group. I have frequently been told, and it is generally believed, that whales are partial to warmth, and frequent few places outside the tropics. This, if true, would be singular enough; but the main reason for their frequenting the summer seas at particular seasons is the procurement of food, which is there to be found in greater abundance; and there appears to be little doubt that in migrating these animals move with the currents, until they find their food in plenty, and then continue in such locality until it is exhausted.

A number of instances are known in which, at certain seasons, strong currents have been experienced in places where, three months afterwards, they were found to have ceased altogether, or even to have changed their direction. I have now particular reference to the N.W. coast.

Having pointed out the different belts in the Pacific, I will now refer to the localities in the Atlantic and Indian Oceans, where the sperm-whale fishery is most successful.

These, in like manner, are found to correspond, and are connected with the obstructions of the submarine currents, or the places where, from opposing causes, they become lost.

In the Atlantic Ocean:

1. Off the Azores or Western islands.
2. „ Cape De Verdes.
3. North of the Bahama banks.
4. Gulf of Mexico.
5. Caribbean sea.
6. To the eastward of the Windward islands.
7. North coast of Brazil.
8. South coast of Brazil.
9. Carrol ground, or a space of ocean lying between St. Helena and Africa.

In the Indian Ocean:

1. Off the southern end of Madagascar, and between it and Africa.
2. „ northern end „ „ „
3. The coast of Arabia.
4. West coast of Java.
5. North-west coast of New Holland.
6. South coast of New Holland, and between it and Van Diemen's Land.

The periods or times allotted to these fisheries coincide with the times at which it might be expected that the food of the whale would be most plentiful, if brought by the polar streams.

The Atlantic fishery is for the most part carried on in a smaller class of vessels than those used in the Pacific; the voyages are of less duration, and less capital is therefore required in this business than the other. In speaking of cruising-grounds, I shall follow the order in which they are visited.

The first in point of time is that near the Azores. This ground does not extend more than 200 miles from these islands, and lies principally to the southward of them. Here whales are found during the summer months, and as late as October. These islands, it will be well to remark here, lie in the route of the Great North Polar Stream, and form an obstruction to its passage; consequently the food is arrested in its progress and is accumulated here.

The next ground visited is off cape Blanco and the cape De Verdes, and it is also searched by the outward-bound ships of the Pacific fleet.

The whalers of the Atlantic next pass to the north coast of Brazil, in the months of October, November, and December, and thence to the Brazil bank, and off the mouths of the Rio de la Plata, where they fish in January and February; after this they seek St. Helena and the Carrol Ground, which lies from fifty to two hundred miles south-east of that island, towards the cape of Good Hope. On the latter ground they remain during the months of March, April, and May; and thence they pass to the westward, along the South American coast, to the eastward of the Windward islands; thence to the Bahama banks, cape Hatteras, and along the coast of the United States, home.

The smaller class of whalers seldom extend their cruising to the south of the line; but after they have visited the first two whaling-grounds, they usually pass to the westward, towards the islands of Fernando de Noronha, and thence along the South American coast, till they reach the Windward islands. They frequent the Caribbean sea in the months of January and February, and farther to the westward, off the peninsula of Yucatan and Cuba, in April; after which time they

proceed through the gulf of Mexico, to cruise off the Bahama banks, and cape Hatteras, in May. Thence they pass northward, on either side of the Gulf Stream, to the eastern side of the Grand banks.

In the Indian ocean, the south part of Madagascar, off point Dauphin, is visited in March and April; in May, June, and July, the ground of the south-west cape of Madagascar, in the Mozambique channel, and upon both sides of that channel. The whalers usually recruit in St. Augustine's bay, where supplies are to be had in abundance, and both wood and water are easily procured. After this, they usually spend some time off cape Corrientes, with the cape and headlands on either side, and visit the Comoro isles. Sperm whales are frequently found in numbers among these islands, and ships usually do well in their vicinity. The African coast, from Mozambique to Zanzibar, is good ground, and the latter place is also a good port for repairing.

Some ships extend their cruising during the north-east Monsoon, from October to April, to the Arabian coast, but the African is generally preferred. The Chagos Archipelago at times affords some success, but it is very doubtful ground, and has not been often frequented. The proper season is during the south-west Monsoon.

The most profitable ground in the Indian ocean is the west and north-west coasts of New Holland, as far eastward as the islands of Timor, Lombock, and Angier, and westward to the Keeling islands, including the coast of Java.

It will be perceived how nearly these grounds coincide with the places wherein, according to the views already stated, the polar streams are obstructed by land or islands, so as either to interrupt their course, or create such an impediment as to change it.

The Sooloo sea is the only place that remains to be noticed. American ships, however, have seldom gone thither; but some English vessels are reported as having met with much success there.

There are two routes by which whale-ships can enter the Pacific: one by the cape of Good Hope and round New Holland; the other, by cape Horn.

To take the first route, they ought generally to time their departure so as to meet the season off New Zealand in March, and this is also the best course for ships sailing in the autumn from the United States. They will then reach their whaling-ground at the earliest possible season, and place themselves at once in a situation to reap the harvest of which they are in search; and they would, in all probability, have time to refit and recruit after the outward voyage. This is much more important for insuring success in this employment than very many either of the masters or owners are aware. After a few days in port, and a supply of fresh vegetables, they would find both their ships and crews in a better condition to take the sea and keep it. After remaining six weeks or two months on the New Zealand ground, until the winter season and boisterous weather approach, the vessels should pass to the northward, towards Sunday island, and thence cruise to the eastward, between the latitudes of 22° and 28° S., or even in a few degrees higher latitude. The lower latitudes are, however, found to be the most frequented by the whale. Along these parallels they proceed as far as the coast of South America, so as to arrive there in the course of the month of September, after passing part of the time to the westward of the islands of Juan Fernandez and Massafuera.

Other vessels reach the Society islands in June, and thence pass to the westward,

in order to meet the season off the Samoan and Feejee Groups; thence again without the Tropics to the south, either on the "middle ground," between New Holland and New Zealand, or to a higher south latitude, and again meet the season off New Zealand at the end of summer or in March. Those that reach the coast of Chili generally recruit in the bay of Talcahuana, or in the port of Payta, in Peru, and are ready to take up the season on the "off-shore ground" in November.

Vessels leaving Europe in the beginning of summer would do better to take the route round Cape Horn, reaching Chili or Peru in time to recruit before the month of November, at which time they repair to the "off-shore ground," where they remain for one, two, or three months; thence pass to the Marquesas islands and to the westward of them, and thence to the west, along the Equator, as far as the Mulgrave islands and the coast of Japan. Returning, they proceed to the north-west coast of America, California, and finally reach the Sandwich islands to recruit by the months of October or November. Other vessels pass directly from the "off-shore ground" to the neighbourhood of the Sandwich islands, where they spend the months of February, March, and a part of April; they then proceed to the Latitude of 30°, and continue their cruising on each side of that parallel between the meridians of 145° and 165° W., until October, when they repair to the Hawaiian islands to recruit.

CHAPTER XIII.

THE MAGNETISM OF IRON SHIPS.

In "Notes on the Physical Geography of the South Atlantic" is given a general description of the various elements of Magnetism as exhibited in the "Variation" of the compass, in the "Dip" of the needle, and in the "Total Force" of which the variation and dip are component parts; it is sufficient here to refer the reader to those remarks, and to draw his attention to these magnetic elements being represented on the charts of the Indian ocean which accompany this work; observing, however, that on one of the charts it is not the Total Force which is given, for that *total* force being the expression of two forces, one "Horizontal," and the other "Vertical," it is only necessary to delineate the former,—a knowledge of which, with the "Dip," enables us to anticipate the changes that take place in a ship's magnetism, and consequently in the deviation.

This work does not propose to enter largely on the general and important subject of the magnetism of iron ships, for the seaman will find it more to his advantage to peruse and master the "Admiralty Manual" relating thereto; it may, however, be useful in this place to draw his attention to a portion of an excellent paper published in the *Philosophical Transactions*, "On the Reduction and Discussion of the Deviation of the Compass," by Captain J. Evans, R.N.

1. *On the best Direction for Building an Iron Ship.*

In those built head N.E., East, West, and N.W., strong *south* polarity (or an *attractive* force on the north end of the compass needle), obtains on one side of the ship adjoining the compass as usually placed between the middle section and the stern; the resulting disturbance is not lessened as the compass is moved in a fore-and-aft line within these limits.

MAGNETIC CHART of the INDIAN OCEAN

[LINES OF EQUAL DIP]

LONDON, James Imray & Son

In vessels built head S.E. and S.W., *north* polarity obtains under the same conditions.

In vessels built head North or South, the conditions arise, that in the former the attraction is toward the stern (the topsides in their action being neutral to a compass in the middle line of the deck), and diminishes in force as the compass is moved towards the bow. In the latter the law is reversed, and small compass deviations are obtained as the stern is approached.*

In an iron *sailing* ship, built head to South, there will be an attraction of the north point of the compass to the head; and if built head to North, a like attraction to the ship's stern; and so far there would seem to be no advantage in one direction over the other. But in the first case the topsides near the compass have weak magnetism; in the second case they are strongly magnetic: the first position seems therefore preferable.

In an iron steam-ship, built head to South, the attraction due to machinery is added to that of the hull, whereas in one built head to North, the attractive forces of hull and machinery are, in the northern hemisphere, antagonistic, and a position of small, or no "semicircular" deviation for the compass may generally be obtained. To iron steam-vessels engaged on the home or foreign trades in the northern hemisphere, this direction of build is therefore to be preferred.

2. *On the Position and Arrangements of the Compass.*

The position of the compass, whether standard or steering, must depend, as will have been observed from the foregoing conclusions, on the direction of the ship's build; that is, in those built head North the compass must be as far removed from the stern as circumstances will permit; in those built South, placed as near to the stern as convenient, without approaching so close to the rudder-head or iron taffrail as to cause the ship's general magnetism to be overpowered by the magnetic influence of those masses.

In ships built East or West there is little choice of position, except to avoid, as a general rule, proximity to vertical masses of iron; in vessels built with their heads on the intercardinal points, a position approximating to the bow or stern respectively, where the action from the topsides (to be determined experimentally) is at a minimum, is to be preferred.

Ample elevation above the deck, and to be strictly confined to the middle line of the ship, are the primary conditions of position for every compass in an iron ship,

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* Hence it follows that the *character* of the deviation—*though not the amount*—may be approximately represented in a tabular form, as follows:—

Approximate Magnetic Direction of Ship's Head while Building.	Maximum Easterly Deviation occurs when Ship's Head by Compass is near.	Maximum Westerly Deviation occurs when Ship's Head by Compass is near.
N.	W.	E.
N.E.	N.W.	S.E.
E.	N.	S.
S.E.	N.E.	S.W.
S.	E.	W.
S.W.	S.E.	N.W.
W.	S.	N.
N.W.	S.W.	N.E.

and no compass, whether steering or standard, should be nearer the iron deck beams than 4 feet: for the steering compass this arrangement could be met by the use of a vertical card for the helmsman.

The standard compass, which as a rule I should recommend to be invariably uncompensated, requires an elevation of at least 5 or 6 feet from the deck, and to be fitted on a separate and permanent pillar or stand: it is by this superior elevation that the strong magnetic power of the iron beams and adjoining topsides is correspondingly lessened.

As every piece of iron not composing a part of, and hammered in the fabrication of the hull—such as the rudder, funnel, boilers, and machinery, tanks, cooking galleys, fastenings of deck houses, &c.—are all of a magnetic character differing from the hull of a ship, their proximity should be avoided, and, so far as possible, the compass should be placed so that they may act as correctors of the general magnetism of the hull.

A compass placed out of the middle line of the deck is affected by the nearest topside, and its deviations must necessarily be much increased if that topside has the dominant polarity, as in the ships built East or West.

Experience has proved that the practical value of mast or elevated compasses has in some cases been overrated; they are, in fact, affected by the ship's magnetism to an amount depending on their elevation and the direction of the ship's build. Thus, in ships built North or South, but especially the latter—the compass being on the mizen mast—the deviations will be large comparatively. In ships built East or West the deviations will be comparatively small, from the topside (which would affect a deck compass) being more directly under the mast-compass; they may, therefore, be useful in the latter cases, and valueless in a ship built head to the South. The wear and tear on the pivots and agate caps of mast-compasses, from the increased motion due to their elevation, require constant attention when they are employed.

3. *On Various Sources of Error affecting a Compass placed under favourable conditions.*

Errors arising from changes of geographic position must of necessity occur, as also incidental causes of error due to anomalous rather than general conditions. There is, however, one source of compass-error—that arising from the heeling of the ship—which has not yet been alluded to, as the ship in all the points hereto reviewed is assumed to be on an even keel.

The few experiments made in ships of the Royal Navy tend to prove, as also does the test of experience, that when the original compass deviations are small, the errors from heeling are generally small in proportion; and conversely, that exaggerated errors from heeling are the consequence of exaggerated errors while on an even keel. Ample elevation from the deck, in order to raise the compass above the level of the topsides and adjacent deck beams, is one of the chief conditions for reducing this source of error.

MAGNETIC CHART of the INDIAN OCEAN

[LINES OF EQUAL HORIZONTAL FORCE]

LONDON, James Imray & Son.

With head built	North,	on heeling,	the north end of compass needle will be *attracted* to the weather or nearest side from its *south* polarity.
,,	N.E.	,,	,, the same.
,,	East,	,,	,, the same.
,,	S.E.	,,	the north end of needle will have but little error from the balanced conditions of north and south polarity of topsides.
,,	South,	,,	the north end of needle will be *repelled* to the lee side by the *north* polarity of nearest or weather topside.
,,	S.W.	,,	the north end of needle will have but little error, as at S.E.
,,	West,	,,	the north end of needle will be *attracted* to the weather or nearest side.
,,	N.W.	,,	,, the same.

These laws only hold good as long as the topsides in the immediate vicinity of the compass retain their dominant polarity due to their original direction of build in Great Britain: if in south magnetic latitudes a change of polarity takes place, the conditions of heeling correspond to such change.

The maximum disturbance on heeling in all these vessels is when their heads are (by disturbed compass) magnetic North or South, and this disturbance vanishes when the head is East or West. This law of disturbance may be thus explained: when the vessel's head is north or south on an even keel (by disturbed compass), the needle lies parallel to the topsides by their combined action, which neutralizes each other; on heeling, the nearest topside exercises its then dominant polarity at right angles to the direction of the needle, and hence the maximum error. With the ship's head east or west, whether on an even keel or heeling, either pole of the compass-needle points directly to the topsides, and is consequently unaffected except in a vertical plane.

As the amount of disturbance on heeling varies under the various conditions of direction of build, height of compass, and breadth of ship or distance of topsides, added to the prevailing permanent or inductive magnetic condition of the latter and the deck beams, each ship must have an individual character, to be determined only by experiment or observation at sea. There are, however, strong grounds for inferring that by a judicious position of the compass, so as to ensure small errors while on an even keel, the errors arising from the ship's heel will be so proportionally reduced as not practically to affect the navigation of the ship in the hands of a prudent seaman.

In conclusion, it is recommended to every master of an iron ship or steamer that he be provided with GODFREY'S "Time Azimuth Chart," whereby, with incredibly little trouble, he can determine the true bearing (within 1° or 2°) of any celestial object when its meridian distance is greater than two hours; so that by observing the object's bearing by compass at any given instant (within the limits stated), and then measuring the true azimuth on the chart, he at once knows the error on the course he is steering.

Table of the Variation of the Compass in the Indian Ocean, 1866.

	Longitude East.																								
Lat.	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°	125°	130°	135°	140°	145°
20°N.	°	°	°	°	°	°	°	−1	−1	−1	0	+1	+1	+2	+2	+2	+2	+2	+2	+1	0	°	°	°	°	°
15°					−5	−4	−3	−2	−1	0	0	0	+1	+1	+2	+2	+2	+2	+2	+1	+1	0	0	0	0	
10°							−3	−2	−2	−1	0	0	+1	+1	+2	+2	+2	+2	+2	+1	+1	0	0	+1	+2	+3
5°N.						−5	−4	−3	−2	−1	−1	−1	0	+1	+1	+1	+2	+2	+1	+1	+1	+1	+1	+2	+3	+4
0°					−7	−5	−4	−3	−3	−2	−1	−1	0	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	+2	+3	+4
5°S.					−9	−7	−5	−4	−3	−2	−2	−1	−1	0	0	+1	+1	+1	+1	+1	+1	+1	+2	+2	+3	
10°					−12	−9	−7	−5	−4	−3	−2	−2	−1	−1	0	0	0	0	0	0	0	+1	+2	+3	+4	+5
15°					−14	−12	−9	−7	−6	−5	−4	−3	−3	−2	−2	−2	−2	−2	−2	−1	−1	0	+1			
20°				−20	−19	−15	−13	−10	−8	−7	−6	−5	−5	−4	−4	−4	−4	−3	−3	−2	−2					
25°				−23	−20	−18	−16	−14	−12	−11	−9	−9	−9	−8	−8	−8	−7	−6	−5	−4						
30°			−27	−26	−24	−22	−19	−17	−16	−15	−13	−12	−12	−12	−12	−11	−10	−8	−7	−6						
35°	−30	−30	−29	−28	−27	−25	−24	−22	−21	−19	−18	−17	−17	−16	−16	−15	−14	−12	−10	−8	−5	−3	0	+3	+6	+8
40°	−30	−31	−31	−31	−30	−29	−28	−26	−25	−24	−23	−22	−21	−20	−19	−18	−17	−15	−12	−10	−7	−3	0	+2	+6	+8
45°	−30	−31	−32	−33	−33	−32	−31	−30	−29	−28	−28	−27	−27	−26	−25	−23	−21	−18	−15	−12	−8	−5	−1	+2	+6	+9
50°	−30	−31	−33	−34	−35	−35	−34	−34	−33	−33	−32	−32	−32	−32	−31	−29	−27	−23	−19	−15	−10	−7	−2	+2	+6	+10

+ Signifies Easterly Variation; and − Westerly Variation.

MAGNETIC CHART of the INDIAN OCEAN

[LINES OF EQUAL VARIATION]

The mark + signifies annual increase, and the mark − annual decrease, in minutes.

LONDON, James Imray & Son.

PART II.

SAILING DIRECTIONS

FOR THE

PRINCIPAL PORTS IN THE INDIAN OCEAN.

SOUTH AND EAST COASTS OF AFRICA.

*** The Variation of the Compass in 1864 was;—Table Bay to Cape Agulhas 29° 40′ W.;—Cape Recife 29° 35′ W.;—the mouth of Buffalo River 29° 15′ W.;—Port Natal 27° W.;—Delagoa Bay 24° 20′ W.;—Cape Corrientes 22° 30′ W.;—Quillimane River 18° W.;—Mozambique 14° 15′ W.;—Cape Delgado 11° 48′ W.;—Port Zanzibar 10° 20′ W.;—Pemba 9° 40′ W.;—Mombaz 9° 7′ W.;—Cape Guardafui 2° 40′ W.

TABLE BAY.—Table Bay, at the southern extreme of the west coast of Africa, is situate on the northern side of that peninsula, the south extremity of which bears the name of the Cape of Good Hope. In the south part of the bay, at about two miles eastward from the town, is the Royal Observatory, in Latitude 33° 56′ 3″ S., and Longitude 18° 28′ 42″, or 1h. 13m. 55s. east of Greenwich. The Lion's Rump, Robben Island, and Blaauwberg may be considered as the extremes of Table Bay, which give it an extent of 7 miles from north to south, and 5 miles from east to west. In it the soundings range from 5 to 20 fathoms, the former depth being found at ½ a mile or less from the shores, except in the southern part of the bay, abreast the town, where there are but 5 and 6 fathoms at nearly one mile from the land, towards which the water thence shoalens very gradually.

With the exception of the off-lay from the shores, the only danger to be feared is the *Whale Rock*, an isolated rocky patch over which the sea breaks, when there is any swell, but at other times the water passes smoothly over it; it lies ⅘ of a mile

S. by W. from the south point of Robben Island, and has 5 and 7 fathoms close to it all round, and 4, 5, and 6 fathoms between it and the island. When approaching the bay from the southward, the rocks named the *Lion's Paws*, which lie about $\frac{1}{2}$ a mile off shore at the foot of the Lion's Head, and also the coast in their vicinity, should be avoided, by giving the land a berth of one mile or more.

ROBBEN ISLAND lies 24 miles southward of Dassen Island, $5\frac{1}{4}$ miles N. by E. $\frac{1}{2}$ E. from Green Point lighthouse, and $3\frac{3}{4}$ miles from the shore at Blaauwberg. It is low and flat, about $1\frac{3}{4}$ mile in length from N. by E. to S. by W., one mile in breadth, and bounded by reefs which from its western shore project $\frac{1}{2}$ of a mile; rocky ground deepening gradually from 5 to 10 fathoms also extends W. by N. one mile from the western extremity of the island, and causes heavy breakers when the wind blows strongly from S.W. to North. The north-east side of the island is free from danger, but the eastern shore is fronted by a rocky shoal, which extends E. by S. from the church tower to a depth of 4 fathoms, at the distance of half a mile from the land; the depths upon it are irregular, varying from 2 to 4 fathoms, and its position is well marked by an abundance of seaweed.

At the south end of Robben Island there is a hospital for lunatics. There is, or was, also a depot for convicts from the Cape, who are or were employed in quarrying lime-stone, of which the base of the island is composed. Grapes and vegetables are grown, and there are several springs of good water. The soil is sandy. The highest part of the island is Minto Hill, situate at its south end, the summit of which is 106 feet above the sea level: upon this hill there is a lighthouse (consisting of a round white tower, 76 feet high) which shows a *fixed white* light at 154 feet above the sea, visible from a distance of about 20 miles.

Few vessels touch at Robben Island, and such as have occasion to send a boat's crew to shore, anchor on its eastern side, it being unsafe to anchor on its western side on account of the heavy swell. The best landing-place is in Murray Bay, on the north-east shore of the island; another place is in the cove at its south-east side, near the lunatic establishment.

CAPE TOWN, situate in the south-west corner of Table Bay, at the foot of Table Mountain and Devil's Peak, and on the eastern side of the Lion's Head and Rump, is built upon a shelving plain, which gradually rises to the foot of those hills: the last two of which stretch out to the northward, and shelter the bay from westerly winds. The town is defended by numerous forts and batteries, and all kinds of supplies can be readily procured for shipping on reasonable terms.

The Castle, at the eastern extremity of the town, is a pentagonal fortress of considerable strength, containing some public offices, barracks, &c., and having outworks which command both the bay and the roads to the country. A little further eastward, the town has an additional protection in Fort Knockle and some fortified lines of defence. And on the northern side it is guarded by Amsterdam, Chavonne, and other batteries.

The town is regularly laid out, contains several good squares, and the streets, which are straight and wide, cross each other at right angles, many of them being watered by canals, and planted on either side with trees, in the Dutch fashion. The houses are generally two stories in height, and are constructed with flat roofs in consequence of the violent winds to which the place is subject. They are built of


TABLE BAY
Nautic Miles
Blueberg
ROBBEN ISLAND
Whale Rock
(Breakers)
Salt River
Mouillé Pt.
Chavonne Bat.
Amsterdam Bat.
H.W. 2h 20m
Rise about 5ft.
Central Jetty
CAPE TOWN
Lions Head
Dangerous
Rocks
Camps Bay
Royal Obsy.
(Time Ball)
Devils Peak
(3376)

stone, their exterior being either whitewashed or neatly stuccoed; their interiors are spacious and convenient, and many of them have terraces or stoeps before them. They are frequently shaded by a small row of fir-trees, which form an agreeable relief to their dazzling whiteness, and at the same time afford the advantage of a shady walk. The terrace walks in front of the houses are generally the favourite lounge of the family in the evening or during the heat of the day, and at all times they afford an agreeable promenade. The rooms are airy, but unprovided with ceiling, the naked joists being seen, with the floor above them. The floors are generally varnished; very few rooms boast of fire-places, and from the deficiency of chimneys the aspect of the town is such as to make one believe it a foreign rather than an English settlement. The Heerengracht, or Gentleman's Walk, is the principal and fashionable street of the town.

The principal public buildings are the Government House, with extensive gardens, the burgher senate-house, barracks, commercial exchange, custom-house, town and district gaol, military depôt, and tax-office; English, Dutch, Lutheran, and Presbyterian churches; Roman Catholic, Independent, Wesleyan, and missionary chapels; Somerset Hospital, and two others; the theatre, Freemasons' Lodge, South African College, police office, &c. Cape Town is the seat of the supreme court of justice for the colony, the Vice-Admiralty Court, a court for the recovery of small debts, a Government bank called the Lombard Discount Bank; and contains a savings' bank, a public library, several public free schools, and many literary, scientific, religious, and benevolent associations. The town and district also possess several water-mills, tanneries, hat, candle, snuff, and soap factories, an iron foundry, breweries, distilleries, sawing and steam mills, &c. It is likewise plentifully supplied with good water.

British residents in India frequently resort here for improving their health; and the town has generally a gay and bustling appearance; balls and theatres are the favourite amusements. The environs are very picturesque, and between the town and mountains which surround it, many handsome private gardens have been laid out.

The *Observatory* is a large and elegant structure situate $2\frac{1}{4}$ miles eastward of the town, on a flat sandy heath. The central part of the building is allotted to the instruments, and the wings form the residences of the astronomer and his assistants. In front of this is the time-ball apparatus.

Signals.—A time-ball has been erected at the flag-staff at the Observatory, for the purpose of daily communicating to ships in the harbour the instant of *one o'clock*, Cape mean time, which corresponds to 11h. 46m. 5s. (*a.m.*) of Greenwich mean time. As the ball attached to the Observatory is not generally visible by the shipping on the eastern side of the bay, owing to the intervention of buildings, another has been established on the Lion's Rump, where there is likewise a beacon and flag-staff.

By pointing the common ship spy-glass to the signal-ball at the Observatory a minute or two before 1h., and noting by the chronometer the instant of the fall of the ball from the top of the staff, and afterwards subtracting 11h. 46m. 5s. from the time by chronometer, the error of the chronometer, or Greenwich mean time will be obtained, which, compared with the error obtained at departure, will give the rate during the interval.

When ascertaining the rate by the time-ball on the Lion's Rump, the observer should note the time by his chronometer when that ball begins to fall, and then sub-

tract one second from that time, he will thus have the moment of 1h. *p.m.* by mean time at the Observatory.

The rate of a chronometer obtained on shore rarely agrees with the true rate at sea; this arises from the motion of the ship and other causes. It therefore becomes necessary to ascertain the sea-rate after the chronometer has been placed on board in the berth it is to occupy during the voyage, and from which it should not be removed throughout that period. The time-balls at Ascension, St. Helena, and at this place afford the requisite convenience for obtaining this important object, and that with but little calculation or difficulty. When the vessel continues a week or more in the bay, it is advisable to ascertain the existing rate. Should the rate be trifling, perhaps less than the probable errors of observation, it will then be right to diminish the latter, by dividing the observations into two or more groups, and to take the mean of each group for one observation; the differences of these means, divided by the intervals of days, will give a determination not far from truth.

The following *general signals* are shown from the Port office only when, from local experience and good barometers, a severe gale may be expected. It is strongly recommended that all commanders immediately repair on board their respective vessels, and answer them by hoisting the Answering Pendant, or the Ensign, at the peak-end, or any of the mastheads. They are repeated from the Lion's Rump signal-station. Any neglect in the observance of, or departure from, the foregoing instructions, will be reported to the agents for Lloyd's, and to the consignees:—

White, pierced blue, over Union Jack.—*Clear hawse and prepare to veer cable.*

Union Jack over white, pierced blue.—*Veer to a whole cable, and see the third anchor clear.*

Union Jack over blue, white, blue, horizontal.—*Strike lower-yards and top-masts, and rig in jib-booms.*

Blue, white, blue, horizontal, over Union Jack.—*Down top-gallant yards and masts, point yards to the wind, and see everything clear for working ship as far as practicable.*

Union Jack over No. 4, white and red, vertical.—*Shorten in cable to same scope as when first moored.*

Ships or vessels having Marryat's Code of Signals can make their wishes known to their agents, in blowing weather, through the Port Office; and any assistance required will be strictly attended to as far as practicable; and vessels not having the code can make the following with their ensigns:—

1st. Ensign in the fore-top-mast rigging.—*I am in want of a cable.*
2nd. Ensign in the main-top-mast rigging.—*I am in want of an anchor.*
3rd. Ensign in the fore-rigging.—*I have parted a bower cable.*
4th. Ensign in the main-rigging.—*I want an anchor and cable.*
5th. Wheft where best seen.—*Send off a boat.*

In order to notify to the public as promptly as possible the occurrence of casualties on the coast near Cape Town, by shipwreck or otherwise, it is directed that, whenever a vessel is known to be in need of assistance, three guns will be fired from the Chavonne Battery, at an interval of two minutes between each, to be taken up and answered by one gun from the Imhoff Battery.

Lights.—On Green Point there is a lighthouse 52 feet high, which exhibits a *white* light *flashing every* 10 *seconds*, at 65 feet above the sea, visible from a distance of 13 miles. At three-fifths of a mile eastward from Green Point, there is a lighthouse on Mouillé Point, which shows a *fixed red* light at 44 feet above the sea, visible about 10 miles. The building is a round tower 30 feet high, painted in red and white bands.

In addition to the lights on Green and Mouillé Points, two small ones have been established in front of the town;* one at the commencement of the north jetty, and the other at the commencement of the old south jetty. The *former* is coloured red, is lit from sunset to sunrise, and is intended to guide vessels running for the anchorage at night. After having cleared and rounded Mouillé Point, steer on until the light becomes visible—the course may then be altered, steering for the light, and anchor in five or six fathoms, according to circumstances. The *latter* is coloured green, and only lit during northerly gales. Should vessels part from their cables during a northerly gale, and be unable to work out, it is strongly recommended to run for the light, and beach close southward of the Castle ditch, the crews remaining in their vessels, by which means little or no danger to life is to be apprehended. It is also recommended that, in the case of such vessels taking the ground, any after-sail which may have been set in running for the beach should immediately be taken in, keeping the foresail or fore-top-sail set, as the case may be, until the vessel is firmly grounded.

The following signals may be made from the most convenient point to vessels that be stranded:—

In day-time, a number will be shown, white upon a black ground.

At night, the number will be shown transparent.

No. 1. You are earnestly requested to remain on board till assistance is sent; there is no danger to life.

No. 2. Send a line on shore by cask and look out for line from rocket or mortar.

No. 3. Secure the rope: bend a warp or hawser to it, for us to haul it on shore for the boat, or for us to send you a stout rope, to be made fast to some firm part of the wreck, that we may haul off a boat for bringing you on shore.

No. 4. Life-boat will communicate at low water, or as soon as may be practicable.

No. 5. Have good long lines ready for life-boat, and prepare to leave your vessel; no baggage will be allowed in the life-boat.

ANSWERS TO THE ABOVE SIGNALS.

By day.—A man will stand on the most conspicuous part of the vessel, and wave his hat three times over his head.

By night.—A light will be shown over the side of the vessel, where best seen. (1855.)

Currents.—In the Admiralty instructions for the port it is stated that a current

* We are doubtful if these lights are now shown. A green light (visible between south, round by west, and north) is exhibited on the outer staging of the works of the breakwater now in progress of construction.

varying in strength from half a knot to two or three knots an hour, sets northward past Table Bay and Robben Island, but during the winter months, when N.W. winds prevail, a current sets into Table Bay from the N.N.W., and impinging on the south-east shore of the bay, about Salt River, divides into two streams, the one setting northward along the coast and out between Robben Island and the mainland at Blaauwberg, while the other takes a westerly course as far as the Cape-town Castle, then northerly, sweeping the south-west shore of the bay, and carrying away loose soil from the south sides of the jetties and projecting rocky points. During the summer season it has been observed, particularly during south-easters, that a gentle stream set round Mouille Point to the S.S.E. into the bay, and out by the Blaauwberg beach, as in the winter.

The rocks about the beach from Green Point to the Amsterdam Battery are bare, and always free from sand; but in the depth of the bay, from the Castle to the Salt River, vast quantities of sand and seaweed are removed from the beach by the draw-back of the rollers, and carried away by the current, leaving the sea-shore a platform of rock, which is again covered to the depth of two or three feet during the months of summer.

Anchorage.—Vessels may anchor off the eastern side of Robben Island in from 10 to 12 fathoms, at from 1 to $1\frac{1}{2}$ mile from the shore; or within $\frac{3}{4}$ of a mile of the island in 6 or 8 fathoms, and obtain shelter from a S.W. swell by the island and reefs. A vessel may remain here until the wind comes to S.W. or W., which generally happens in the morning during the fair season; then weigh, and, if necessary, proceed to the anchorage off Cape Town. During a N.W. wind, a vessel will obtain good shelter under this island, when she would be quite exposed off the town.

In the Admiralty instructions for this coast it is stated that the best position for a large vessel to anchor in is "with the Whale Rock (upon which the sea almost constantly breaks) open eastward of the south point of the island, bearing S.W., and the north extreme of the island N.W. $\frac{1}{2}$ N. or N.W. $\frac{3}{4}$ N., in 8 or 9 fathoms water, sandy bottom. In this position H.M. steamer *Hermes* rode out with ease a heavy south-easter, and without undue strain upon her cable. Smaller vessels will find excellent shelter on the above bearing off the northern extreme of the island, and with the Whale Rock shut in by the south-east extreme of the island S.W. $\frac{3}{4}$ S. in 5 or 6 fathoms. Closer to the shore than this, the ground is rocky. When at anchor, Murray Bay, which has a sandy beach, and where landing can be effected, will bear between W. by N. $\frac{3}{4}$ N. and W. by N. $\frac{1}{4}$ N."

Secure berths may be had off Cape Town in the summer months, when the S.E. winds prevail. The bay is, however, much exposed to wind and sea from N. and N.W. during the winter season, when the winds prevail from these quarters, and send a heavy swell into the bay. It is, in fact, extremely dangerous to remain here after about the middle of May, for N.W. winds may then be expected to set in, and they blow so violently that no ship can possibly ride them out. N.W. gales may be experienced in every season, but it is said they seldom blow home in the bay from November to May, though several vessels have been driven on shore by them, even in the month of April. In the summer months, a ship may moor in about 6 fathoms, with Mouille Point lighthouse bearing N.W. $\frac{1}{2}$ N., and the flag-staff on the Lion's Rump W. $\frac{1}{2}$ N., at the distance of half a mile from the shore at Chavonne Battery. When N.W. winds are expected, ships should not anchor in less than

6½ or 6 fathoms, because the swell runs more regularly than in shoal water, and at these times they should ride with a whole cable or more, lest they drive, in which case it would be difficult to bring them up again. Smaller vessels anchor in 3½ fathoms with Mouille Point lighthouse bearing N.N.W., and the flag-staff on Lion's Rump W. by N. ½ N., at 4 cables' lengths from the shore and abreast Amsterdam Battery; or, still further in, in 2½ fathoms.*

There are two or three inconvenient and insufficient wooden jetties at the town, said to be half devoured by the worm, where goods and passengers land and embark. But plans for a floating steam-wharf, breakwaters, wet docks, sea-walls, &c., have been entertained, one or the other of which may probably be shortly carried out, and thus give greater security and accommodation to vessels calling.†

Mr. Webster says, "The water of Table Bay exhibits a very different appearance, according to the quarter from which the wind blows. With a N.W. wind the water is a dirty red, and turbid, as if mingled with a small quantity of blood.

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* "Table Bay, as a place of discharge, and even as a place of call for refreshments, has obtained a very bad reputation. Many owners put a positive veto on their vessels going there. I think, however, its bad character is overrated, and an unnecessary degree of fear entertained with regard to the safety of vessels riding in the roadstead. I write advisedly, when I affirm that three-fourths of the wrecks which have taken place on entering this bay, have arisen from running unnecessary risks, or from the carelessness and ignorance of the parties in command. Neither would a vessel, properly moored on arrival with good ground tackle and a good stock of cable before the violence of the gale sets in, be so liable to drive or part her cables. A sufficient degree of care and attention is seldom paid to seeing anchors laid down clearly, and in a proper position. In most cases, as soon as one anchor is gone (that very likely foul from the vessel's having head-way, and overlaying it with the cable), the master goes on shore, where he remains, never thinking of mooring, in all probability, until a gale commences. It is also quite common for vessels, calling for a temporary purpose, to get huddled together in such a manner as to prevent them paying out cable when it commences blowing. The same circumstance occurred during my present stay in the bay. The consequence was, as soon as the gale commenced, four or five vessels were all driven together; and had the gale been of ordinary violence, they must have gone on shore, and added to the unjust degree of dread with which this anchorage is viewed at the present time."—*Mexicano in Nautical Magazine*, 1842, p. 807.

"From the experience of five winters," says the Port Captain, "I am of opinion that chain cables do not answer in this bay in northerly gales; and unless a vessel has a good hemp or coir cable on board during the winter months—viz., May, June, July, and August—when such gales are prevalent, accidents must occur. In some vessels the chain cables are evidently defective, either from corrosion, or from being too small for the purpose."

The comparative merits of chain and hempen cables have been thus commented upon by CAPTAIN OWEN:—"Chain cables are to be preferred for anchoring in every situation where the bottom is foul or rocky, and in all places where anchorage is usually sought. But under any circumstances, where the ship is exposed to the ocean swell and heavy winds from seaward, hempen cables are decidedly preferable, for then a vessel's only security is to veer two or four cables, end on end; and these, by their length, lightness (being nearly of the same specific gravity as water), and elasticity, enable her to ride over the sea with buoyancy; whereas, if riding by a chain, it is no benefit to veer a long range of cable, as the chain will lie upon the ground, and not being elastic, but of great weight, it will operate against the rise of the vessel with the swelling wave, and she will be subject to the most sudden and violent shocks from the strokes of the sea, which either breaks over her, or causes her to plunge through the waves instead of riding over them. No ship liable to be so exposed should, therefore, be without two hempen cables, or, what is far better, coir, which is so much lighter than hemp that it floats upon the water. It is also strongly recommended to all vessels to use some few links of chain near the anchor, the advantages from which are obvious, especially where the bottom is rocky, as the links of chain may lie over any sharp or projecting fragment without danger of being cut in two by the friction. By this combination the cable, if well spliced, loses none of its strength; while, by the suspended but not excessive weight at the end, it obtains a greater degree of pliability, which makes the ship ride with more ease and safety.

"Many of the numerous shipwrecks in Table Bay may be attributed to the indiscriminate use of chain cables, their nature and management being ill understood; and several examples are on record where vessels have been obliged (even in the midst of a gale of wind) to slip their chains and let go an anchor with hempen cables, the necessity for so doing being pointed out by the danger of their situation."

† A breakwater is being built. It starts from the shore at Somerset Hospital, and extends in an easterly direction. (1865.)

After a S.E. wind, on the contrary, the water is so beautifully pellucid, that the anchor by which a vessel is riding in 10 fathoms, may be distinctly seen from on board."

For a general description of the Winds, see p. 69.

Supplies, &c.—At Cape Town all kinds of necessities and refreshments are obtainable; there is plenty of good water, but wood is said to be scarce and dear. Sheep, oxen, and other provisions can be obtained at moderate prices; also vegetables, fruits, &c. The water is brought down to the head of the pier in pipes, and hoses are then used to convey it from the pipes to the casks in the boats.

Boat hire is expensive, but the surf is at times so very dangerous, that the reward demanded cannot be considered disproportionate. Coolies, or public porters, are stationed in the market-place, the charges for hire being regulated by the town authorities.

"All vessels bound eastward, or to the Australian colonies with passengers or emigrants, and intending to call at some intermediate port for supplies, should, in my opinion, give a decided preference to Table Bay over any harbour on the Brazil coast. Supplies at the Cape are of superior quality and moderate price, whereas in the Brazils they are very inferior and expensive. Neither in general cases would there be so much detention caused to the vessel by calling at the Cape as on the Brazil coast. Port charges are very moderate, and vessels calling for refreshments only pay one-half."—*Mexicano.*

Directions.—The following instructions for entering Table Bay were officially issued in 1864, when the light on Minto Hill, Robben Island, was first exhibited:—

"Vessels bound for Table Bay from the southward should not shut in Cape Point light with the land at Slangkop Point until Robben Island light—which will be seen before the *flashing* light on Green Point—bears N.E. $\frac{1}{3}$ E., when they may steer for it; and when Green Point light bears east, an E.N.E. course may be followed until the *red* light on Mouillé Point comes open northward of Green Point light, bearing S.E. by S. This route will clear the Vulcan Rock and the reefs in its vicinity. The course may now be altered to S.E. by E. $\frac{1}{2}$ E., which will carry a vessel one mile northward of Mouillé Point light, and within this distance no stranger should round the point at night. When Mouillé *red* Light bears S.S.W., a course about S. by E. $\frac{1}{2}$ E. may be steered for the anchorage, bearing in mind not to approach the *green* light on the end of the breakwater too close. When the *flashing* light on Green Point is shut in with the hillocks near Mouillé Point, or Mouillé Point *red* light bears N.W., distant about one mile, a vessel may anchor in from six to eight fathoms water. Small vessels may anchor in four or five fathoms, with Mouillé Point light bearing about N.W. by N.

"Vessels bound to Table Bay from the northward should give Robben Island a good berth, and not be misled by its light, for the island is low, and the dangerous Whale Rock lies S. by W. $\frac{1}{2}$ W., only $1\frac{4}{10}$ miles from the lighthouse, and nine cables from the nearest point of the island. Having sighted Robben Island light, a vessel should haul to the S.W., if the light bear anything to the westward of south, until the *flashing* light on Green Point bears S. by E. or S.S.E., then steer for it until Robben Island light bears N.E., when steer S.E.; and when Mouillé *red* light bears S.S.W. steer about S. by E. for the anchorage.

"With Robben Island light and Green Point or Mouillé Point light, a vessel may readily determine her position by cross bearings; but in working for the

anchorage the safest and easiest plan to adopt is, whilst Green and Mouillé lights are open of each other, to tack when Robben Island light bears N. by W. $\frac{3}{4}$ W., and when they approach each other or become in line, to tack when Robben Island light bears N. by W. This will prevent accidents from the low Blaauwberg beach, on the eastern shore of the bay, and its deceptive appearance at night. Little, if anything, can be lost in thus beating in by giving up the smooth water near the shore, as a constant northerly current sets out between Robben Island and the main land; added to which, the wind blows with greater violence from the S.E. on the east side of the bay than it does more to the westward, though not in such sudden and violent gusts."

The Cape of Good Hope, on approaching either from the eastward or westward, has the appearance of a large island, when you are at such a distance as not to be able to discern the connexion between its mountains. The highest and most remarkable of these is Table Mountain, at the south part of Table Bay, which is 3550 feet above the level of the sea, flat at top, and sloping almost perpendicularly down at its eastern end, where it is joined to a rugged peaked mountain, named the Devil's Peak, 3270 feet high, the division forming an apparent gap or chasm between. Table Mountain falls down also to the westward, in a similar steep and sudden manner, until it joins the foot of Lion's Head, a mountain whose elevation is 2180 feet; this is joined on the northern side by an oblong hill 1150 feet high, named Lion's Rump. These three, in fact, make but one mountain, for, though disjointed at their summits, they unite at a very considerable height above their base. The Devil's Peak appears broken into angular rugged points, while the Lion's Head is rounded similar to a dome, and looks like a work of art. They partake of the form of an amphitheatre, with its face towards the N.E., the town being situated at their base.

Should a ship, in making Table Bay, be driven northward of Dassen Island, by the current or winds, the soundings will be a good and safe guide to approach the land by, for between Saldanha and Table Bays the depths are regular, and the soundings extend several leagues from the land. From Dassen Island to Robben Island the depth of water is from 30 to 40 fathoms at five miles from the shore, and three miles from the land there are from 20 to 22 fathoms; about ten miles N.W. of Robben Island are 30 fathoms, and ten miles westward of Dassen Island, in the parallel of 33° 30′, are 110 fathoms.

All vessels going to Table Bay should pass between Green and Mouillé Points and Robben Island, while those going from it may pass between that island and the main, for the strong S.E. winds produce a favourable current between that island and the shore, while that between Robben Island and the points will be running into the bay.

Between the foot of the Lion's Head and Green Point, numerous rocks, visible above water, lie at some distance from shore. Give these a good berth as you run in, and you will shoalen your water pretty gradually from 36 and 34 to 26, 20, 16, and 12 fathoms. You may borrow towards Green Point lighthouse to 10 fathoms, without danger. Then steer up the bay, and you will have 11, 9, and 7 fathoms, regular but rocky soundings, till you get about a mile within Green Point, when the bottom becomes sandy and fit for anchorage.

When abreast of Green Point, should it happen that a vessel suddenly meets with furious breezes from S.E. or E.S.E., blowing so hard out of the bay that it is im-

possible to work to windward, which is frequently the case, then she must bear away for Robben Island, taking care, of course, to guard against the Whale Rock. A ship may anchor off the north side of that island in 9 or 10 fathoms; but when going to this anchorage, a good berth should be given to the north-west point of Robben Island to avoid the reef running half a mile from it.

Should a south-easter blow so strongly that a ship cannot bring up under the north end of Robben Island, and consequently be driven to sea, she should haul round as soon as possible, and make short tacks to the southward of Green Point, and lie under the high land until the violence of the wind has abated.

Capt. Horsburgh has observed that "the south-easter comes from the land with great fury; it is, therefore, prudent to take in a reef or two in the topsails before a ship has reached Green Point, if near or a little past noon. By neglecting this precaution, I have seen ships rounding the point with all sail set in a light breeze; then suddenly meet the fiery south-easter on opening the bay, which compelled them to let fly everything to save their masts; and one of these ships, whilst the people were aloft securing the topsails, nearly ran on shore, on the east side of the bay, in veering."

Port Regulations.—We believe they are as annexed:—

1. On the arrival of merchant vessels in Table Bay, a proper berth will be pointed out to the master thereof by the port captain, when he boards them; and no master of a merchant vessel shall shift his berth without permission from the port captain, unless in case of extreme urgency, when he shall report his having done so, as early as possible, at the port-office.

2. Should it be the intention of a master of a vessel to discharge or receive on board any considerable quantity of merchandize, a berth will be pointed out to him as close to the jetty or other landing-place as the safety of the vessel and other circumstances will admit; and the master will then moor with two bower anchors, with an open hawse to the N.N.E., taking especial care, in so mooring, not to overlay the anchor of any other ship, or in any way to give the vessel near him a foul berth.

Ships and vessels touching in Table Bay for water and refreshments only may ride at single anchor in the outer anchorage; but in this case it is particularly recommended to veer out 80 or 90 fathoms, if they ride by a chain cable, as the liability of starting or fouling the anchor, or breaking the chain, will thereby be greatly lessened; and, if riding by a rope or coir cable, to run out a stream or good kedge to steady the ship; and in both cases the other bower anchor should be kept in perfect readiness to let go. When the vessel is properly moored with bower anchors, or well secured with a bower and stream anchor, and with good cables, buoys, and buoy ropes, the master will then take the exact place of the ship by the bearing of two land-marks, and the depth of water; and should any accident occur by which the vessel may drift from her situation, or lose her anchors, a good bearing and depth of water must be taken at the time, and the same must be notified in writing to the port-captain. It is particularly recommended that vessels be kept as snug as possible, to counteract the effects of periodical winds, which at times blow with considerable violence.

HOUT BAY.—Hout Bay is about 11 miles south-westward of Table Bay; the intervening coast is high and bordered with rocks, and therefore requires a berth of two or three miles. The bay runs in to the N.E., on the eastern side of Chapman's

Head, and forms a basin about 4 or 5 miles in circumference, where, with moorings laid down, twenty sail of the line could lie land-locked in from 9 to 5 fathoms water, fine sandy bottom. High water at full and change at 3h.; rise about 6 feet. The entrance is remarkably fine, cannot be mistaken, and has deep water near to either shore within a stone's throw.

Except the rocks about Slangkop Point, or Snake's Head, and those lining the shore of Chapman Bay, immediately northward of that point, the only known danger in the way of entrance is the *Vulcan Rock* (awash at high water), which lies about 2 miles westward of the entrance of Hout Bay, and $\frac{5}{8}$ of a mile from the shore of Chapman Head; within this rock are some dangerous breakers, with an islet and reef, named Duyker Islet and Shoal. These rocks are quite out of the way of vessels approaching from the southward, and being always visible, are easily avoided by vessels coming in from the westward with a north-westerly wind.

The entrance to Hout Bay is about $1\frac{1}{4}$ mile broad, and has a depth of 18 to 12 fathoms, but rather open to the S.W. It is usual to enter along the eastern shore, which is very high and rugged, and quite inaccessible; and having passed the middle of the entrance, to luff up under the west point, and there anchor. The summit of a remarkable peak, Constantia Berg, upwards of 3000 feet in height, seen over high cliffs, brought to bear E. $\frac{1}{2}$ S. (E.N.E. *true*) will lead directly to the bay. On the west point, named York Point, there is a small battery, and on the opposite side there is another and a block-house, all in ruins in 1864.

Captain the Hon. H. J. Rous, of H.M. sloop *Podargus*, has described this bay in the following terms:—

"With the exception of Saldanha Bay, there is no harbour so commodious, safe, or that has so many advantages, as Hout Bay. Situate at the south-west extremity of the Cape Colony, it presents a secure retreat to ships not able to weather Cape Point in strong south-easterly winds, when they could not beat to the anchorage in Table Bay; and also in the winter, to ships meeting north-westerly gales, when they find it impossible to work into False Bay, and they dare not attempt the anchorage on a lee shore in Table Bay.

"Yet with this local superiority, situate in a rich and healthy part of the Colony, with abundance of water, a large farm a mile distant, which supplies the navy contracts with beef and vegetables, and within 10 miles of Cape Town, it is entirely neglected.

"One objection assigned is, that a heavy swell rolls into the land with a south-westerly wind. But this swell cannot dangerously affect ships lying in a land-locked harbour: and south-west winds are seldom prevalent during the dry season at the Cape.

"I presume to state my opinion that Hout Bay, in every point of view, is the proper situation for our dockyard establishment. Its great facility of ingress and egress, which was exemplified soon after the Cape first fell into our possession, by a French frigate having run in, completed her water, obtained supplies of cattle and vegetables, and again made sail with impunity; in consequence of which a fort and blockhouse was erected on the eastern shore, and a captain's guard of 130 men stationed there during the last war. The short distance from Cape Town both by sea and land, the superiority of the harbour, and rich country surrounding it, render it infinitely superior to Simons Bay, which is exactly the reverse in all those leading points. Besides the difficulty of getting to Simons Bay either in the north-west or

south-east gales, ships are liable to be detained three weeks by the latter, whereas at Hout Bay the wind blows out of the harbour every morning at daylight.

"When the numerous dangers in False Bay are considered, and the number of wrecks every year in that and Table Bay, I cannot help regretting that this excellent harbour should remain useless, and that such an indifferent situation as Simons Bay should be chosen for our Naval Arsenal."

A correspondent (CAPTAIN L. BILTON, of the *Queen of the East*) of the *Mercantile Marine Magazine*, in October, 1860, writes as follows:—

"Having for the last ten years been constantly engaged in the Australian and Indian trades, and having read an account of Hout Bay, Cape of Good Hope, by CAPTAIN the HON. H. J. ROUS, of H.M. sloop *Podargus*, describing it as a safe harbour, capable of supplying water, vegetables, stock, &c., I had often felt a great desire to make myself acquainted with it. Of late years, however, I had made Ascension my calling port on the homeward passage, which I would recommend to all masters in preference to St. Helena; and having got into the habit of going there, my wishes as to Hout Bay were never gratified until the present voyage. Being chartered by H.M. Government to take coolies from Demerara back to Calcutta, it was imperative, from a clause in the charter party, that the ship should touch at the Cape, and I at once determined that Hout Bay should be the port. I ran down my easting in 38° S., with fine weather, but, till the last week, very unsteady wind: not having a chart of the Cape Colony, and the weather being hazy, I had some difficulty in making out the entrance to Hout Bay, which is not open till a ship is close down on the breakers in Chapman's Bay; once having seen it, however, it can never be mistaken again. An irregular conical hill forms the western entrance, which is easily distinguished,—but the best way is to bring the centre of Table Mountain to bear E.N.E., and then steer right in fearlessly, and the entrance to Hout Bay will soon be visible: a ledge of Rocks called Chapman's Horns, having a good passage inside of them, will also be seen,—the sea always breaks on them, and they lie about a mile to the west of the fairway in, towards the entrance, which is about a mile in width, with no danger within a musket-shot of the shore, except a small spit about half that distance on the west side. The eastern side has many rocks lying about a quarter of a mile off, inside the bay; the eastern side, therefore, must be avoided. I anchored in seven fathoms, with the blockhouse and old Dutch buildings bearing E.S.E., and an old fort on the western shore bearing West: this is probably the best place for a large ship (the *Queen of the East* is 1226 tons), as from the prevalence of S.E. winds, which often blow strong, a vessel has room to veer out a good scope of cable, and this is also the very best position for getting under weigh. A smaller vessel should anchor about a quarter of a mile further to the W.N.W., behind the old fort, where she would be completely landlocked, and have 5 fathoms to within a cable's length of the shore—or a large ship in winter would be equally safe.

"There are two fishing stations in this bight (belonging to MESSRS. DE PASS & Co., and MESSRS. BOONZIAR), whence boats come off on a vessel entering the bay, and assist, for a moderate sum, in towing her in if becalmed. They will, also, if required, fill and tow off water from the river, at about one dollar per cask—there is no trouble in landing the casks, as, when thrown overboard, they go right ashore at the mouth of the river, at the bottom of the bay, in which the water is excellent,

and is easily accessible. Boats can enter the river at high water, for the purpose of taking off dry stores that might be injured by the surf, or they can be taken off from De Pass's fishing station, where it is always smooth. About 20 ships can lay in Hout Bay with the most perfect security all the year round, and can procure refreshments at a much lower rate generally than in Cape Town; and were ships to use it more frequently, the enterprising proprietors, Messrs. Boonziar & Co., would have supplies of everything needful on the spot. A great drawback is the bad road from Hout Bay to Wynberg, distant 7 miles, but this is about to be remedied. As it is, anything can be got to Wynberg cheaply from Cape Town, and there are always carts from Hout Bay to bring it on at moderate charges, and the whole need not occupy more than one day. It is rather a shaky business, however, riding over those roads in a cart, and let no one be so imprudent as I was on the first occasion, and refuse a pillow when one is offered, or he will return 'a wiser but a sorer man.'

"Pigs, sheep, fowls, potatoes, pumpkins, onions, butter, milk, eggs, &c., are ordinarily to be obtained at moderate prices; but from the late very wet, succeeding a very dry season, everything was much dearer than in general. Fish, fresh and salt, is to be had at the stations in the bay, at reasonable prices, and of excellent quality: there is also abundance of game, viz.,—deer, pheasants, &c.,—while rabbits are to be met with all about the neighbourhood, and plenty of fish could be caught from the ship if time admitted. The farmers in the vicinity, who cultivate the grape chiefly, and vegetables for sale at Cape Town, are hospitable in the extreme, and I may here bear testimony to the kindness and attention I received from Captain Norman and his family, also from the Messrs. Boonziar.

"I landed all the coolies to let them wash in the river, and the benefit arising therefrom was very great in their case, as they left really in better condition than when starting from Demerara, and I was enabled at the same time to get the ship cleaned and whitewashed afresh, and both myself and Dr. Channell were of opinion that a better place for a ship to touch for the purposes we required could scarcely be met with than Hout Bay. We were, however, there in the summer season, and have yet to learn how it would answer in winter. One thing is certain, a ship could lay there in safety when Table Bay would be untenable. Horses or light carts are to be hired at Hout Bay and at Wynberg, at about 7*s.* 6*d.* each way, and from the latter place an omnibus runs to Cape Town every two hours during the day, fare 1*s.* 6*d.* The whole distance from Cape Town to Hout Bay can be done in four hours. Now, when it is considered that no Master can safely leave his ship long in Table Bay, it seems astonishing that Hout Bay should be almost unknown. The Cape Town people, of course, would oppose it tooth and nail; yet it seems impossible but that sooner or later it will be turned to better account than hitherto. It is necessary to report and clear at the Custom-house at Cape Town, both of which occupy but a few minutes. It certainly created some sensation my going there, as I believe no ship of the same size has ever entered the bay on any previous occasion. I found no trouble either on entering or leaving, although I left again in the dusk, very early in the morning."

CAPE OF GOOD HOPE.—From Hout Bay the coast runs 19 miles in a southerly direction to the Cape of Good Hope, and is throughout of a bold description. As this part does not appear to have been closely examined, it will

be advisable to give it a wide berth, especially as a sunken rock has been reported to lie 1 or 1½ mile from Slangkop Point; the Cape also should not be closely rounded, because a reef extends from it about a mile to the westward.

FALSE BAY.—False Bay runs in northward between the Cape of Good Hope on the western, and Cape Hangklip on the eastern side, which capes bear from each other N.W. ¾ W. and S.E. ¾ E., distant 16½ miles. The bay is of nearly a square form, being about 18 miles in length, and the same in breadth. The soundings in it decrease from 50, 40, and 30 fathoms in mid-channel, to 20, 15, and 10 as the shores are approached. Simons Bay is situate in the north-west part of False Bay, 11 miles within the cape, and is about 1¼ mile in extent, with depths in the offing of 11, 10, and 8 fathoms, shoaling to 15, 12, and 6 feet near the jetties of the town. Gordon Bay lies in the eastern part of False Bay, 14 miles within Cape Hangklip, and has a depth of 3, 4, and 12 fathoms.

The whole eastern coast of False Bay, from Gordon Bay to Cape Hangklip, wears a dismal, inhospitable appearance; it is one continual rocky chain, and scarcely approachable. Colebrook Bay, so named in consequence of the wreck of the *Colebrook*, is southward of Gordon's Bay; and farther southward is Pringle's Bay, where Admiral Pringle is said to have landed.

The land on the east and west sides of False Bay is high; but Seal Island and the land on the north side of the bay, from Gordon Bay to Muysenberg Mountain, is low, flat, and sandy, and can only be seen at a short distance.

The Cape of Good Hope is a precipitous cliff, with a peak, the summit of which is about 880 feet in height. Cape Hangklip, sometimes called False Cape, and at others Hottentot Point, is a steep bluff, resembling a quoin, which may be seen at 8 leagues distance, and appears to lean over to the west when viewed from southward; hence its name.

TIDES, &c.—There is no perceptible current in the bay. A current varying in strength sets round the Cape of Good Hope to the north-west from the Bellows Rock.

Lights.—On the eastern part of the extremity of the Cape of Good Hope an iron tower, 30 feet high, and painted white, has been erected, from which a *revolving white* light, showing a *bright* face for the space of 12 seconds every minute, is exhibited at an altitude of 816 feet above the mean level of the sea, and in clear weather is visible at the distance of 36 miles. It can be seen all round the compass, except between the bearings from a vessel of S.S.W. and S. ½ E., and between S.S.E. ⅛ E. and S.S.E. ¾ E., on which latter arc of 7° it is obscured by the intervention of a peak rising 64 feet above the light, at 1800 yards from the light tower. Position of lighthouse, lat. 34° 21′ 12″ S., and long. 18° 29½′ E.

From the south-west Reef this lighthouse bears E. ½ S. distant 1¾ mile; from Bellows Rock N.N.E. ¾ E. 2¼ miles; from the Anvil Rocks N.N.W. ¼ W. 2 miles; and from the Whittle Rock S.W. by W. ¼ W. 7¼ miles.

There is a lighthouse on the Roman Rocks, abreast Simons Bay, which is 48 feet high, with its upper part painted white, and the lower black. It exhibits a *revolving white* light, showing a *bright flash* for a period of 12 seconds every half minute, at a height of 54 feet above the sea, visible to the distance of 13 miles in clear weather. From this lighthouse, Noah's Ark bears S.W. by W., nearly, distant 7/10 of a mile;

the Dock Yard Clock W. $\frac{3}{4}$ N. $1\frac{3}{8}$ mile; and the Castor Rock, with only 15 feet on it, N.N.E. $\frac{3}{8}$ E. 2 cables' lengths.

Dangers.—The most prominent dangers met with when entering False and Simons Bays are, the South-west Reef, Bellows, Anvil, Dias, Whittle, and Roman Rocks, the rocks in the vicinity of Seal Island, and those fronting the shore eastward of Simons Town.

The *South-west Reef* is a rocky patch one mile W. by S. $\frac{3}{8}$ S. from the south-west extreme of the Cape of Good Hope, being distant $1\frac{3}{4}$ mile W. $\frac{1}{2}$ S. from the lighthouse; between it and the shore the ground is foul and rocky. The *Bellows* is a large rock, even with the water's edge, over which the sea constantly breaks; it lies with the lighthouse on the Cape bearing N.N.E. $\frac{3}{4}$ E. distant $2\frac{1}{4}$ miles, and has deep water all round it. The *Anvil* is another rock, separated from the Bellows by a safe channel (which, however, it may not be wise to attempt) of 10 to 22 fathoms; it has 10 feet water over it, and lies with the lighthouse bearing N.N.W. $\frac{1}{4}$ W., distant 2 miles, and the Bellows W. $\frac{3}{4}$ S., 2 miles; the sea breaks upon it only at low water and with a heavy swell. A master of the navy has asserted, with evident probability, that there are other rocks near the Anvil, but we have no particulars respecting them. The *Diaz* is a small rock above water, named after the celebrated navigator who first doubled the southern promontory of Africa; it lies about a cable's length from shore, and 925 yards S. by E. $\frac{3}{4}$ E. from the lighthouse.

S.S.E.-ward $5\frac{1}{2}$ miles from the Cape lighthouse is the north-western edge of an extensive bank of rocky soundings, whereon the depths are from 12 to 25 fathoms. Around and between it and the Anvil Rock are 37, 26, 40, and 20 fathoms. It has not been thoroughly examined, but is supposed to be about 3 miles in extent.

The *Whittle* is the shoalest spot on a ledge of rocks, named the Trident, which is about a mile in circumference, and has on it soundings of 4, $4\frac{1}{2}$, 5, and 15 fathoms. The Whittle is about the size of a boat, bottom upward, and the least water yet found over it is 13 feet, but there may be even less than that discovered when a more complete examination is made; from this depth the lead will suddenly drop into 7 fathoms, and, therefore, great care should be exercised when approaching it. The tide of flood and ebb sets strongly over the ledge. From the Whittle the Cape lighthouse bears S.W. by W. $\frac{1}{4}$ W. distant $7\frac{3}{4}$ miles, and the nearest point (Point Miller) of the western shore N.W. $\frac{1}{2}$ W. $4\frac{1}{4}$ miles, with from 20 to 25 fathoms between. Its position is further indicated by two beacons, the western having a staff and black ball, and the eastern a staff and white ball, and both situate on the western shore, $2\frac{3}{4}$ miles northward of the Cape lighthouse; when they are in a line W. $\frac{3}{4}$ S. they lead to the rock. There is also another beacon with a staff and white ball, near Simons Town, which, if kept in a line with the beacon on Oatland Point,* bearing N.W. by N., will likewise lead on to it. By day, if the weather be hazy and the

* The beacon on Oatland Point is triangular, 35 feet high, and painted *white* with a red band in the centre. It stands on a large flat-topped rock, a few yards from the shore near Oatland Point, and $8\frac{1}{2}$ cables from the *white* beacon, with staff and ball, on the shoulder beneath Simons Berg. From the Whittle Rock the two beacons are in line, and also in line with a large patch of whitewashed rocks on the hill north-west of Simons Town, bearing N.N.W. $\frac{3}{8}$ W. The advantage of this new beacon is, that it points out to vessels that they are westward or inside the Whittle, whilst it is kept open eastward of the beacon on the shoulder beneath Simons Berg. This was somewhat difficult with the patch of whitewashed rocks for a mark, as they were obliged to run far to the eastward before the patch opened out clear of the shoulder of Simons Berg. Vessels from the eastward will find this patch serviceable for pointing out the position of the Whittle.

latter beacons indistinct, there is a dark peak (Chapman Peak) over the southern side of Hout Bay, which if brought on with Elsey Peak on a N. by W. ½ W. bearing will lead clear of, but close to the west side of the Whittle Rock. Or, Roman Rocks lighthouse in line with Elsey Peak will lead midway between Whittle Rock and Miller's Point.

The *Roman Rocks*, now distinguished by a black and white lighthouse upon them, are nearly level with the sea at high water, and situate in the fairway of the entrance to Simons Bay; they are about 130 yards in length from north to south, and 80 yards in breadth. A small detached rock of 15 feet, named Castor, lies 2 cables' lengths N.E. by N. ½ N. from the lighthouse; it is marked by a beacon placed 30 fathoms north-eastward of it. Between this rock and the lighthouse are a few patches with from 19 to 24 feet over them, and from 5 to 10 fathoms between them and the Roman Rocks. Vessels should, therefore, give the lighthouse a good berth when passing round its eastern and northern sides, leaving the above-mentioned beacon to the southward.

Noah's Ark, having the form of a barn, lies nearly 3 cables' lengths from the shore, immediately under Whittle Rock Beacon, with that beacon S.W. by W. ¼ W.; it is about 10 or 15 feet above the sea at high water. Close around it there are from 5 to 6 fathoms water, and within it several rocky patches of 3 and 8 feet, so that, when passing through the channel south-westward of the Roman Rocks, the shore should have a berth of 4 or 5 cables given it, till up with the Phœnix Beacon, which marks the extremity of a dangerous reef of 3 and 5 feet only.

Sea Island, lying 14 miles N.E. ½ E. from the Cape lighthouse, is small, and surrounded with rocks, especially on its northern side, where they extend off fully ½ a mile, and probably the same on its eastern. A large rocky patch, named York Shoal, of from 2 to 6 fathoms, lies 1¼ mile southward of it, and there is a shoal spot 3¼ miles distant in a S.E. ½ E. direction from the islet.

Anchorage.—Simons Bay is considered a safe retreat for thirteen or fourteen sail of ships, where they may be moored in security in all seasons. It is sheltered from winds between the N. round by W. and S.E., but, being small, cannot contain a numerous fleet sheltered from S.E. winds, though it is said that those winds coming from the bottom of the bay, or from the mountains bordering the coast—namely, between S.E., by the E. and N., never blow so strong as to endanger shipping, so that the bay may actually be looked upon as a safe retreat, wherein vessels may lie sheltered from all winds. The best situation to lie in is, with Noah's Ark S.E. by S.; the Roman Rocks E.S.E. ¼ E., distant 1¼ mile, and the time-ball * near the dockyard in Simons Town W. by S. ½ S. In this berth, you will be distant about ½ a mile from the shore, in 9½ or 10 fathoms, and have sufficient room in case of driving, from whatever quarter the wind may happen to come, as you are quite sheltered by the mountains from those which blow with the greatest violence. If intending to make a long stay, or in a smaller vessel, you may anchor further in, in 8 or 9 fathoms, with Cape Hangklip entirely shut in by the eastern side of Simons Bay.

Mr. C. P. Bellamy, Master R.N., says, "You ought to moor your vessel in this road S.E. and N.W., with this particular caution, that, from the month of May to

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* *Signal.*—The time signal-ball drops daily at *one* o'clock precisely of mean time at the Cape Observatory. Its position is 2″·45 (or eleven seconds of time) W. of that observatory.

September, your stoutest ground-tackle should lie to the N.W., as the winds from that quarter blow the oftenest and with the greatest violence; on the contrary, from September to May, you ought to lay it to the S.E., because the south-easterly winds are then prevailing. However, it is seldom that any vessel goes thither in the latter season, Table Bay being at that time much preferable."*

Gordon Bay affords good shelter from S.E. and northerly winds, and has several fair landing-places from half-flood to half-ebb, but at no other time of tide, excepting at the bar, which is formed by a bank of sand, and cannot damage the bottom of the boat: this bank has generally about two feet water over it, but at low water, spring tides, it is perfectly dry. There are other landing-places which with S.E. winds are smooth; but you must always be attentive to the tide. Here there is good anchoring ground, holding well, being of coarse brown sand; vessels may anchor in from 13 to 15 fathoms, with the peak of Hangklip just open southward of the south point of Gordon Bay, and with the upper farmhouse open to the left of the lower farmhouse; small vessels may ride farther in, where the inner anchor is placed in good security, the Cape of Good Hope being shut in by Gordon Bay south point.

Winds, &c.—For a general description of the Winds, see pp. 69, 70.

Supplies, &c.—The country being mountainous, little or nothing is produced here, and there are comparatively few houses exclusive of the public buildings. All kinds of supplies may, however, be obtained, or damages repaired; there is a patent slip capable of hauling up a vessel of 1000 tons burthen; also a magazine of marine stores. Victualling and other necessaries are procured from Cape Town, which is 17 or 18 miles distant. You may wood and water here very readily; the water is both good and abundant; and, in case of necessity, a vessel may heave down by a hulk.

All the landing-places in Gordon Bay afford plenty of water, running down in streams, but the best is near the fish-house; here, although the passage is difficult and intricate, it has a spacious beach, well defended from the sea by reefs running in opposite directions, the only obstacle being the delay for the tide. Fruits, vegetables, and stock can be had here, but not expeditiously, as they must be brought from a considerable distance. If a pier were constructed here and another in Simons Bay, suitable even for small vessels, it would probably be the means of creating a market for the produce of the eastern part of the colony, more convenient than that of Cape Town.

Directions.—The Bellows Rock always breaks; but not so the Anvil, which only breaks at low water and with a heavy swell. Sailing vessels should not pass between these dangers and the South-west Reef and the Cape, unless with a commanding breeze. The most advisable course, when coming in from the westward with a N.W. wind, is to pass southward and eastward of the Bellows and Anvil, at

* Capt. Flinders has observed, "I found it to be a prevailing sentiment, that, were it not for the advantages of Cape Town, Simons Bay would, in every respect, be preferable for the Royal Dockyard and the equipment of ships of the Royal Navy. It was remarked to me, by an officer of discernment, captain of the flag-ship, that instances of vessels being driven from their anchors by winds blowing into Simons Bay were exceedingly rare. He had observed that the strain upon the cables with these winds was much less than with those of equal strength blowing off the land; and he accounted for it from the water thrown into the bay by sea-winds rebounding from the shore, and forming what is termed an undertow, which tended to keep a ship up to her anchors. This takes place in Simons Bay with S.E. winds, but not in Table Bay with those from the N.W., which blow into it, owing in part to the distance at which ships ride there from the land, and apparently, also, from the undertow passing out on the eastern side of the bay, clear of the anchoring ground."

the distance of 2 miles, or according to circumstances. From abreast the Bellows, at 2 or 3 miles, haul up no higher than E.S.E. or E. by S., until you have run 5 or 6 miles in this direction, whence you may steer E.N.E. and N.E., till the lighthouse bears W.N.W., when you will be clear of the Anvil. In advancing thus, you may always gain a proper anchoring-ground, in case of a calm or an unforeseen shifting of the wind. You may now haul up N.N.E.-ward, and pass eastward of Whittle Rock, between it and the reefs southward of Seal Island, though the western channel is undoubtedly the best for strangers. Should you, however, wish to adopt the former do not bring the Cape lighthouse southward of W.S.W., until Noah's Ark bears N.W., you will then go clear of the Whittle Rock. Do not go too near Seal Island, on account of the rocky patch which lies southward of the island, over which the sea will oftentimes break. Steer now towards the Roman Rocks, giving them a berth on either hand, as most convenient, especially their northern side; haul into Simons Bay, and anchor where before directed.

The foregoing, however, is considered by some as running unnecessarily eastward, and thereby occasioning much loss of time and ground, accordingly they recommend leaving the Bellows ½ a mile to the northward, and steering E. ½ S. till the Cape lighthouse bears N.W., and then haul up N. by E. to pass inside the Whittle. Having brought the southern end of the lofty Zwartkop Range (which is over the northern side of Smith's Winkle Bay) to bear N. W. by W., you should keep the Cape lighthouse between S.S.W. ¾ W. and S.W ⅔ W., until the Roman Rocks light bears between N. and N. by W. ½ W., when you may haul towards it. These limits leave the rocks off Miller Point on the one hand, and the Whittle on the other, half a mile distant. If the Roman Rocks light is brought in a line with Elsey Peak, N. ¾ W., it will lead up midway between Miller's Point and the Whittle.

As you approach Simons Bay, Noah's Ark will soon be discerned; it is a smooth level island, appearing like a pontoon at a distance; but the most conspicuous objects, and first to be seen, are the white sand-downs, appearing like snow, in the hollows between the mountains to the north-west of Noah's Ark. You may coast along Noah's Ark, as it is steep, and has 9 fathoms close to it; in the channel between it and the Roman Rocks are 10 to 15 fathoms; hence a vessel should steer direct for the white sand-downs to the anchorage, passing eastward and northward of the Phœnix Beacon and Rock. If working with a N.W. wind, you may go northward of the Roman Rocks, taking care not to go too near them on account of the detached rocks already alluded to. This is also a clear channel, and may indeed be deemed more convenient with the winds from the N.W., as it is double the width of that between the Rocks and Noah's Ark.

Mr. J. Brown, of H.M.S. *Winchester*, says,* "When a vessel has rounded the Cape of Good Hope from the westward, the Roman Rocks light will open clear of Miller Point on the bearing of about N. by E.; and if it be intended to work up False Bay, between the Whittle Rock and the western shore, the light should not be brought westward of N. by W. ¼ W. until she is well up with the high land about Miller Point, and consequently northward of the Whittle; nor should the light be brought at any time to bear eastward of N. on account of the rocks off the western shore.

* Although these directions were written before the lighthouse was erected on the Roman Rocks, and while the lightvessel was moored on their northern side, the substitution of the *lighthouse* for the *lightvessel* does not at all affect their value.

"If the vessel is to work up eastward of the Whittle, the light should not be brought north of N.N.W. ½ W., in order to avoid that rock; nor westward of N.W. by W. ½ W., so as to give a sufficient berth to Seal Island and the shoal near it. But by whichever of those channels a ship approaches, short tacks should be made until certain of being within 5 miles of the light.

"With a leading wind the light may be brought to bear N. by W., which will clear the Whittle; and that course should be continued till within a mile of the light. The light must then be well opened on the port bow, so as to round it at not less than half a mile distance. When the light has been brought to bear S.S.W., steer in West for the anchorage, and bring up in 14 to 10 fathoms, according to the weather.

"When coming from the eastward round Cape Hangklip, it will be observed that the Whittle lies nearly in a direct line between that cape and Simons Bay; and therefore, if the wind be fair, bring Roman Rocks light to bear N.W. by N. and steer for it.

"These instructions are intended for seamen not acquainted with Simons Bay; those who know the passage between the Roman Rocks and Noah's Ark, will probably adopt it in the day-time, but from the position of the Phœnix Rock, and the narrowness of the passage, all ships at night should pass eastward of the light, and haul round it on the north side."

Vessels from eastward should not bring the Cape lighthouse to bear more westerly than N.W. ½ W., by which they will clear all danger off Cape Hangklip. A tongue of low land stretches from this cape in a S.W. ⅔ W. direction for 1⅕ mile, rendering caution necessary in passing Cape Hangklip in hazy weather, especially if bound into Simons Bay.

If bound eastward out of Simons Bay, leave as soon as the north-westerly winds begin to blow; but if you intend to sail westward, you must wait till the north-westerly winds are on their decline, and get under sail in the roadstead, so soon as those winds shift from W.N.W. to West, for, as they most commonly veer thence successively to S.W. South, and S.E., they will prove fair for doubling the Cape of Good Hope, and lying up afterwards to N.W. The only directions to be given for leaving the bay is to reverse those for entering it.

To ships working out of Simons Bay, Gordon Bay will afford a ready shelter on the approach of night, for they can stretch into the outer part of it, and anchor for the night, well in shore, with a kedge or stream anchor; for it is generally observed, that when the wind blows strongly from the S.E. at the anchorage in Simons Bay, and other parts of False Bay, a ship will not have advanced half a mile within Gordon outer bluff before she will get into a light breeze, scarcely sufficient to carry her to the anchorage; here she may lie until daylight; then weighing and stretching out into the true wind, and work out either round the Cape of Good Hope or Cape Hangklip.

Gordon Bay will prove equally safe and advantageous for vessels standing in for Simons Bay late in the evening, and not considering it safe to run for anchorage there; for then they may stand over for Gordon Bay, and anchor for the night: they cannot mistake it, the land in the front, when standing eastward, being so very remarkable. This might easily be made a good place for shipping, for on each side of the bar are rocks, with plenty of large loose stones about them, and by piling up these stones upon the rocks, a pier might be constructed to any distance out; and if

a swinging crane were erected on the south pier, it would considerably facilitate the lading and unlading of the boats. The same plan might be pursued with the bay northward of the fort.

The harbour regulations and signals of Simons Town are similar, we believe, to those at Cape Town. See pages 276, 277, and 282.

From False Bay the coast trends 11 miles in an E. by S. ¼ S. direction, and is bold all the way, with rocks projecting from the base of the cliffs, close to or at a very short distance from which the soundings are deep, hence a good berth should be given to this part. At 9 miles from Cape Hangklip is the outlet of the ***River Palmiet***, which is barred; this river is a rapid stream in winter, when fully charged with water, but is dry, or nearly so, in summer;—at half a mile eastward from it there is a small rocky cove, where a boat can land in fine weather. The coast now falls low and changes its direction to S.S.E. for about 5¾ miles, or as far as the rocky projection named Point Mudge, forming thereby an open bay called Sandown. The land immediately behind this shore is very lofty, rising into mountains, visible in clear weather many miles at sea; Sharp Peak, in Lat. 34° 20′ and Long. 18° 53½′, is estimated to reach an altitude of 2780 feet; the Crags, in Long. 19° 1′, 7025 feet; and Onrust Berg, over Point Mudge, 1575 feet.

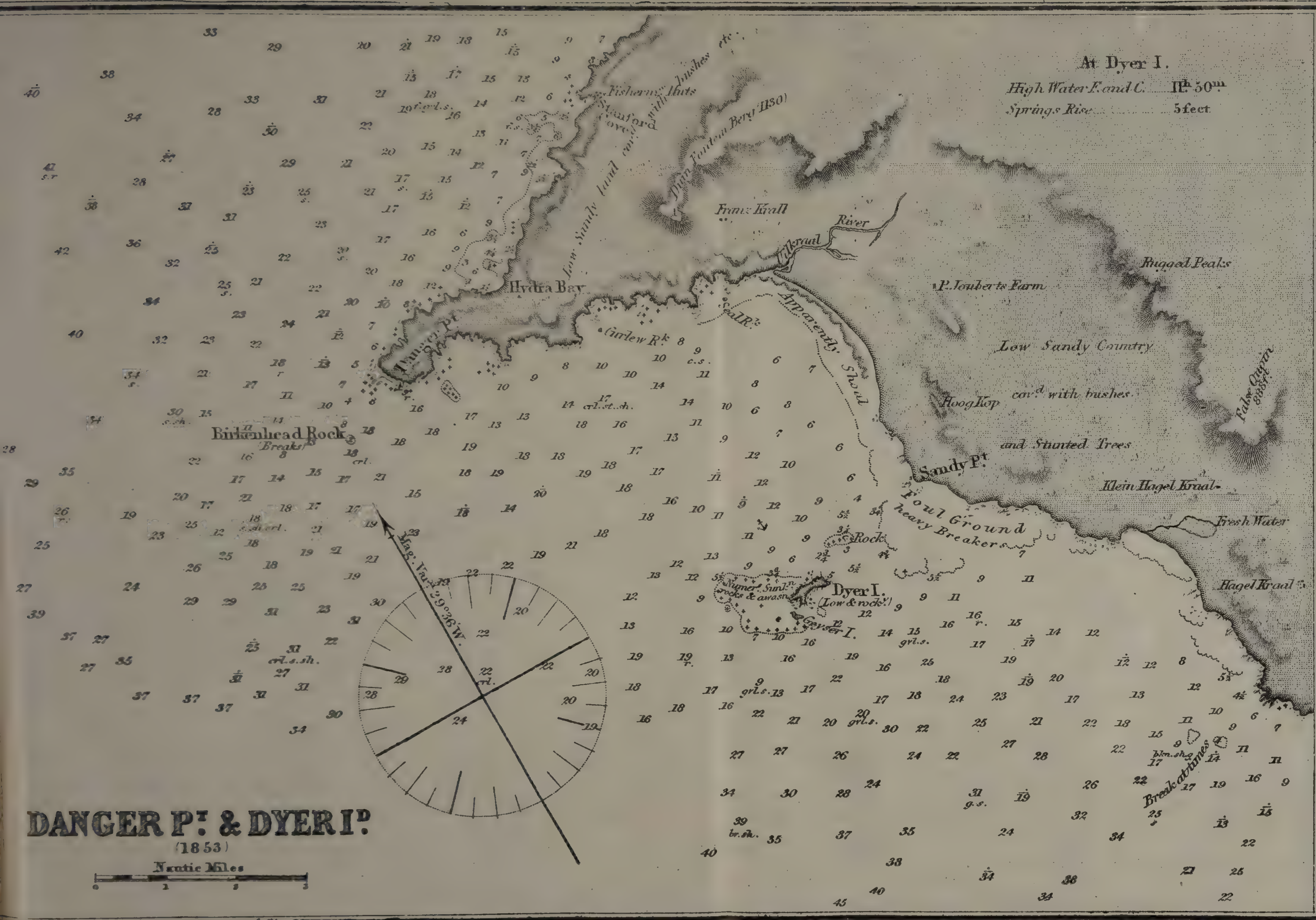
Point Mudge is a low headland with rocks extending from the base of the cliffs about half a mile, close to which are soundings of 5 and 6 fathoms, rapidly deepening to 20 fathoms, the latter being at not more than ¾ of a mile from the point. A cove named D'Urban, formed by these rocks, will admit of a landing in fine weather while the wind is from the south-eastward, and a boat's crew may also land on the north side of the point at the same period; but D'Urban Cove is better and safer.

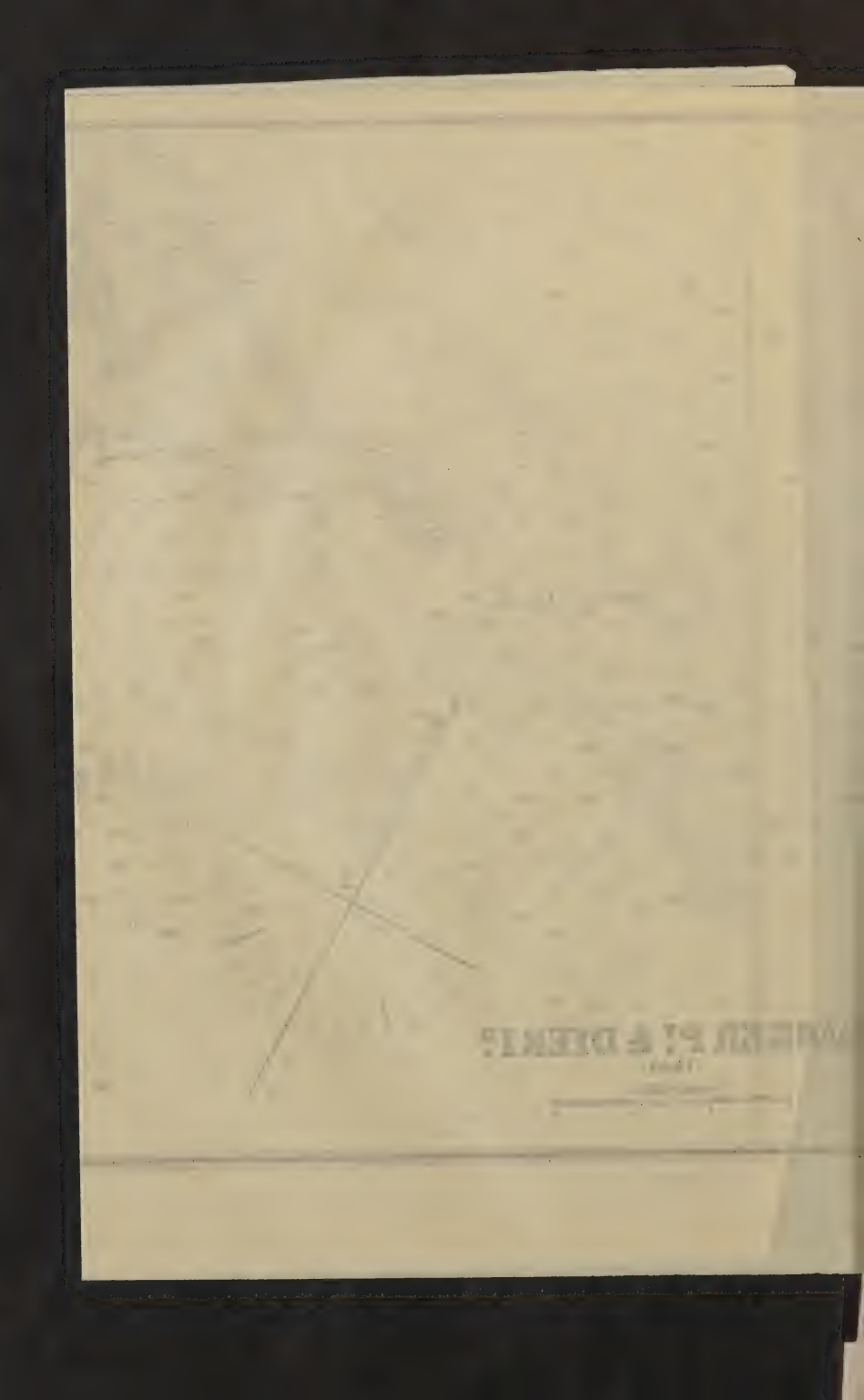
From Point Mudge a rocky coast trends E.S.E.-ward 7 miles, then a low sandy beach southward 9½ miles, which is succeeded by a rocky coast projecting W.S.W. about 6¾ miles, the latter terminating in Point Danger, a low headland, the extremity of some low sandy land covered with bushes and stunted trees, which juts out from the base of Duin Fontein Berg, a remarkable bluff hill, 1130 feet high. The part comprised between Points Mudge and Danger, termed Walker Bay, is quite open to westerly winds, and offers no advantages to shipping.

Walker Bay is remarkable for its sandy shore and high sand hills, one of which rises to the height of 427 feet. A long heavy swell always rolls into it, and the water is deep within 1 or 2 miles of the shore. Kleine River, in the north part of the bay, is barred with sand.

Danger Point affords shelter to vessels during the strong south-east gales of summer, and boats may land in Stanford Cove, a small rocky inlet on the north side of the point at 5 miles from its extremity, during easterly and south-easterly winds, if care be taken to avoid the rocky patches off it; Hydra Bay, nearer the end of the point, is, however, a better place, the swell there not being so strong, but equal caution is necessary to clear outlying rocky patches. The bay is only a shallow indentation of the land, and may be easily recognised by a sand patch which marks the face of the hillock over it.

If intending to anchor in Hydra Bay, and running for it from the south-westward, the pitch of Point Danger should not be approached nearer than 2 or 3 miles, when the bluff hill of Point Mudge may be steered for until the sand patch is well open, when the rocky spit projecting from Point Danger will be cleared. Then haul up for the bay, and anchor in 12 or 14 fathoms, at about ¾ of a mile from the shore.


At Dyer I.
High Water F. and C. II^h. 50^m.
Springs Rise 5 feet
Fisherm. Huts
Stanford Cove
Low Sandy land cov^d. with bushes &c.
Franz Krall
River
Hydra Bay
Danger Pt.
Girlew R^k.
Seal R^s.
Apparently Shoal
Rugged Peaks
P. Jouberts Farm
Low Sandy Country
Hoog Kop
cov^d. with bushes
and Stunted Trees
Sandy P^t.
Klein Hagel Kraal
Fresh Water
Hagel Kraal
Foul Ground heavy Breakers
Rock
Dyer I.
(Low & rocky)
Geyser I.
Birkenhead Rock
(Breaks)
Mag. Var. 29°36' W.
Breaks at times
DANGER P^t. & DYER I^d.
(1853)
Nautic Miles



taking care to give a 2 fathom rocky patch in the centre of the bay, upon which the sea often breaks, a wide berth. H.M.S. *Hydra* anchored here, with Duin Fontein Berg bearing E.S.E., southerly; extremity of Point Danger S.W. by W. ¼ W.; and the sand patch in the bay S.S.E. ½ E., southerly.

Danger Point has rocks about it extending off more or less ½ a mile; there is also a rock 12 feet under water, known as the *Birkenhead Rock*, from the loss of H.M.S. *Birkenhead* upon it in 1852, situate W.S.W. 1 mile from the extremity of the point, whose position is generally indicated by breakers. Upon account of the Birkenhead Rock it is requisite to give the land hereabout a wide berth, especially as that danger is very steep, the lead dropping from it at once into 7 or 10 fathoms; the appearance of the shore is also deceptive, being low and backed with high land; hence Point Danger was usually termed Bluff Point, but improperly, as the high land which appears at a distance like a bluff is at least 3 leagues inside of it.

Danger Point is prolonged under water about 3 miles in a similar direction to the inclination of the land hereabout (W.S.W.), by a bank of 10 fathoms, increasing to 20 fathoms as you recede from the coast. Almost all the soundings upon this bank are of rock and coral.*

DYER AND GEYSER ISLANDS.—From the extremity of Danger Point the coast runs E. by S. ¼ S. 5¾ miles to a small barred stream, named Oilkraal, and then turns southward 3½ miles to Sandy Point, a low projection from the coast, as its name implies. Behind this shore the country has but slight elevation, and is covered with bushes and stunted trees. Dyer and Geyser Islands are situate 2½ miles W. by S. from Sandy Point, and almost the whole space between is occupied by a reef extending from the point, the channel left being very narrow, and safe only to those acquainted with the locality; this channel lies between the east end of Dyer Island and a rock above water inshore; it has a depth of 2¾ fathoms, and is only suitable, therefore, for small vessels,—when the wind blows from S.E. or South the sea breaks quite across it. The islands are small, low, and rocky, and hence are

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* Danger Point and the neighbouring coast formed the subject of a communication to the *Cape Monitor*, by Mr Maclear, when engaged in triangulating the coast, previous to its hydrographical survey, dated March 4, 1852. The following is an extract:—

"One of my trigonometric stations is upon the southern extremity of the bluff or promontory of Danger Point, at the height of 1055 feet above the level of the sea. From the bluff a tongue of low land, partially covered with bush, runs out south-westerly at an angle with the meridian of 63¾°, then submerges, forming a ridge or shoal in the same direction, gradually deepening, and extending out to a considerable distance. During a gale the water seemed to break as far as two miles or more from the extremity of the land, though the farthest out visible rock in calm weather was only about 500 yards from it.

"This projecting land, and its continuation under water, forms the west horn of an extensive bight or bay, of which Gunner's Quoin with its projecting shoal is the eastern; it forms also the eastern horn of the sweep to Mudge Point. Dyer's Island is situate close in on its eastern side, being separated from it by a narrow channel.

"On the south-east side of it the shore is rocky, but a boat may pass along it and through the narrow channel just mentioned, up to the sandy beach in the immediate vicinity of two farm-houses. On the north-west side the shore is also rocky, but I think less so. Close in is a stalactite cavern, immediately under the bluff; whence to Mudge Point the beach consists chiefly of sand. On this side I do not recollect having seen any house nearer than that now occupied by Captain Smales.

"The rocks are chiefly of sandstone; but on the land this formation is combined with limestone—a characteristic of all the promontories between Capes Hangklip and Agulhas.

"With respect to geographical position, I observed the depression of the extremity of the point below the horizon of my station. From this, together with elements derived from triangulation, I find that the latitude of Point Danger is 34° 37′ 44″; the latitude of the breakers just mentioned about 34° 40′, and their longitude east of the Naval Yard at Simons Bay 39′ 12″."

visible only at a short distance, the difficulty of distinguishing them being increased when viewed with the background of sand-hills on the adjacent shore.

Dyer and Geyser Islands, of which the former is nearer the coast, are seated on a reef which extends from them 1¼ mile in a W.N.W. direction; the edges of this reef are steep, as from them the lead at once drops into 7 or 8 fathoms. On their S.S.E. sides the islands are bold, and here the sea generally breaks with great violence, especially during the prevalence of southerly winds. The islands cannot be considered otherwise than very dangerous to vessels running along the land, and must therefore have a wide berth; a depth of 20 or 25 fathoms will be quite near enough, as these soundings will place the vessel at little more than a mile from them.

Dyer and Geyser Islands, with the reef connecting and projecting westward from them form, with the reef running from Sandy Point, a natural breakwater, on the north side of which vessels may anchor and find protection from southerly and south-easterly gales. When approaching this anchorage from the southward, great care will be necessary to clear the dangerous reef which projects from them in a W.N.W. direction, as previously mentioned, and especially when the sea is so calm that its position is undistinguishable by breakers. To clear it, keep the extremity of Danger Point in one with the valley in the high land near Cape Hangklip, and steer thus until the highest part of Geyser Island is in one with the Quoin; change the course now to the north-eastward and steer for Duin Fontein Berg (the bluff hill behind Danger Point), and when the extreme of Dyer Island is in line with the Quoin, steer for the Quoin, and anchor in 10 fathoms with Dyer Island extremes bearing S.S.E. ½ E. and S.S.W. ½ W., southerly; the pile on Duin Fontein Berg N. by E.; the extremity of Danger Point N.W. ⅝ N.; and the pile on Gunner's Quoin S.E. The bottom is of sand, and the holding ground good, but it must be considered a very exposed anchorage and unfit to ride in when the wind blows from the S.W. quarter; it is safe only so long as the wind is not westward of S.S.W.

From Sandy Point the coast trends S.S.E. 12 miles to Quoin Point, a headland situate in Lat. 34° 46¾′ and Long. 19° 38½′. It is foul more or less all the way, and the 20 fathom line of soundings is nowhere further out than 2 miles. Two shoals, which may possibly be dangerous, lie about midway between the points at a mile from the shore, with the hills named False Quoin, 888 feet high, bearing N.E. by N.; Carruther, 630 feet high, E. ½ S.; and Gunner's Quoin, 997 feet high, S.E. by E. On the eastern of these shoals a depth of not less than 4 fathoms was found by the surveyors; but they remarked that the sea broke over them occasionally.

Quoin Point is a square projection of hummocky land, and distinguishable when viewed from the southward by two sand-hills near its extremity; from it foul ground extends out a mile south-westerly, upon which the sea generally breaks with violence. This foul ground is very steep, there being soundings of 9 and 12 fathoms close to it, which rapidly increase to 20, the latter being at not more than 2¼ miles from the point on its south-west side, and at less than 1½ mile from it on its western side, and consequently at only a moderate distance from the reef.

The country behind Quoin Point is low and bushy. The hill Gunner's Quoin, or Buffel Jagt Berg, as it is named by the Dutch, is 3½ miles northward from the point, and may be recognised from some positions of view by its resemblance to a quoin: it is 997 feet high. All this coast is exposed to gales from the southward, which cause

heavy breakers upon it; so violent are these breakers, that it is generally impossible to effect a landing.

There is a small rocky cove at $2\frac{3}{4}$ miles northward of the extremity of Quoin Point where boats can land when the wind is from the south-eastward. From it the pile on Gunner's Quoin bears about E. by N.

The coast eastward of Quoin Point for about 7 miles is very dangerous, being fronted by reefs which extend $1\frac{1}{2}$ mile from it; on the outermost of these are two small rocks above water. As these reefs are steep they should not be approached nearer than the depth of 30 or 25 fathoms, and it should be remembered that the country immediately behind them is low and bushy, so that an error in the estimation of distance can easily be made.* The soundings of this part of the coast as far as Cape Agulhas are shown by the recent survey of LIEUTENANT DAYMAN, R.N., to be very irregular; hence the need of more than usual caution when running along the land.

CAPE AGULHAS.—From Quoin Point to Cape Agulhas the distance is about 17 miles in a S.E. $\frac{1}{2}$ E. direction; between, the coast recedes about $2\frac{3}{4}$ miles from an imaginary line connecting those points. The Cape is the most southern projection of the continent of Africa, and is described as a headland of moderate elevation visible some miles at sea, the hills forming it rising to about 450 feet above the water. Rocks extend out from its shore from $\frac{1}{4}$ to $\frac{1}{2}$ a mile, close to which is a depth of about 4 fathoms, which rapidly deepens to 12, 15, and 20 fathoms, the latter being at 2 miles southward from the lighthouse.

SIR T. MACLEAR, in charge of the Observatory at the Cape of Good Hope, says of Cape Agulhas—"It is the rocky projection from the south-east corner of the promontory of Agulhas, the centre of which promontory is about $\frac{3}{4}$ of a mile westward of the projection, and about 200 yards more southerly, being the most southern part of Africa. The features of the land about Agulhas distinguish it from the neighbouring headlands. A ridge-shaped undulating clump rising from the flat ground is separated into four ridge-shaped hills by irregular ravines running nearly *true* East and West. The middle ridges enter wedge-like at the east end, and are lost towards the centre, where the ravine widens to a mile in breadth. The middle ridges are the lowest; the northern and southern are of equal height.

When viewed at a distance from seaward, *easterly or westerly*, the north and south elevations being seen nearly end on, resemble two oblong hummocks; but the former, extending more easterly, appears the highest as seen from the eastward.

When viewed at a distance from the *southward*, the south ridge masks the others, save at their east end; but the ravines being hid, the whole appear to be united.†

The highest part of the south ridge is 455 feet above the level of the sea, and its

* In the Admiralty sailing directions for this coast, it is stated that "H.M.S. *Hydra* found tolerable shelter and smooth water, in a strong N.W. wind, at anchor under the lee of the reefs eastward of Quoin Point, and it is possible that a small vessel might find the same close under the extreme of the point, between which and the reefs there appears to be a clear but narrow passage. Between Quoin Point and Cape Agulhas the coast is low and sandy, except abreast of the flat-topped range of Zoet Anys Berg, where the shore is steep and rocky. The whole of it is exposed to the full force of the ocean swell, and landing upon it is impossible."

† Only the south and middle ridges are shown on the chart. They are all given on COLONEL MICHELL'S plan.

true meridional distance from the shore is almost exactly one mile. From this point the descent eastward is rather gradual. Westward the descent is at first steep, then slightly undulates. Southward it is steep, then undulates to within 300 yards of the shore, where the ground becomes flat.

"It is on the first undulation from the shore, which is about 55 feet above the level of the sea, that the lighthouse is built. The position of this building is nearly *true* South from the highest point before mentioned, and at N. 30° W. 520 yards from the point generally known as Cape Agulhas."

Lighthouse.—The lighthouse on Cape Agulhas is 100 feet high, and painted in red and white zones. It shows a *fixed white* light at 128 feet above the sea, visible at the distance of 18 miles in clear weather, when it bears between S.E. by E. and W. —*i.e.*, over 19 points of the compass. Its position is Lat. 34° 49′ 45″ S., and Long. 20° 0′ 40″ E. The following particulars relative to this light are from the official notification of its establishment:—

"*If a vessel approach Cape Agulhas from the westward* the light will be first seen on a S. 57° 15′ E. (or nearly S.E. by E. ⅛ E.) bearing. The extreme end of the low ground called Gunner's Quoin Point bears N. 52° 30′ W. (or N.W. ⅝ W.) from the lighthouse, distant 19⅝ miles, but is not visible from it. The sea was remarked breaking a long way off the point; it will, therefore, be necessary to keep off the land until the light becomes visible.

"*If a vessel approaching the Cape from the eastward* passes Struys Point at the distance of 5 miles from the shore, and steers a W. by S. course exactly, she will pass the most southerly projection of Northumberland Point reef at the distance of 4½ miles, and the light at the distance of 5⅛ miles, and clear Gunner's Quoin. *This is the limit northward within which no vessel should be found.* It secures every advantage that could possibly be obtained by a closer course, and at that distance the light will be brilliant.

"In clear weather the light may be seen, when 5 or 6 miles eastward of Struys Point, from a look-out at the height of 35 feet; and if the vessel should then chance to be close in shore, by steering the above course she might touch the shoal off Struys Point. To guard against this, when the light is first seen it should be brought immediately to bear W. by N., and keeping this bearing of the light, the vessel will pass at 2 miles southward of any danger respecting Struys Point.

"Care should be taken when approaching the land before the light is discovered, for in hazy weather, or when there is spray with a fresh breeze, combined with the distance of Struys Point (about 15 miles), the light may be faint or altogether obscured, and the vessel may get within the line of danger. Under these circumstances the lead should not be neglected, and the depth should not be less than 20 fathoms, without putting about immediately to the south. The like precautions are required even during daylight, particularly in foggy weather, for the high land of Agulhas may be invisible while the sand-hills of Struys Bay and the breakers off Northumberland Point are distinctly seen. On these occasions it is difficult to determine whether the vessel is eastward or westward of Struys Point, because the shore features of the bay eastward of that point are similar to those of Struys Bay, although the extent is less.

"Sailing vessels in particular should adhere to these rules, for if it should fall calm, the heavy swell which constantly rolls towards the shore would carry them with it, and the only resource, that of anchoring, would probably be of no avail,

from the rocky nature of the bottom, combined with the swell. The *St. Mungo* is said to have been wrecked in this way."

NORTHUMBERLAND POINT.—From the lighthouse on Cape Agulhas to Northumberland Point the distance is $3\frac{1}{6}$ miles. Immediately eastward of the lighthouse are two indentations of the coast, of which the first bears the name of St. Mungo's Inlet; the second is wider and deeper, and the projection which separates them is called St. Mungo's Point. From the last inlet the shore runs jagged to the dangerous projection called Northumberland Point, from being the site of the wreck of the *Duke of Northumberland*, which point forms the west horn of Struys Bay.

The whole of the beach from the west side of the promontory of Agulhas to Northumberland Point consists of rugged sandstone and quartz rocks, or rocky reef, perfectly impracticable even for a boat. At the promontory, groups of rock prevail; at the cape, rocks and a rocky reef extending out $\frac{1}{3}$ of a mile; at the inlets, flat rocky reef exposed at low water for $\frac{1}{3}$ of a mile; and thence rocks to Northumberland Point, where it is sand and reef. As this iron-bound shore is exposed to the full force of the Southern Ocean, the sea breaks heavily upon it, especially during the prevalence of southerly winds—a vessel, therefore, touching upon it has not the slightest chance of escaping destruction.

Northumberland Point is low and sandy close up to the beach, and from it a very dangerous ledge of rocks projects out about a mile in a S.E. by S. $\frac{1}{4}$ S. direction, the extremity of which bears nearly E. by S. $3\frac{9}{10}$ miles from the lighthouse. Westward from the point the reefs extend out about $\frac{1}{3}$ of a mile, and break heavily when the wind is from the S.E. In one or two places it breaks further out, but in no place further than half a mile.

When surveying at Northumberland Point, Mr. Maclear observed breakers at some distance from the land, the position of which he fixed by intersection as follows:—From Northumberland Point, S. 58° 30′ E. (S.E. by E. $\frac{1}{8}$ E.) $1\frac{1}{8}$ mile, and from the lighthouse on Cape Agulhas S. 81° 40′ E. (E. $\frac{3}{4}$ S.) $4\frac{1}{3}$ miles.

STRUYS BAY.—Struys Bay lies between Northumberland and Struys Points, which are distant from each other $11\frac{1}{2}$ miles. The coast between is low and sandy, but at a short distance from the beach there is a line of sand-hills, varying from 50 to 150 feet in height, some of which are covered with dark-coloured bush, a feature that also distinguishes the coast eastward of Struys Point as far as the next point to it. There is no high land sufficiently near to interfere with the distinguishing character of the hills northward of Agulhas as viewed from seaward.

The landing place in Struys Bay is in a small bay or cove north-westward of Northumberland Point, which is sheltered by a projecting shelf of shingle from each extremity of the cove. The jetty, constructed from pieces of wreck, renders the landing easy; but at the outer horns of the shingle there is only water sufficient for a boat at quarter flood in fine weather. Three or four huts at the head of the jetty point out its position from the bay. Immediately in the neighbourhood, on higher ground, is a stone dwelling-house with a signal staff a few yards behind it, termed the *Telegraph-staff* on the chart.

Struys Point, the eastern extremity of Struys Bay, is the outer extreme of a number of sand-hills. It bears from Northumberland Point N. 79° 30′ E., or

E. $\frac{7}{8}$ N., and N. 82° 20′ E., or E. $\frac{3}{4}$ N. from the lighthouse on Cape Agulhas.* This point is more dangerous than Northumberland Point, because reefs lie much further off its shore, and there is no high land by which a seaman may determine the position of his ship. Circumstances did not permit Mr. Maclear to include this point in his survey of Cape Agulhas, but during a strong south-easter he observed from the summit of the sand-hills near the point that the reef extended seaward about three miles, and that breakers were then breaking upon it with violence.

Like Northumberland Point, the colour of the water off Struys Point changes to seaward from brown to light, then dark green, from which it may be inferred, together with the known shallowness of the sea off Northumberland Point, that the lead as well as the colour of the water will always warn a ship of the vicinity of danger.

In Struys Bay shelter may be obtained only during westerly or north-westerly winds, as all others blow directly on shore, consequently the bay must be avoided with the wind between S.W., round by S., and E. With any of the latter winds it is unsafe, if not impossible to ride in it, for the sea rises to such an extent as to break in 7 or 8 fathoms, a circumstance that was remarked on two occasions while H.M. steamer *Dee* was standing off waiting for the weather to moderate to enable her to anchor. At the time of anchoring, although the wind had subsided several hours, the water nearly broke in 7 fathoms, where the anchor was let go; and at the place whence she had put to sea three days before in $4\frac{3}{4}$ fathoms, the sea was breaking heavily. As a general rule, vessels seeking shelter in this bay, in a N.W. gale, should put to sea immediately after it subsides, for the wind frequently changes in a few hours from a strong N.W. to a S.E. or S. point, in which case it is very difficult to work out, in consequence of the heavy sea that rises with these winds.

When anchoring, the best place is in 5 fathoms sand, with the large stonehouse near the beach bearing W. $\frac{1}{2}$ S., and the sandy extreme of Northumberland Point S.W. by S. Here the bottom is clear, while to the westward and nearer the reef, where the water is smoother, the bottom is foul,—rocks interspersed with patches of sand. The latter is unsafe; the cable is liable to snap from fouling the rocks, an accident that befel the *Dee* while lying there in a light south-west wind, accompanied by the usual swell.

Vessels from the westward should not bring the lighthouse on Cape Agulhas to bear more westerly than W. by N. $\frac{1}{2}$ N., until Northumberland Point bears N.W. $\frac{1}{2}$ N. Then steer N.N.E. or N.E. by N., until the stonehouse previously mentioned bears W.N.W.: this will lead clear of the outer detached reefs off Northumberland Point. Proceed now to the N.W., and bring the anchoring marks on.

The light on Cape Agulhas is not visible from the anchoring ground, owing to the swell of the intervening land.

Mr. Maclear says, "During our examination of the coast in September, 1848, no current was observed in Struys Bay, nor about the coast $2\frac{1}{2}$ miles from the shore, so far to the westward of Agulhas as the letter E on the chart; but it was confidently asserted by fishermen, and the residents at Struys Bay, that a very strong current frequently sets to the westward round Northumberland Point.

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* So stated in the original official notice of the establishment of Agulhas Light, but the bearings appear to be nearly E. and E. $\frac{1}{4}$ N. by the chart.

"A ship becalmed in the offing was observed setting eastward, at a rate exceeding a knot an hour. On two other occasions, close to the shore, about 2 miles westward of Agulhas lighthouse, the stream ran during a whole night steadily to the N.W., at $1\frac{1}{4}$ knot an hour. These changes may probably be traced to the effect of the wind.

"Circumstances did not allow of the tides being observed with due accuracy. Two copper plugs were let into rocks south-west of the lighthouse, to mark the high and low water points nearly at spring tides. The comparisons with these plugs on October 15, 16, 18, 19, 28, and 29, and an observation at the jetty in Struys Bay on October 28, give the establishment and rise and fall nearly similar to what prevails in Table Bay and Simons Bay."

Commander J. Foote, R.N., of H.M.S. *Rosamond*, in 1848, has remarked of Struys Bay:—"With any northing in the wind, vessels may find good holding ground in 7 fathoms, sand, with Northumberland Point bearing S.W.; but while there is any southing the anchorage is exposed. There is an excellent boat harbour formed by a reef of rocks, to enter which you must pass over a bar, which, when the *Rosamond* was there, did not break at all heavily, and we were informed by an inhabitant of the bay that by keeping close to the rocks to the northward of Northumberland Point, boats might enter at any time, and we found by following this direction we entered by the smoothest channel; when once in the boat harbour, the water is perfectly smooth, and the landing excellent.

"Sailing vessels should not anchor within 2 miles of this landing place. Her Majesty's steam sloop, under my command, anchored in $5\frac{1}{2}$ fathoms, at about $1\frac{1}{4}$ mile distant from it. Vessels entering this bay should give Northumberland Point a wide berth; the rollers break occasionally in 10 fathoms, and the reef extends fully 2 miles in a S.E. direction. There is only one house or building in the bay, rented by a Mr. Barry, upon which a red ensign was hoisted. There are several wells in the neighbourhood, but the water is brackish. Sand-hills studded with heath and brushwood are the prominent features of the surrounding country, but upon the hilly ground, near Agulhas and Northumberland Points, limestone is found."

At 2 miles eastward of Struys Point is a projection of the coast named *Hoop Point*, from which it is probable shoal water runs off $1\frac{1}{2}$ mile. It has been asserted that reefs or blinders extend so far as 6 miles from Struys Point, and that there is a depth of 3 fathoms on their extremity, and a channel of 6 fathoms depth between. Upon these reefs the sea has been observed to break in heavy southerly gales. A safe channel exists inside them, if it be true, as stated, that a vessel has been seen to pass through it apparently unaware of danger.

From Struys Point the coast trends nearly E. by N. $16\frac{1}{2}$ miles, and is low with sand-hills; it then turns to the E.S.E. 19 miles, or as far as *Cape Infanta*, and gradually becomes bolder as it proceeds eastward. Reefs extend from the projecting points of this shore, rendering a wide berth necessary when coasting, especially as it has not been surveyed, and from the following may be suspected to have isolated dangers off it. A rock (the existence of which was unknown until it caused the loss of the Dutch ship *Atlas*) was examined by Mr. Skead, R.N., in 1859, from which it appears that it is of very small extent, not more than half an acre, and has 3 fathoms water upon it, with 6 and 7 fathoms close to it all round at low tide; its position is two miles from shore in Lat. 34° 37½′, and Long. 20° 22′ 50″, and from it

Struys Point bears W. ¾ S. 7 miles, and a triple isolated peak inland N.W. ¼ W.—the peak on this bearing resembles a cone.

ST. SEBASTIAN BAY.—Cape Infanta, on the northern side of which is St. Sebastian Bay, is of moderate height and surmounted by sand-downs, which give it a desolate appearance; its position is about Lat. 34° 31′, and Long. 20° 53½′. From it a rocky coast runs north-easterly nearly 4 miles to Point St. Sebastian, and then turns sharply round westward, forming St. Sebastian Bay. "At the bottom of the Bay, north-west of Cape Infanta, there is a valley between the mountains, through which the Infanta River descends to the sea, and there is said to be good anchorage off the River Breede, where a ship might be sheltered from north-westerly and westerly winds; but a considerable sea generally tumbles into the bay."

St. Sebastian Bay is only a very shallow indentation of the coast, which affords shelter with winds from the land, as all others send in a very heavy sea,—the exposure is from E., round by S., to S.W. The River Breede, known to the colonists as Port Beaufort, is said to be capable of receiving vessels drawing 8 or 10 feet, and it is asserted that these can ascend it 30 or 40 miles. It has been proposed to deepen the outlet of this stream, to permit the entrance of vessels of larger size, and as there is generally some water in it in the dry season, and some perceptible current, such a proposal, if carried into effect, might render it a serviceable harbour. The depth in the bay is understood to be about 9 fathoms, and at two leagues from shore 36 and 38 fathoms.

Northward of St. Sebastian Bay there is a flat table-hill, and further to the north-eastward a mountain with a hummock on it resembling a cupola.

KAFFIR KUYL RIVER.—From St. Sebastian Bay the coast runs S.E. by E. about 22 miles to Cape Barracouta, situate in about Lat. 34° 27′, Long. 21° 24′, and is rocky all the way. Deep soundings prevail along the coast, for at two miles southward of the Cape the depth is 22 and 25 fathoms. From Cape Barracouta to Kaffir Kuyl River the distance is nearly 7 miles in an E. by N. direction.

Kaffir Kuyl River is a small stream, the mouth of which is in Lat. 24° 22½′, and Long. 21° 31′. A bar, dry, or nearly so, at low tide, crosses the entrance, having passed which the depth increases to only about 3 feet, so that nothing larger than boats can frequent it. The soundings outside the bar are 4 to 6 and 8 fathoms, and here vessels sometimes anchor while the wind is from the land.

When approaching Kaffir Kuyl River it will be prudent to give the coast on each side of it a good berth, because of the reefs, which probably run off ¼ to ½ a mile from them.

From Kaffir Kuyl River the coast trends about 14 miles in a S.E. by E. direction to Yzervark Point, which is bold and rocky and has a hill, Buffel's Kop, 740 feet high, at 1⅓ mile inland from it. It may be known by a round bare sand-hill, 200 feet high, close to the sea, at 1½ mile West of it. This hill terminates the sandy feature of the coast in the bight between Kaffir Kuyl River and Yzervark Point. Aasvogelberg, a long elevated hill, 1620 feet high, stands N. by E ½ E. 11⅓ miles from the point, and may serve to identify it.

Between Yzervark Point and Cape Vacca, a distance of 10 miles on an E. by S. bearing, the coast consists of rude jagged rocks, on which a heavy sea is constantly beating. The land immediately at the back slopes to the height of 700 to 500 feet,

and is covered with bush and vegetation. There is a small but remarkable sand patch of a reddish colour midway between Yzervark Point and the Gouritz River, and half a mile from Bull Point. This point is not easily distinguished, as it is only a very slight projection from the general line of the rocky shore. South, three-quarters of a mile from the red sand patch, and one-third of a mile from shore, there are patches of detached reef, which break, and show at low water. At the distance of 1½ mile from this rocky coast the soundings range from 30 fathoms off Yzervark Point, to 20 fathoms south of Cape Vacca.

GOURITZ RIVER is a small stream distant 8¾ miles from Yzervark Point and 1½ mile westward from Cape Vacca. It has a sandy beach at its western entrance, but the breakers are generally too high to make it available as a landing place for boats. The sea breaks right across its mouth, which at the outer part is only half a mile in width; and at half a mile inside it is only 10 to 15 yards wide.

CAPE VACCA is distant 10 miles from Yzervark Point and about 24 miles from Kaffir Kuyl River, and will be recognised by being a low flat composed of rock and shingle, jutting out from a round hill over the eastern entrance to the Gouritz River, and which bears N. 62° W. 1⅓ mile from the cape. The sea breaks half a mile outside the cape in rough weather, at which distance a depth of 9 fathoms was found by the surveyor, MR. SKEAD. From the discoloration of the sea, and the uneasy ground-swell in the vicinity, it is more than probable that shoal rocky ground exists there. Be cautious in rounding this low cape, as the light on Cape St. Blaize, distant 15 miles E. ½ N., is not visible from it; hence the lead will be the best guide at night or in thick weather.

FLESH BAY.—On the north-east side of Cape Vacca is Flesh Bay, situate between the cape and Fish Point, which bear from each other N. 64° E. and S. 64° W. distant 2⅔ miles. The shore of the bay is sandy throughout—except at the extremes, which are rocky. In about the middle of the bay there is a bare sand-hill, 280 feet high, just over the beach. This bay affords no shelter for vessels, save as a temporary one in N.W. gales, and it can only be used as a landing place in tolerably fine weather. The island, and the facilities this bay afforded for procuring fresh water and cattle, mentioned by VAN KEUTEN and the early Dutch navigators, no longer exist; there is no island in the bay; and very little fresh water is found near to the sea, and that is brackish. In 1862, cattle were not to be procured, the inhabitants living entirely on sheep.

FISH BAY, on the north-east side of Fish Point, is formed by a deep curve (of 3 miles) in the coast-line between Fish Point and the well-defined commencement of the rocky cliffs which extend 4 miles westward from Cape St. Blaize, and which is called Pinnacle Point. From Fish Point to Pinnacle Point the bearing is N. 82° E., and the distance nine miles. The whole shore of Fish Bay is sandy, with small patches of rock showing out about low water mark, and the breakers are generally high throughout the bay. The land at the back, at the distance of a mile, rises 400 to 500 feet in height, and is covered mostly with bush and vegetation. The bay may be used by vessels seeking shelter from N.W. gales: the best anchorage will be found 1½ mile from the sandy shore, in 7 to 8 fathoms—Fish Point bearing S. to S. 10° W.,

and the extreme of the bluff cliffs near Cape St. Blaize E. ¼ S. It is advisable for vessels seeking shelter to put to sea as soon as the gale subsides, for then a heavy S. W. swell sets in and causes a dangerous breaking sea. The best landing is near Fish Point, in a small sandy cove, between rocks; but in fine weather boats may land in the bight under Jackson's farmhouse.

The coast between Pinnacle Point and Cape St. Blaize, a distance of 4 miles, consists of precipitous rocky cliffs of a reddish colour, about 250 feet high, with deep water close to: it is quite impracticable for boats landing. The higher land, half a mile inland, ranges from 600 to 200 feet in height towards the cape, and is mostly covered with grass and bush; Cape St. Blaize Bluff is the eastern extreme of these rocky cliffs; a windmill stands on the high land near the cape, but it is only visible to vessels approaching from the southward or the eastward. The cape itself is a tongue of low flat land fronted by rugged reef which juts into the sea 500 yards from the bluff on which the lighthouse stands. A remarkable *whitewashed* rock, the Logan stone, poised upon natural supports, stands just beneath the bluff. A sunken rock, called Blinder or Windvogel, with 15 feet water over it, lies one-third of a mile outside the cape; upon this rock there are heavy breakers at low water during rough weather.

MOSSEL BAY is bounded on the south-west side by Cape St. Blaize and on the north-east side by the mainland, which are distant from each other about 8 miles. The Blinder Rock off the cape is very steep, as there are soundings of 5 to 7 fathoms close to it, and there is a corresponding depth in the narrow channel between the rock and the cape. On the west side of the bay, at 3 miles from the cape, there is a small island near the beach, named Seal or Robben, and north-eastward of this are three rivers in succession, the Hartenbosch, Little Brak, and Great Brak. The bay is open to all winds from the southward, and these generally send in a heavy swell, especially if they have prevailed with strength for some hours. South-east gales seldom last more than one day, and generally become weakened in force towards evening. The soundings at 4 miles from shore are 22 and 20 fathoms; thence gradually decreasing to the beach, close off which they are 5 and 7 fathoms; all are of sand.*

Mr. Skead, R.N., describes Mossel Bay in the following manner, 1864. Magnetic variation allowed 29° 50′ W.

"The **Lighthouse** on Cape St. Blaize is a square white tower, 45 feet high, with buildings at its base for the light-keepers; it is in Lat. 34° 11′ 10″ S., Long. 22° 9′ 31″ E. It exhibits a *fixed red* light, at an elevation of 240 feet above the sea, and is visible from N.N.W. round by the East, South, and West to S. 80° W., or N. 80° E. from a ship 10 to 12 miles distant. As Cape Vacca bears S. 87° W. from the lighthouse, vessels

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* Mossel Bay is considered to be the best bay on the south coast of Africa after Simons and Saldanha bays, as a landing can safely be effected in it at almost all times; still it is exposed to heavy seas when the wind is from the southward. It has been suggested that a breakwater, supposing it possible to run one out from Cape St. Blaize, would be a great boon to vessels rounding the southern shore of Africa during stormy weather, as there is no place affording adequate shelter on all the coast. Near the shore of the bay only brushwood can be obtained, but a little way up the Great Brak River there is plenty of large timber; the new settlement of George Town is on the bank of this river, at about 15 miles north-eastward from the bay, in Lat. 33° 57′, and Long. 22° 25′.

proceeding westward must be careful not to lose sight of the light, as they will then be either getting in towards the rocky coast westward of Cape St. Blaize, or into Fish Bay. Vessels well acquainted with the coast may take this liberty, and use Fish Bay for a smooth water board in working westward; the lead must then be a guide, but 20 fathoms is the limit within which none but a coaster should be found.

"From Cape St. Blaize the land takes an abrupt trend to the N.W. by N. for 3 miles, still retaining (with the exception of three sandy coves) its rocky coast feature; the outermost two of these coves are called Vaarkens and Mauro Bays—in the former of which landing is generally made. At the end of these three miles the coast curves to the N.E. for 3 miles, with a sandy beach, to the mouth of the Hartenbosch river, and 2 miles further on to the Little Brak river, from which to Cape St. Blaize may be considered as the limit of Mossel Bay. Just to the N.E. of the Hartenbosch river there is a large conspicuous sand patch, which extends to and beyond the mouth of the Little Brak river; this patch is useful for strangers from the eastward in identifying the bay, and from the westward for clearing the Blinder or Windvogel rock, when rounding Cape St. Blaize. In the depth of the bay, at one-third of a mile from the sandy shore, and N. 12° W. $2\frac{3}{4}$ miles from the light-house, lies Seal Island, a small rocky islet about 15 feet high, with a depth of 3 to 4 fathoms between it and the shore; it has deep water close around it.

"Mossel Bay affords excellent shelter to vessels during the *winter* months, April to September, when heavy N.W. gales are of frequent occurrence; and it is far preferable to use it as a place of shelter than to buffet the sea about Cape Agulhas, which is 120 miles only to the westward. During the strength of these gales the water in the bay is smooth, and ships ride well, but it sometimes happens that a heavy S.W. swell sets into the bay if the wind veers to West and W.S.W., and this renders the bay unsafe, and landing very difficult or impracticable. During the *summer* season, when S.E. gales occur, the bay is exposed to the full effect of the open sea; but these gales seldom last longer than thirty-six hours, and do not blow home. A heavy breaking sea then rolls in, and ships trading to the port usually ride with a long scope of cable, secured to a coir or hempen spring to ease the strain on the cables; with this precaution vessels ride safely, and the holding ground is good. As in Algoa Bay, there appears to be a strong easterly current, or 'under-tow,' which assists to ease the strain on the cables. Should a vessel, however, not wish to risk riding out a *south-easter* in the bay, by putting to sea early she will be well able to clear Cape St. Blaize by first making a good long board to the eastward, in which she will be assisted by the 'undertow.' Captain Laws (the harbour-master) has found by observation that a rise of the barometer usually precedes a south-easter, and that the increase of the wind is gradual at the commencement.

"*Anchorage.*—The anchorage space is included—(1) between a line drawn from Cape St. Blaize lighthouse through the Ladies' School (a conspicuous building with a double gable point, and the only house near to the cape), bearing S. 27° W.; and (2) a line drawn from the Windmill through Barry's Store (a large two-storied stone building which stands on the mound close to the sea at the west side of Vaarkens Bay), bearing S. by W. $\frac{1}{2}$ W. Small vessels may anchor in this space in from $3\frac{1}{2}$ to 4 fathoms water, with the outer low point visible, bearing between S. by E. and S.E. by S.; but vessels *seeking shelter* ought not to go inside a depth of $6\frac{1}{2}$ or 7 fathoms in either season of the year. The windmill in line with the new jetty is a good line for strangers to anchor upon, suiting their depth of water to the size

of their vessels and the object they have in visiting the bay. Vessels intended to load or unload may take up a berth more to the westward, and in the depth of the bay—not, however, going within the line of the windmill and Barry's Store already mentioned. Ships of war visiting the bay should not anchor in less than 7 fathoms during the summer months, the lighthouse bearing S. by W. $\frac{1}{4}$ W.; nor in less than $5\frac{1}{2}$ to 6 fathoms in the winter, the lighthouse bearing S. $\frac{3}{4}$ W. There is a substantially-built jetty in the nook or cove, called Vaarkens Bay, abreast of the anchorage. With a small outlay in making a rough stone pier from the outer point of the bay, to protect the jetty from the breaking sea that sometimes comes in, landing might be effected in almost any weather. At present the rollers render landing almost impracticable at times, endangering even the jetty itself.

"*Provisions.*—Fresh water is supplied from a pipe at the jetty end, at the rate of about thirty tons a day. Fresh provisions and vegetables are to be had in any quantity, and it is in contemplation to erect a flagstaff at the lighthouse, so that vessels wishing to be reported can make their wishes known, and have information sent by electric telegraph either to Cape Town or Port Elizabeth.

"*Mossel Bay from the Westward.*—Cape St. Blaize is a conspicuous bluff, the land at the back being quoin-shaped, and somewhat resembling the Bill of Portland. To round Cape St. Blaize keep Pinnacle Point open to the southward of the cliffs just to the west of the lighthouse bluff, N. 72° W., until the large patch of sand at Hartenbosch river bears N. $\frac{1}{2}$ E., or until a large stone *beacon*, which is *white* and stands 500 yards to the N.W. of the lighthouse, comes open to the northward of the Logan Stone; this will clear the Windvogel rock.

"*Mossel Bay from the Eastward.*—Coming from the East and South-east, Cape St. Blaize is more difficult of recognition, as the land shows on each side of it; but it may now be identified by the lighthouse, which shows conspicuously against the dark background—by the Logan Stone, which is also white—by the windmill on the bluff—and by the remarkable sand-patch at the mouth of Hartenbosch river.

"*Tides.*—There is no regular stream of tide in Mossel Bay."

For a general description of the Winds, see p. 70.

Mr. Lawes, harbour-master at Mossel Bay, says:—"Mossel Bay derives its name from Jacob Mossel, who was Governor-General of Netherlands India in 1757. It was formed by a bend of the coast on the eastern side of Cape St. Blaize, which is a low point projecting from a bluff in Lat. 34° 10′ S., and Long. 22° 18′ E. A rock named Blinder or Windvogel lies about $\frac{1}{3}$ of a mile from the east end of the cape, and the sea breaks heavily upon it at low water. This bay affords complete security to vessels during the winter months of May, June, July, and August, when the prevailing winds are off the shore; south-easterly winds are then unfrequent, moderate, and of short duration. From September to April strong breezes from the N.E. occasionally prevail, bringing into the bay a heavy break of sea. These, however, seldom continue thirty hours, and vessels with good ground tackle may ride with safety, or if desirable, beat out at the usually gradual commencement of the breeze, and clear the cape in one good board. Moderate S.W. winds, even at this season of the year, are very common.

"*Aliwal.*—The village of Aliwal stands upon rising ground on the north side of Cape St. Blaize, and consists of about 130 houses, the greater number substantially built, an episcopal chapel, and a Dutch church; various other buildings are in course of erection. The resources of trade and produce in the interior have been opened to

this port by the formation of a road called the Meirings Poort, through the gorge of the Zwaart Berg range of mountains, in 1858, and a thriving commerce is the result. The population of the village consists of above 600. The civil establishment is composed of a resident magistrate, a collector of customs, a district surgeon, and a small police force. An episcopal clergyman and a minister of the Dutch Reformed Church are resident. There is also a harbour-master and an accredited agent for Lloyd's. Several eminent mercantile houses are established, and there are three hotels, and many provision and retail stores. Postal communication is maintained with the extremity of the colony, the mail-cart departing from the village three times a week, and arriving in Cape Town in thirty-six hours. A supply of excellent water is being conducted to a new jetty for the use of shipping. No port charges exist. The arrivals throughout the year 1858 were 100 vessels.

"Cape St. Blaize may be rounded closely, taking care to avoid the Blinder Rock. A windmill on the bluff is not visible coming alongshore from the westward, owing to intervening land, but will be seen from the southward, and the bay thereby identified. On opening the bay, the town of Aliwal will be seen at nearly $\frac{3}{4}$ of a mile inside the extremity of the cape.

"The proper anchorage in Mossel Bay from April to September is in from $4\frac{1}{2}$ to 5 fathoms water on a bottom of clay with a thin covering of sand, with the village bearing S., or with Blands jetty-head S. $\frac{1}{2}$ W., and the visible extremity of the cape S.E. by S. From September to April vessels should not anchor in less than $5\frac{1}{2}$ fathoms. Ships' boats may land either at the stairs at the jetty-head, or on the beach, there being no surf.

"The heaviest gales during the year are from the W.N.W. Winter gales commence from the N.N.W. with heavy gusts, unsteady both in direction and force, then veering to W.N.W. or W. They blow very hard in continuous gales, with barometer low (29·6 inches); finally, shifting rather suddenly to the S.W., they subside with steady breezes and occasional showers. At this latter period a swell sometimes sets round the bay, but nothing to cause apprehension for the safety of vessels, or interruption to the landing with light boats.

"It is high water on the days of full and change at Mossel Bay at 3h., and the rise of tide is 7 feet."*

Captain Dunn, of the barque *Elizabeth*, of Stockton-on-Tees, in a letter dated July 15th, 1862, thus wrote of Mossel Bay:—"I put into the bay as a port of refuge, having lost sails, store-boats, water-casks, &c., and was astonished at the shelter it afforded from westerly gales, and the abundance of good provisions, firewood, and particularly good fresh water, very important in a long voyage with salt provisions. Ships can use their own boats in landing. There is now a good jetty, and another is being built, along which water will be laid on in pipes. A lighthouse on the cliff, to be immediately erected, will be an excellent mark by day or night, with winds from S. by E., round westerly, to E.N.E. Mossel Bay is all a mariner can desire, and were its advantages better known, no shipmaster would contend with the heavy westerly gales that prevail so long during winter."

From Mossel Bay to Knysna River the coast runs about S.E. by E. 50 miles, and

* These instructions for Mossel Bay by Mr. Laws are from his description of the bay inserted in the *Nautical Magazine*, November, 1861. Some very strong recommendations of the bay as a harbour of refuge are appended to the description, which are chiefly contributed by shipmasters who have frequented it.

includes several rivers, but there are none, we believe, sufficiently deep to permit the entrance of vessels. This is said to be a bold shore, with land near the sea of moderate height, behind which is the range of Outeniquas Mountains. At 18 miles eastward of Mossel Bay is a little cove named Dutton, which is reported to be a very dangerous and impracticable spot.

KNYSNA RIVER.—The entrance to the Knysna River is between two bold rocky headlands, immediately within which the river expands into a large bay or lake, covered with marshes, but having among them a channel, preserved by the river, deep enough for ships of considerable tonnage. The distance between the headlands is not more than $1\frac{1}{4}$ cable's length, and here, in the shoalest part, are 18 feet water at low tide, which soon increases to 48 feet; but decreases again, almost immediately, to 30 and 25 feet, the latter being at about half a mile from the sea; it is at this latter spot where ships usually anchor. The anchorage is sheltered from all winds except those blowing directly into the mouth of the river. When viewed from the southward, the rocky headlands present the appearance of the portals of a large dock.

Captain Wallis, R.N, remarked of this river in 1817, "Any vessel drawing under 15 feet, attending to the tide, may run for this river with safety, it being 288 yards wide at the only dangerous part. It is high water on the days of full and change of the moon at 3h. 45m.; extraordinary tides rise 7 feet, ordinary 5 and 6 feet, and the ebb tide runs out at the rate of 3 or $3\frac{1}{2}$ miles an hour on the springs. The middle of the channel is the deepest water, but it is proper to keep nearest to the western head, on account of the straggling rocks lining the opposite side, which are mostly visible, excepting the Emu Rock, nearly half channel over on the east side of the entrance, and at about a cable's length south-west of Inner Obelisk Point, above which is the signal station; this rock is just outside the northernmost of the straggling rocky islets before mentioned. The brig *Emu* was lost on this rock before its position was known.

"A pilot will come off upon making the usual signal, and a boat should be ready with a line to run out to the rocks in order to steady the vessel in case of it falling calm under the high land, and your being obliged to anchor in the narrow part of the entrance. There is good anchorage outside, the depths decreasing gradually towards the entrance of the river, which affords room inside for about thirty sail of ships, and is as smooth as a dock; and, if necessary, a ship may be hove down to the steep bank, where vessels may also be built, forests of fine timber being contiguous to the river. Nevertheless, this place ought not to be attempted, except in favourable weather, and never in a large ship."

Commander Walker, R.N., surveyed the river in 1817, and described it as the best harbour in the colony. The following signals may possibly still be in use:—

Flag, white and blue diagonally, signifies—*A pilot-boat is coming out.*

Flag, red—*Ship recommended not to attempt to enter the river.*

Flag, white and red horizontally—*Ship may enter. If waiting for the tide, a red pendant will be shown over the flag at a proper time for entering*

Flag, yellow—*Pilot-boat cannot go out, but a pilot is ready to receive the ship within the bar.*

Commander W. E. A. Gordon, of H.M.S. *Hermes*, 1857–60, says, "The entrance of Knysna Harbour, in Lat. 34° 6′ S. and Long. 23° 7′ E., with a depth of 18 feet in it, may be recognised by a mountain terminating in a bluff near the sea, with Seal Cape, a low black point, extending from it to the S.E. at 10 miles E.N.E. from the harbour. When the harbour is well opened, bearing N., a village with two churches will be seen. There are also two beacons for leading marks—one standing on Fountain Point on the eastern side of the entrance, the other on the western shore of Steenbok Island, within the harbour. The pilot-signals are made with flags from a staff erected on Inner Obelisk Point.

When approaching the harbour from the westward steer for the S.E. rocks, which lie S.S.E. about ½ a mile from the entrance, and when the harbour is well open proceed towards the Needles Point on the western side of the harbour's mouth, until the two beacons come in line, which will lead up to Fountain Point. Pass this at 8 or 10 yards off, and steer for the rocky point between Green and Monkey Points, by which a depth of not less than 3 fathoms should be maintained. When abreast of Green Point, haul in for a sandy patch close southward of Rocky Point, and anchor at about 20 yards southward of it."

PLETTENBERG BAY.—From Knysna River to Seal Cape, or Cape Delgado, on the south side of Plettenberg Bay, the distance is about 10 miles, along a bold coast, the general inclination of which is E.S.E. This cape is remarkable, being a long, narrow headland, nearly separated from the main by a gap in the cliffs at about 1½ mile from its extremity; hence when viewed from the southward at an offing of some miles it presents the appearance of an island. The position of the extremity of the cape is estimated to be Lat. 34° 5′ and Long. 23° 20′.

The bay has an extent of about 5 miles in a north-easterly direction, but is very shallow in depth as the coast bends in westward not more than 2 miles. It is quite open to the southward and south-eastward, from which directions a very heavy swell is sent in when the wind prevails with strength; consequently, the anchorage can be considered safe only with winds from the land. South-easterly gales seldom blow longer than 24 hours. Owing to extensive forests in the neighbourhood, Plettenberg Bay is frequently visited by small vessels in the coasting trade. Landing is easy, and it is not difficult to get to sea when dangerous gales from the south-eastward are expected.

Around Plettenberg Bay the land is hilly, and inland northward of it, there is a mountain of irregular shape named Buffalo Mountain, the highest part of which is at its east end; at about 60 miles eastward from this there is, inland, another of a sharp conical form, called Peak Mountain; at 30 miles further eastward there is a table hill termed Flat Mountain; and between these is a round hill, called Round Mountain.

Several brackish rivers fall into Plettenberg Bay. The first of these, named Pissant, is at 3½ miles from the extremity of Seal Cape, and has near it, on its northern bank, the government storehouses; beyond this is Kurboom River. At 5 miles from the Kurboom River, following the coast, is a small peaked hill close to the shore, off which are some rocks; and, at 2½ miles from the latter, is the Kromkromma River,—all this shore consists of a rocky cliff.

The soundings in Plettenberg Bay, at 3 miles from the shore, average 30 fathoms, which decrease gradually to 4 fathoms close to the beach; the bottom consists of fine sand. It is usual to anchor in 17 or 18 fathoms, at about $\frac{3}{4}$ of a mile S. by E. $\frac{3}{4}$ E. from the governor's storehouses; or in 9 to 8 fathoms with the cape bearing S. by E. $\frac{1}{2}$ E., and the gap S.W.; here the ship will be in good ground and well sheltered from all but easterly and southerly winds.

Lieut. Rice, R.N., who surveyed Plettenberg Bay in 1797, says:—"The only danger in approaching the bay is the *Whale Reef*, a circular shoal of rocks bearing S.E. by E. from the cape, nearly 1 mile distant; the sea in general breaks over it very high, and between it and the cape there is a channel, in breadth about $\frac{3}{4}$ of a cable's length, with 7 fathoms the least water. This channel should not be attempted but in case of necessity, as there is generally a great swell, and when it blows strongly, the wind is unsettled and baffling near the cape. By giving the cape point a berth of a little more than a mile, ships may pass safely to the southward and round the east side of the Whale, which is steep, having 18 fathoms water at about a quarter of a cable's length from it; and when the south end of the long sandy beach is open with the high rocky point on the north side of Seal Hill, they will be northward of the shoal, and if the wind permit, may haul close into the bay.

"The bay is sheltered from all winds except those at S.E. and eastward. The wind from E.S.E. to S.S.W. sends in a heavy swell, but south-easterly gales are of short duration here, as at Mossel Bay. The landing-place is on a sandy beach near the governor's storehouses, at the south end of which there is a small river that descends from a farm at the distance of $1\frac{1}{4}$ mile; but the entrance is generally closed with a dry sandy bar. At both ends of the beach rocky points project, and at a cable's length E.S.E. from the south point are some rocks, dry at low water, which break off the sea.

"Wood may be cut near the landing-place; watering is difficult, as the casks must be rolled nearly 300 yards over a heavy sand, and then rafted through the surf, which frequently runs high. Beef and poultry may be had at reasonable prices; vegetables are scarce; fish are plentiful near the cape and about the rocks off the landing-place. Vessels from Table and Simons Bays load timber here, for at 12 miles north-westward of the landing-place there is a forest where various sorts of timber may be had, some of large dimensions, proper for either house or ship-building.

"Tide.—There is no regular stream of tide, but a southerly current generally sets in the morning between the Whale Rock and Seal Cape."

From Plettenberg Bay the coast trends S.E. by E. 75 miles to *Cape St. Francis*, and is throughout a very dangerous, inhospitable shore, with deep soundings at a short distance off. It is of moderate height near the sea, but rises rapidly inland to a range of mountains, which, meeting the warm winds from the water, gives rise to such dense fogs and mists, that it is frequently hidden from view, and consequently several vessels have been lost upon it; it is also supposed that the current hereabout sets directly on shore. At Cape St. Francis the mountain range nearest the coast gradually declines to the sea. The depth at 15 miles southward from Cape St. Francis is supposed to be about 60 fathoms.

Cape St. Francis is a bold point with rocks about it, and must, consequently, be

approached with caution; the rocks are said to extend out about a mile, but this is uncertain, for no part of the coast has been surveyed. In the French charts this cape is called the Cape of Mountains, although it is not high land; but inland, due North (*true*) from it 20 or 25 miles, there is a remarkable rugged piece of high land, the flat and round mountains before mentioned, which may have been mistaken for it in thick weather.

ST. FRANCIS BAY is on the east side of Cape St. Francis; but this term is generally applied to the whole sweep of coast between the cape and Cape Recife, the bay immediately eastward of Cape St. Francis being called Kromme Bay, from the river Kromme, or Crooked, which falls into it.

Kromme Bay is quite open to all winds from the southward and south-eastward, and is said to be a very bad anchorage, the bottom being rocky; hence necessity alone should cause a vessel to run for it.* Winds from sea, if violent, would drive a ship badly found in ground tackle on shore, when nothing could save her from destruction; added to which the landing is bad, the only place being at the entrance to the river, where there is usually a high surf. The water of the river, like that of most of the rivers on this coast, is brackish, but there is a spring of good quality at about a mile from the sea, whence supplies may be obtained by means of casks hauled through the surf to a boat anchored outside. It is said that at high water spring tides the depth on the bar of the river is 7 or 8 feet.

From Kromme Bay the coast runs nearly East (*true*) 35 miles to Cape Recife, Algoa Bay, and nautically speaking, is unknown, no survey of it having yet been made.

CAPE RECIFE.—Cape Recife, immediately eastward of which is Algoa Bay, is a low sandy point of land having a small conical hill near its extremity, which is distinguishable only at a short distance; the lighthouse on the cape is therefore an important mark to vessels approaching from the southward or eastward, as it is the chief means by which the position of this very dangerous point can be known. This building consists of a tower 80 feet high, painted in four horizontal bands, alternately red and white, which exhibits a light *revolving every minute* at 90 feet above the sea, visible 17 miles (supposing the eye 12 feet above the horizon) between the bearings from the lighthouse of N. by E., round by S. to W.; when viewed from a short offing the light appears to be *fixed*, with *bright flashes every minute*. The lighthouse stands in Lat. 34° 1′ 40″ S., and Long. 25° 42′ 8″ E., and from it the Cockscomb Mountain, 5400 feet high, bears N.N.W. ½ W.

The low shore of Cape Recife is rocky, hence a wide berth should be given to it

* Captain Horsburgh mentions that "Kromme Bay was formerly visited by some vessels in distress. The *Pigot* got water and other refreshments here in June, 1785, and the *Countess of Sutherland* remained in it (after losing her masts at sea) from July 18th to August 17th, 1801. While the latter vessel continued at this place there were frequently land and sea breezes, with strong winds at times from S.E. blowing into the bay, rendering her situation very dangerous, for the cables were much injured, and some of the anchors were broken by the rocks, although she moved from 10 fathoms on the east side to 7 fathoms on the west side of the bay to endeavour to get better anchorage. At a little eastward of the entrance of the river, the *Pigot* found a spot of 7 fathoms, sandy bottom, where she moored at a little more than a mile from the shore, the eastern extremity of the land in sight bearing E. 10° N. (*true*), and a round mount in one with the entrance of the river, which is the best situation to moor."

when running into Algoa Bay, and a still wider berth when sailing westward, the coast immediately westward of the cape having reefs about it and being as yet unsurveyed. A very dangerous reef (from its situation, being an outlying patch) in the vicinity of Cape Recife is the *Thunderbolt*, a reef $\frac{2}{3}$ of a mile in extent, the centre of which is $\frac{6}{10}$ of a mile S.W. $\frac{1}{2}$ W. from the lighthouse; this reef has close to it all round a depth of 4 to 6 fathoms, and in the narrow channel between it and the cape, soundings of 4 to 2 fathoms—outside it the water rapidly deepens to 24 and 30 fathoms, the latter being at not more than 2 miles from the lighthouse, consequently the greatest possible precaution is necessary while in its vicinity.*

ALGOA BAY.—From Cape Recife the coast trends northward about $5\frac{1}{2}$ miles to the town of Elizabeth, and thence north-eastward and eastward 42 miles to the Bird Islands, the whole space comprised within these limits being considered Algoa Bay—the direct bearing and distance from the lighthouse on Cape Recife to the lighthouse on the Bird Islands is E. $\frac{3}{4}$ S. 30 miles, so that the shore of the bay bends in considerably from a straight line supposed to be drawn between those objects. The general depths are 40, 36, 28, 20, and 10 fathoms, the last being found at from 1 to $1\frac{1}{2}$ mile from the shore, except off Port Elizabeth, where similar soundings are obtained so far out as $2\frac{1}{2}$ and 3 miles. The bay is of a horse-shoe form, well protected from the violence of winds, except between E. $\frac{1}{2}$ S. and S. by E. $\frac{1}{2}$ E., and is considered the best and safest roadstead on the Cape Coast during the winter months.

Riy Bank.—In the entrance to Algoa Bay in the direction of E. by S. $\frac{1}{4}$ S. from Cape Recife, there is a bank of 6 to 10 fathoms, named Riy Bank, the shoalest part of which, 6 fathoms, is situate $8\frac{1}{2}$ miles from the lighthouse at the cape on that line of bearing. It is rather more than a mile in extent, and appears to consist of an eastern and western bank, bottom rocky and foul, with 12 to 20 fathoms between and around. The sea breaks heavily after S. W. gales, especially over its north-west or shallowest part.

The coast northward of Cape Recife is fronted by a reef which extends out from $\frac{1}{3}$ to $\frac{1}{4}$ of a mile, but the 5 fathom line of depth is not more than $\frac{1}{2}$ a mile from the beach; hence this shoal is very dangerous, and especially so as there is an outlying shallow patch, named the *Dispatch Rock*, so far from the land as one mile. This reef consists of numerous heads of rock rising above a bed of rocks fully 500 feet long, the least water over which is 8 feet. There are 9 and 10 fathoms close to it on its eastern, and 5 and 6 on its western side. It lies $2\frac{3}{4}$ miles N.N.E. $\frac{1}{4}$ E. from Cape Recife lighthouse, with that building in one with a red beacon situate north-eastward of it, and two beacons,† placed a little within high-water mark at $2\frac{1}{2}$ miles northward

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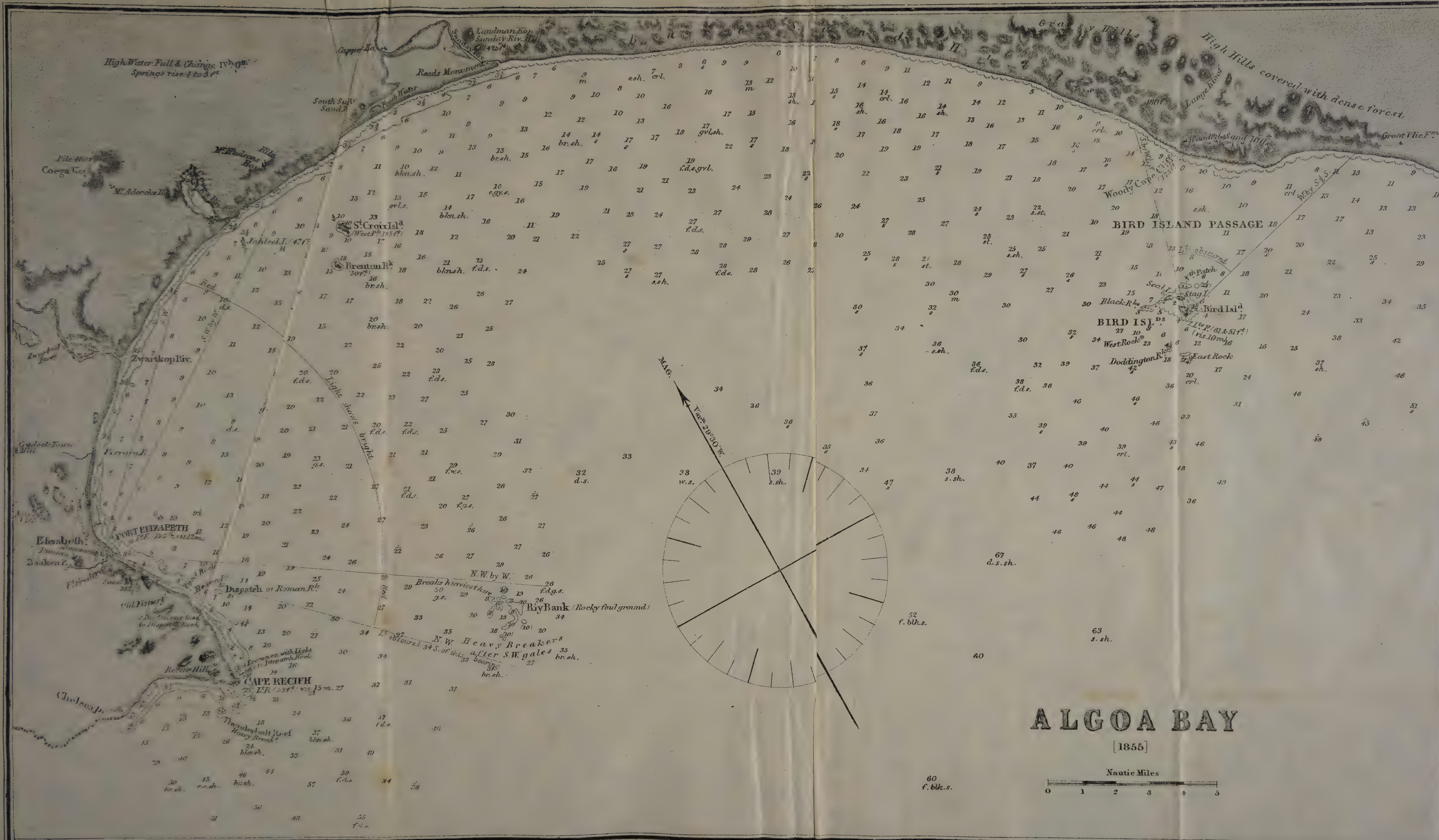
* "No vessel should approach the coast for 4 miles westward of Cape Recife, nor the cape itself nearer than $2\frac{1}{2}$ miles, and then only in a commanding breeze or in a steamer, as the reefs extend nearly $1\frac{1}{4}$ mile from the shore, and because there is a very decided and dangerous indraught towards them.

"Neither should any one be tempted, by the absence of breakers, to approach nearer the east side of Recife lighthouse, as it often occurs that it does not break upon a 7-foot patch a mile from the lighthouse, and yet it will, without previous warning, break in 7 fathoms, and even in 10 fathoms. It is seldom prudent to get less than 13 fathoms water while still outside of Recife. When the height of the lighthouse subtends an angle of 23′, the distance from it will be $2\frac{1}{2}$ miles, and, therefore, no greater angle should be obtained."—*Nautical Magazine*, 1856.

† These two beacons are each 25 feet high, surmounted by a ball, and painted in alternate bands of red and white. They are distant from each other 1200 yards on an E. $\frac{1}{4}$ N. and W. $\frac{1}{4}$ S. bearing.


ALGOA BAY
[1855]
Nautic Miles
0 1 2 3 4 5
High Water Full & Change IVh. 0m.
Springs rise 4 to 5 ft.
Landman Kop
Sunday Riv. Hill
Reads Monument
South Surf Sand H.
High Hills covered with dense forest.
Woody Cape
BIRD ISLAND PASSAGE
Bird Isld.
BIRD ISLDS.
Black Rk.
Stag I.
West Rock
Doddington Rk.
East Rock
Coega Kop
Mr. Adcocks H.
St. Croix Isld.
Brenton Rk.
Jahleel I.
Zwartkop Riv.
Light shows bright
PORT ELIZABETH
Elizabeth
Baaken R.
Dispatch or Roman Rk.
Riy Bank (Rocky foul ground)
Breaks heavies there
N.W. by W.
N.W. Heavy Breakers after S.W. gales
Lt. obscured
CAPE RECIFE
Thunderbolt Reef
Heavy Break.
Roeme Hill
Chelsea P.
Old Fishery
MAG.
Varn. 29°30' W.
Groot Vlie Fm.
Langekloof
Woody Cape
Gray Hills
Lt. obscured
N. by W.
S.W. by W.
Red
Red

of the lighthouse, in a line with each other—it is consequently a mile from the nearest land.*

Port Elizabeth.—From Beacon Point, off which is the Dispatch Rock, to the town of Elizabeth, the distance is about 2½ miles along a sandy coast covered with bushes. Port Elizabeth is the principal port of commerce on the south coast of Africa next to Cape Town. The town is not extensive, compared with European cities, but it is rapidly increasing in importance. Water and refreshments of all kinds can be procured at moderate prices, and leaky and dismasted vessels are sometimes hove down, repaired, and refitted at their anchorage off the town. It is the practice of merchant vessels regularly trading for wool cargoes to moor on arrival, and to strike their top or top-gallant masts, and unbend sails. They are found with ground-tackle superior to ordinary merchant vessels, and ride out in safety the summer gales from the S.E. The port captain assigns the berths, and shipmasters are bound to attend to his orders. There is a jetty at the mouth of Baaken River, where a landing can always be effected except in rough weather from the south-eastward.

The surf constantly beats on the beach of Port Elizabeth, and sometimes with extreme violence. At times, it is almost impossible to land.

A lighthouse is situated on a hill behind the town at nearly 25 yards S. ½ E. from Donkin Monument. It shows a *fixed* light at 225 feet above the level of high water, visible about 12 miles between the bearings, when viewed from sea, of N.W. and S. W. From sea it appears *red* between the bearings of N.W. and N.W. by W.; *white* between N.W. by W. and S.W. by W.; and again *red* between S.W. by W. and S.W.†

There is anchorage in 6 to 8 fathoms in front of Port Elizabeth, and it may be remarked, as a general rule, that a sandy bottom and good holding ground will be found anywhere in 7 fathoms. When taking up a berth, however, room should be left to admit of veering to 100 and even 130 fathoms, as less than this quantity should never be tried; and, indeed, it is seldom judicious to use less than this quantity anywhere, unless the harbour is landlocked and the water much less than 7 fathoms in depth. There is a little foul ground in the south-west part of the bay. Vessels may anchor in about 6 fathoms, grey sand, with the south-east angle of Fort Frederick bearing W. ½ N., and the Bird Rock at Beacon Point S. ¾ E.;—or further out in 8 fathoms, similar bottom, with these objects respectively W. ¼ S. and S. by W.

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* The Dispatch Rock appears, from the survey made in 1855 by LIEUTENANT DAYMAN, R.N., to be the only outlying danger between Cape Recife and Port Elizabeth; but it should be mentioned that in 1819 a rock was reported by CAPTAIN HUNN, of H.M.S. *Redwing*, the cross bearings of which, as given, place it further in the bay than the Dispatch Rock, and in a position where not less than a depth of 6 fathoms is shown on LIEUTENANT DAYMAN'S chart. The report was as follows:—"The reef appeared to be about 8 fathoms in length and 2 or 3 fathoms in breadth, having 2½ fathoms upon it, the least water, with 8 fathoms close to it. When upon it, the extremity of the breakers off Cape Recife bore S. 8° E.; Cape Recife S. 2° E.; Bird Island, off Beacon Point, S.; Fort Frederick W. ½ S.; and St. Croix, north-easternmost island, N.E. by E. ½ E. It was off shore about 1½ mile." Notwithstanding this circumstantial account, the rock is believed by the residents at Port Elizabeth to have been the Dispatch Rock, the correct position of which has now been fully determined by LIEUTENANT DAYMAN.

† As it is possible that in consequence of its elevation this light may occasionally be seen by vessels approaching Algoa Bay from the eastward before the revolving light on Cape Recife comes into view, care should be taken not to bring it southward of W. until that light can be clearly distinguished; which it will be, immediately it is above the horizon, by its greater brilliancy, as well as by its *revolving* once a minute.

From the town of Elizabeth the coast turns to the north-eastward 5½ miles to the mouth of the Zwartkop River, and is low all the way; this river is barred, and will only admit boats. Hence to Coega River, another barred stream of similar character, the distance is 5 miles. At half a mile southward from this latter river there is a small islet, 47 feet high, named Jahleel, which is separated from the shore by soundings of 5 to 7 fathoms, and has immediately outside it a depth of 8 and 9 fathoms.

St. Croix Island.—St. Croix is a small islet, ⅓ of a mile in extent, situate in the north-east part of Algoa Bay, at about 2 miles from the shore. Its west peak is 195 feet high, and its surface is of nearly bare rock. On the north-east side the island is steep, with a depth of 10 fathoms almost close to it; its south-west side is less steep, and here some stunted vegetation grows. Numerous penguins and gulls make it their resort, and it is occasionally used as a stopping-place by sealers when in search of seals, which frequent the adjacent rocks, especially Jahleel Island.

At rather more than a mile south-westward from St. Croix Island there is a rock 50 feet high, named Brenton. The depth close to it all round is 4½ and 5½ fathoms, and immediately outside this depth 13 and 14 fathoms; the latter rapidly increases seaward to 18 and 20 fathoms.

There is good anchorage under St. Croix Island in all winds, but extra care is required with those from the south-eastward, which send in a very heavy sea. The best position is in 10 fathoms, sand, at about ¼ of a mile from the island, with its west peak bearing S. by E., because there the island affords some shelter against heavy seas in blowing weather; the extent of sheltered anchorage is, however, very confined.*

Woody Cape.—From Coega River the coast trends eastward about 10 miles to the outlet of Sunday River, and thence 21 miles south-easterly to Woody Cape, off which are the Bird Islands. Throughout it is formed by an unbroken chain of sand hills, which extend inland from 1 to 1½ mile, and rise in some places near Woody Cape to the height of 350 and 450 feet above the sea level. At Woody Cape the sand-hills are covered with dark bushes; they present to seaward a series of decayed sandstone cliffs, fronted by a beach of rugged rock, which extends along shore for 2 miles, when the sand-hills are again met with, though not so high nor so bare as those to the westward. These reach as far as Point Padrone, 9 miles eastward of Woody Cape, which is also formed by cliffs similar to those at that point, with a beach of rugged rock and shingle.†

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* It has been remarked that it would have been better for the colony if the town of Elizabeth had been erected on the shore opposite St. Croix Island, because the anchorage in that part is better than in the west extreme of Algoa Bay, where the town stands, and the open country with the Zwartkop River would have afforded no mean advantages; but in opposition to this it must be observed that Port Elizabeth is preferable for communication with the mainland, since it is often found that the surf abreast the island and at the mouth of Zwartkop River is high and dangerous after the prevalence of south-westerly winds, and continues so for a longer period than on the beach of Port Elizabeth.

† Lieutenant H. G. Simpson, R.N., says, "Woody Cape, as its name imports, is covered with wood, except a small patch of sand at its summit, and is the only seaboard land in the vicinity of Algoa Bay that is so, which gives it, in contrast with that for miles on either side, a dark appearance; the land on its west side, from near St. Croix Island, rises into numerous small sandy hillocks, quite bare of vegetation, and that eastward of it as far as Point Padrone is similarly bare. The cape is scarcely distinguished as a cape, except when very near it: not so Point Padrone, which juts out into a low point of sand, forming a determinable cape, without vegetation, from which breakers run out some distance, and the water breaks still further out at times, owing to the meeting of currents there; and after strong winds."

The coast between Sunday River and Point Padrone bears a very monotonous appearance. Behind the sand-hills the country rises into lofty elevations, the summit of Addo Heights being estimated at 1164 feet above the sea; other hills are 1000 to 1200 feet high, and all are covered with grass and dense forest intermixed, but there are no remarkable peaks nor other objects by which any particular part of the coast may be recognised. Woody Cape can only be distinguished from a position close in shore; the cliffs are then seen, but from the southward it is not prominent, the sole conspicuous objects being the wooded sand-hills immediately over it.

At Woody Cape and Padrone Point fresh water may be observed welling out from the base of the sand-hills, just above high-water mark. It is said that fresh water may be also obtained from almost any part of this coast by digging in the sand above high-water mark.

DIRECTIONS.—*Approaching Algoa Bay by day.*—If from the southward, the first land seen will be the high land in the interior. The most remarkable peaks of this mountain range are sufficiently elevated to be visible from a distance of 50 to 60 miles. From Cape St. Francis, 42 miles westward from Cape Recife, the peak named Cockscomb, 5400 feet high, bears N.E. $\frac{1}{2}$ N. 30 miles, and from Cape Recife N.N.W. $\frac{1}{2}$ W. 42 miles; while that named Rugged Top bears from the former cape N.E. by E. $\frac{2}{3}$ E. 35 miles, and from the latter N. by W. $\frac{1}{2}$ W. 30 miles. These bearings will be a sufficient guide when steering for the land, if the capes themselves cannot be seen in consequence of haze covering the low land between the mountains and the sea.

When making Cape Recife from the westward, the hummock called Recife Hillock, $\frac{3}{4}$ of a mile north-westward from the lighthouse, is often seen before that building comes into sight, as it is of greater altitude. This is of some consequence to vessels running along the land.

If making Cape Recife from the southward, care is required not to mistake Cape St. Francis for Cape Recife, which error has frequently occurred; notwithstanding the capes are distant from each other 42 miles; the above bearings of Cockscomb and Rugged Top Mountains should prevent this; besides which, the hummock at Cape Recife can be seen from a great distance. As Algoa Bay is approached, the high land immediately behind the coast between Capes Recife and St. Francis comes into view, soon afterwards the hummock appears as the termination of the coast line in that direction, and there will be noticed immediately westward of it a remarkable strip of bare white sand of considerable extent, which looks much like a beach; then Recife itself will appear a little eastward of the hummock, showing low, but distinctly as a cape,—the lighthouse will not be seen till a further approach of about 4 miles.

The coast westward of Cape Recife for a distance of 6 or 7 miles must be cautiously avoided, and the cape itself should not be approached nearer than 2 miles, and then only in a commanding breeze or in a steamer, as the Thunderbolt Reef is situate a mile from the lighthouse, and is steep on the seaward side. Nor is it prudent to get nearer the lighthouse on its south-east side than this distance of 2 miles, because the sea often fails to break upon a 7 feet patch at a mile from it, and yet, without previous warning, breaks in 7 fathoms, and even in 10 fathoms. As a rule, the depth of not less than 13 fathoms should be maintained while out-

side the cape, especially as a strong current generally sets towards the Thunderbolt Reef.*

Vessels occasionally pass *inside* Dispatch Rock, but it is better to keep outside, the channel being very confined; fine weather and a commanding breeze are essential for safety, and it is seldom that any advantage is gained by adopting it. If compelled by necessity to use this channel, bring the lighthouse on Cape Recife to bear N.W., and steer for it on that bearing until the soundings are decreased to 14 fathoms, when it will be distant 1½ mile; change the course now to N. for about 2½ miles, when you should look out to open the red beacon eastward of the lighthouse, and keep it so. This will lead westward of the rock in a depth of not less than 6 fathoms.† Having brought the two beacons near Beacon Point in one, and again opened them some distance on the other side, steer for the anchorage off the town, taking care not to approach Beacon Point (which is low and sandy, and terminates in rugged rocks) nearer than ¼ of a mile.

To pass *outside* Dispatch Rock.—Bring the lighthouse on Cape Recife to bear N.W. 1½ mile as before, and steer N.N.E. or any course more northward that will admit of the red beacon being kept open westward of the lighthouse, and continue thus until the beacons at Beacon Point are in one, or the staff and point of the Diamond on Fort Frederick are in one with the centre of the remarkable hill behind it, or, if these should not be seen, until Beacon Point bears W.N.W., when the anchorage off the town may be steered for.

Making Algoa Bay from the *eastward*.—In the winter season, vessels from India should endeavour to make the land in the neighbourhood of St. John's River, in Lat. 31° 34′ S., and Long. 29° 29′ E. The land on this part of the coast is mountainous, and the hills appear covered with bush and grass, which distinguishes it from the land further westward, where it assumes a more barren appearance, with sand-hills near the sea. From St. John's to the Cowie River, the current runs with the line of coast nearly W. from 50 to 80 miles in 24 hours. After passing the Cowie, or Point Padrone, the current sets off S.W.; and in strong westerly winds due S. right off the land. When beating along this part of the coast, a ship may safely stand 6 hours in and 4 hours off, and should keep within 30 miles of the land.

When off Point Padrone, the Bird Islands will come into view and be recognised at once by their lighthouse. These islands are very low and proportionably dangerous; and though the main will generally be seen before them, and the distance from them may be estimated by it, yet this is not entirely to be relied on; so, in shaping a course to go outside of them, allowance should be made for the fact that the eddy or return current sets in towards them, and then to the eastward. In clear weather the rugged-topped mountain and the Cockscomb may be seen from these islands, or rather from abreast of them, for the latter would be shut in when on them; but in passing outside the Doddington and East Rocks, the Cockscomb should be kept open west of the rugged-topped mountain, bearing about N.W., and

* A strong indraught will often be felt after passing Cape Recife and Thunderbolt Reef, and allowance must be made for it when shaping the course either inside or outside Dispatch Rock, particularly for the former, as foul ground stretches out a long way off shore between the red beacon on the cape and Beacon Point, and it has often occurred that sailing vessels, by not allowing for indraught, have got on shore.

† Other instructions say in 7 or 8 fathoms, with the exception of one or two casts of 6 fathoms before coming up to the two beacons at Beacon Point.

the ship should steer N.W. by W. ½ W. Having passed the Doddington, the high land at the back of Port Elizabeth will soon appear right ahead.

Approaching Algoa Bay at night.—If running for Algoa Bay from the westward, the coast must not be approached nearer than with the light on Cape Recife bearing E. ½ N. or E., and if unfortunately the vessel gets nearer the land than that line of bearing, she must without fail immediately haul out till the bearing of E. ½ N. comes on,* when an E.S.E. course may be steered till the light bears N. by W., when the course must be altered to E.N.E. till it bears N.W., after which she may steer N.N.E.

Until the light on Cape Recife bears N.W. a depth of not less than 12 fathoms should be maintained, and the vessel should go sufficiently slow to obtain soundings with certainty.

The current sets strongly towards the reefs; therefore, if the vessel find herself, from the altered bearings, dropping upon them, she must immediately haul southward. Whilst steering N.N.E., going eastward of Dispatch Rock, the light on the cape must not on any account be brought southward of S.W., nor must the sounding be decreased to less than 10 fathoms until a run of at least 3 miles after the light bears N.W., but when this distance of 3 miles has been accomplished, a N.W. course may be steered for the anchorage.

But, if the soundings be decreased to less than 10 fathoms, the vessel must be hauled eastward immediately. The town and vessels will appear from under the shadow of the land as the anchorage is approached, even though no light should be seen. During moonlight nights it will sometimes occur that the Beacon Point cannot be distinguished, the only thing distinctly visible being a long line of white sand, the northern extremity of which may be steered for on any course westward of N.W. ½ W.

The channel westward of Dispatch Rock should never be run for at night; even shipmasters belonging to Port Elizabeth would hesitate to attempt the channel.

Tides.—The tides are often irregular, being acted upon by the wind. The surface stream is uncertain in direction and inappreciable.

Mr. G. Chabaud, in a letter to the *Mercantile Marine Magazine* in April, 1859, writes, "Port Elizabeth, I am well aware, has, for many years, been condemned as one of the most dangerous roadsteads on the whole line of this stormy coast (if not in the world)—one in which no vessel, during south-east gales, has any chance of escape. Does it deserve this character?—is a question for its inhabitants to answer. I say, unreservedly and without fear of contradiction—No. On the contrary, Algoa Bay, with ordinary precaution, is one of the best, if not the best, bay on the Cape Coast, and this I am prepared to prove. I do not deny that wrecks were, in former years, of frequent occurrence, and that there has been, at times, great loss of property; but in almost every case this has resulted from the unseaworthy state of the vessel wrecked. In 1836 there were several wrecks—again in 1842, 1848, and 1850, and occasionally one or two between that year and the latter end of 1854; between 1854 and the present time, there have only been two wrecks, one of which was again got off.

"It is very remarkable, that since the period of the establishment, in 1854, of a

* The coast westward of Cape Recife has not been examined, which supplies an additional reason why vessels should keep outside this line of bearing, E. ½ N.

local Marine Assurance Company, wrecks have become quite out of date, and are now looked upon as a novelty: this is the more remarkable when we consider that we have now more than four times the number of vessels that we used to have previous to 1854. Compare the wrecks at Algoa Bay with those of Table Bay and other parts: you will then find that I am correct in asserting that Algoa Bay is as safe a port as any of the others. A vessel well found in ground-tackle has nothing to fear, as the holding ground in this port is very excellent.

"Having said thus much about the safety of the port, I would now call your attention to its capabilities, and the advantages it possesses as a *Harbour of Refuge.* Masters of vessels too often, it is to be regretted, after receiving damage, persevere in their onward course along this coast, during violent north-westerly gales in the winter months, until their crews are quite exhausted, and their vessels unmanageable —thus placing the lives of all on board in great jeopardy. This obstinacy, which probably arises from want of information, has often resulted in serious loss of life and property. Vessels have been known to have sighted Simons Bay, and after all been obliged to bear away for this port.

"In 1850 we experienced a very severe gale from the west-north-west, which lasted for three days, during which period the destruction of property as well as life was something awful—two vessels, one a Frenchman of 600 tons, called *L'Aigle,* and the other an English ship of 1000 tons, called the *Queen of the West,* after beating about for several days in a disabled state, trying to round Cape Agulhas, were wrecked near St. Francis Bay, at a moment when they considered themselves 35 miles off shore. All hands were lost in the latter. These vessels were lost in the night, owing to their having fallen into an error as to their position. The current on this part of the coast sets in upon the land. In the same gale, the ship *Grindlays,* laden with a cargo of tea from Singapore, was abandoned about 12 miles westward of this port, when the captain might, on the day previous, have reached it with ease, where he would have found 12 or 13 vessels loading cargoes in perfect safety. Three other vessels, the *Asiatic, Anna Robertson,* and *India,* put into this port at the same time in a disabled state. Two of these were subsequently repaired, and proceeded on their voyage. The *Ville D'Oleron,* a French barque, was run on shore westward of Recife, in October, 1854, the captain not knowing anything about Port Elizabeth.

"The year 1856 was even more calamitous than 1850. Not less than seven large vessels entered this bay in a leaky and otherwise disabled state, viz.:—the *Collingwood, Star of Empire* (American), *Themis, Nepaul, Sara Lydia, Dalesford,* and *Hispanio Filipanna.* The two latter were supplied with new rudders and necessaries, and dispatched in seventeen days. The *Star of Empire,* of 800 tons, arrived totally dismasted, was sold for the benefit of those whom it concerned, and was purchased by parties here, who fitted her out entirely at this port, and renamed her the *Lady Grey.* Many vessels are known to have foundered, or been abandoned at sea, not 100 miles from this port; the barques *Augusta, Sunny South, Sheridan Knowles,* and the brig *Usk* being among the latter. The Captain of the *Usk* reported having seen a large vessel founder off Fish River. In 1857, the French ships *Donges* and *Mathilde,* and a large American ship called *Bonita,* of 1200 tons, the English ships *Sutlej* and *Exhibition,* and several others put in disabled; the *Donges* and *Sutlej* were both hove down and repaired; the *Mathilde* was also re-

paired, but the *Bonita* and the *Exhibition* were condemned. This year we have had an unusual number of disabled ships, most of which, I regret to say, have been condemned as unseaworthy.

"Port Elizabeth was established in 1820, at which time it could only boast of a small fort (called Fort Frederick), barracks, mess-house, and commandant's quarters, with a population of about 35 souls. The trade was at that time very limited—confined, in fact, to an occasional visit from a small coasting vessel bringing a few articles of merchandise in exchange for a little butter and hides. A wonderful change has, however, taken place since that period—indeed, since September, 1856. Port Elizabeth, at present, numbers about 1000 houses and stores, with a population of between 8000 and 9000 inhabitants. The value of imports in the year 1857 amounted to £1,256,942; and the exports, consisting of wool, hides, horns, ivory, bees'-wax, sheep and goat skins, ostrich feathers, tallow, &c., amounted to £1,084,687, being a very considerable increase over 1856; this is exclusive of the wool, hides, and skins sent coastwise to Table Bay, and of the horses shipped to India on account of the Indian Government, which amount to a considerable sum.

"Those who have not seen Port Elizabeth since 1854 would scarcely recognise the main street, or, in fact, the town. The magnificent stores and public buildings which appear in every direction have quite changed the appearance of the place. Port Elizabeth may also congratulate herself on the rapid growth of trade and the immense increase of her shipping. Three or four years since it was a novel sight to see 14 or 15 vessels at anchor in the bay at one time—now there are seldom less than 20 vessels, frequently 30, and sometimes as many as 38 at anchor at the same time.

"The Eastern Province of the Cape of Good Hope, of which Port Elizabeth is the seaport, contains a very much larger extent of country than the Western Province, of which Table Bay is the seaport. Nearly all the Eastern Province is well adapted for sheep farming, and this will account for the exports being greater than those of Table Bay. The increase in wool and sheep is very great, and may be taken annually at 30 per cent.: the exports in wool alone amounted to upwards of a million sterling last year. This year, I suppose, it will not export less than 70,000 bales. It may therefore be well imagined that the port is in a position to afford considerable employment to shipping."

"Algoa Bay," says Captain Owen, in 1825, "is the name applied to all the country between Capes Recife and Padrone, or Padron. The former is a low point of land, composed of rocks and a few sand-hills: it appears to have been so named from the sea breaking constantly on a few scattered rocks about ⅓ a mile southward of it. Port Elizabeth is the best sheltered spot on the coast for 600 miles from Cape Town. The bay is open to all winds from South to East, and many vessels have been wrecked; a circumstance which may be attributed principally to having no seamen established there in charge of the port duties.

"The S.E. gales generally give a few hours' notice, in which time ships may either put to sea, or prepare to ride out the gale; but for this latter purpose, hempen cables and long scopes must be used, either with or without the chain cables."*

Again, Capt. F. Moresby, C.B., observes, "I consider Port Elizabeth at all times

* See p. 70, and also "Notes on the Physical Geography and Meteorology of the South Atlantic." By W. H. Rosser. p. 167.

equal to Table Bay, and for 6 months very far its superior. H.M.S. *Menai* lay off Port Elizabeth from April 29th until June 25th, 1820; during that period there were only two days we could not communicate with the shore; with a S.E. wind a swell rolled in, but never any high breaking sea. Ships have from time to time rode out the heaviest S.E. gales that have been known.

"Had I my choice of trusting my ship, for the year round, to Tor Bay, Palermo Bay, Table Bay, or Algoa Bay, I should without hesitation prefer the anchorage off Port Elizabeth."

Commander Fishbourne, R.N., has observed that "there are many statements current about breakers having been seen from time to time in Algoa Bay during S.E. gales, yet I believe others than those inserted in the charts have no existence, and that which has been mistaken for them is no doubt the effect of mirage. I had seen the appearance alluded to extend nearly the length of the bay, but examination and patient attention showed it all to be unreal, as it vanished by degrees as we passed along. It may be occasioned by the sudden change of temperature in the air, which, altering its capacity for moisture, causes an evaporation from the sea to take place to the lower strata, and less to the upper, which are therefore of unequal densities, and refract light in different degrees, producing the alternate appearance of white or broken water, and sea-green, and regularly as the particles are set in motion, intermingling by the passage of the sea, and whose surface at the same time being smooth but in motion, reflects the rays from different points to the eye, as it rolls along, giving the rolling-over appearance of a wave crest or roller. There may be a little sea at times, the effect of rain or overfalls, where there are, as here, currents and irregular soundings, but nothing detrimental to navigation; while, on the contrary, the palpable change from a very considerable cross sea in N.W. gales to smooth water, which immediately follows on passing into this bay, is quite remarkable, and renders it a good refuge in such gales, almost in any part from Recife to Bird Islands."

Mr. H. G. Dunsterville, R.N., says, in 1843, "Algoa Bay possesses a capital anchoring ground; as a proof of which, it may be observed that all vessels which have been wrecked on its beach have parted their cables, their anchors having always been picked up from the identical situation where they were first let go. A vessel, in my opinion, with a rope or coir cable, would ride out in this bay a S.E. gale longer than in any other bay on the coast; although there is a heavy swell setting into it with the S.E. wind, still there is not that short break of a sea as in other colonial bays."

Vessels calling merely through stress of weather, or for supplies, should anchor with the town bearing West, in about 7 fathoms. During a period of about 16 years, namely, since 1840, it is said that no vessel was ever known to drag her anchor, with common caution.* Here a vessel may ride out the most violent gales from the westward in perfect safety; the only wind that endangers the shipping is the E.S.E.,

* "The number of cases," says Com. Fishbourne, "of vessels parting their cables induced me to institute inquiries with a view to ascertain the causes. The result left no doubt upon my mind but that they generally arose from the attempt to ride out gales with very insufficient quantities of cable, since there was no room to suppose that their sizes were insufficient, as is evident from a comparison of the size of those that parted with those of ships of war."

Com. Fishbourne recommends riding with a long scope of cable, say 60 fathoms of chain and 30 fathoms of coir (additional next the hawse) in 4 fathoms water, and proportionably more in greater depths.

which rarely blows during the winter months, from May to August. The barometer always gives sufficient warning of a S.E. wind, which never comes on suddenly, but gradually increases—giving ample time for a vessel to get under way and put to sea.

The worst time in Port Elizabeth is in October and March, at the changing of the monsoon, or season when accidents occasionally happen through vessels being unprepared. Ships loading with wool are too light to go to sea, and are obliged to ride it out,—and if not well found, frequently part their chains.

It was stated in 1859 that the new breakwater at Port Elizabeth was well advanced, and that in the beginning of the year shipmasters would be able to land in their own boats.

Port Regulations.—1. In the case of vessels about to discharge or receive on board any considerable quantity of cargo, a convenient berth will be pointed out by the harbour-master, as close to the landing-place as the safety of the vessel and other circumstances will admit. The vessel must then be moored with *two bower anchors*, with an open hawse to the south-east, and especial care taken not to overlay the anchors of other vessels, or in any way to give them a foul berth. But all vessels not provided with anchors and cables according to Lloyd's scale of tonnage are to be anchored to the northward of the other vessels until so provided.

2. In the case of vessels touching for water and refreshments, they may ride at *single anchor*, but they must then anchor well to the northward, so as to prevent danger (in case of drifting) to the vessels moored; and it is particularly recommended, when riding at single anchor, to veer out 70 or 80 fathoms of chain; the other bower cables should be ranged, and the anchor kept in perfect readiness to let go.

3. Strict attention must be paid to keep a clear hawse (when moored), the more so when it is probable the wind may blow from the south-east; and whether at single anchor or moored, the sheet anchor should be ready for immediate use. The situation of the vessel must be taken by landmarks and the depth of water; and should any accident occur by which she may drift from such situation, or lose her anchors, the same must be notified in writing to the harbour-master.

4. It is recommended that vessels be kept as snug as possible, especially such as may have to remain some time in the anchorage, for the periodical winds blow occasionally with much violence. Top-gallant masts and yards should be sent on deck, but topsails, courses, &c., should be kept bent and reefed, until the vessel shall have become so much lightened as to leave her no chance of working out in case of parting, when they should be unbent and repaired, if necessary, and bent again as soon as there is sufficient cargo on board to render the vessel manageable under sail.

N.B.—Masters of vessels are especially warned of the danger of housing top-gallant masts, instead of sending them on deck; a practice which recent disastrous wrecks have shown to be very likely to endanger vessels, by precluding the possibility of the topsails being hoisted to enable them to beat out.

5. If it should come to blow at night, it is recommended that vessels should hoist a light at their main-top-gallant mast-head, although the signal may not have been made from the Port Office; so that, in the event of their parting, or drifting from their moorings, their position may be the more accurately pointed out to the harbour-master.

6. When it becomes necessary for vessels to veer cable in a strong breeze, they must always heave in again to their original scope, *immediately on the return of moderate weather.*

7. All signals made from the Port Office must be answered from the shipping, and strictly obeyed; and any vessel disregarding them will be reported to Lloyd's, as also to their owners.

8. In case of a vessel parting from her anchors, and being unable to work out, it is recommended to run her for the sandy beach to the northward of the town, keeping the headsails set even after striking, for the purpose of assisting in grounding the vessel firmly. No person should attempt to quit the vessel after she has taken the beach, until the life-boat arrives alongside, or a communication is established with the shore by means of Manby's apparatus, or otherwise.

9. On all occasions where it may be considered unsafe to land on the beach, a ball will be hoisted at the yard-arm of the Port Office flagstaff, and it is recommended that *ships' boats* should never attempt to land there, as it is seldom they can do so with safety.

Signals.—Vessels having Marryat's Code of Signals can make their wishes known to their agents, in blowing weather, through the Port Office. Vessels not having the code, can make the following signals with their ensigns:—

1*st.* *Ensign in the fore-topmast rigging.*	I am in want of a cable.
2*nd.* *Ensign in the main-topmast rigging.*	I am in want of an anchor.
3*rd.* *Ensign in the fore rigging.* . .	I have parted a bower cable.
4*th.* *Ensign in the main rigging.* . .	I am in want of an anchor and cable.
5*th.* *Whift where best seen.*	Send off a boat.

The following signals will be made to vessels that may be stranded, from the most convenient point:—

At night.—By means of transparent figures.

By day.—By means of white figures on a black board.

1. You are earnestly requested to remain on board until assistance is sent; there is no danger to life.

2. Send a line on shore by casks, and look out for a line by rocket or mortar.

3. Secure the line, bend a warp or hawser to it, for us to haul on shore, taking care to secure the warp well on board.

4. Prepare to haul on board the end of the warp, which we will send you by means of the line, and secure it well.

5. Life-boat will communicate at low water, or as soon as practicable; have good long lines ready for her, and prepare to leave the vessel; no baggage will be allowed in the life-boat.

6. Secure the warp to the lower mast-head, bowsprit end, or some other convenient place, and send a hauling line to us, that we may get you on shore by means of a traveller.

7.

8.

9.

10.

ANSWERS TO THE ABOVE.

By day.—A man will stand on the most conspicuous part of the vessel, and wave his hat three times over his head.

By night.—A light will be shown over the side of the vessel, where best seen.

GENERAL SIGNALS TO BE MADE FROM THE PORT OFFICE.

11.	*Union Jack over No.* 1, MARRYAT, *white, pierced blue.*	Prepare for bad weather.
12.	*Union Jack over No.* 2, *blue, white, blue* (*horizontal*).	Veer cable.
	Do. with a light over. — *Union Jack over the same, with a ball above.*	Veer to a whole cable.
13.	*Union Jack over No.* 3, *white and red* (*vertical*).	Send top-gallant-masts on deck, point yards to the wind, and see all clear for working ship.
14.	*Union Jack over No.* 4, *blue triangular, with white cross.*	Strike lower yards and top-masts.
15.	*Union Jack over No.* 5, *red burgee.*	Hoist a light during the night.
16.	*Union Jack over No.* 6, *triangular blue, yellow, red* (*horizontal*).	Heave in cables to the same scope as when first moored.
17.		
18.		
19.		

The above signals may also be made at night, by showing the numbers prefixed to them, in transparent figures. The *answer* will be a light at the peak.

By the Customs Ordinance, No. 6, 1853, section 21, it is enacted, "That the Master of any ship arriving at any Port or Place in this colony, whether laden or in ballast, shall, within twenty-four hours after such arrival, and before bulk be broken, come to the Custom-house for the Port or Place where he arrives, and there make due report in writing, of such ship, and shall make and subscribe a declaration to the truth of the same, before the Collector or other proper Officers of Customs at such port; and such report shall contain the particulars of the arrival and voyage of such ship, stating her name, country, and tonnage, and, if British, the port of registry, the name and country of the Master, the country of the Owners, the number of the crew, and how many are of the country of such ship, and whether she be laden or in ballast, and if laden, the marks, numbers, and contents of every package and parcel of goods on board, and where the same was laden, and where and to whom consigned, and where any and what goods (if any) had been unladen during the voyage, as far as any particulars can be known to him; and the Master shall further answer all such questions concerning the ship and cargo, and the crew, passengers, and voyage, as shall be demanded of him by such Officers of Customs; and if any goods be unladen from any ship before such report be made, or if the Master fail to make such report, or make an untrue report, or do not truly answer the questions demanded of him, he shall forfeit the sum of 100*l.*; and if any goods be not reported, such goods shall be forfeited."

The master should therefore take care to bring with him to the Custom-house the certificate of registry, together with the shipping bills, clearances, or manifests for the cargo, and also such other ship's papers as he may have concerning the ship, cargo, and voyage; and if a passenger vessel, the official list of the passengers, &c.

SUPPLIES, &c.—At Port Elizabeth every facility is offered to vessels wanting supplies or repairs. A shore boat waits upon the ships three times a-day, at the rate of two shillings per diem. Water is led to the beach in pipes, which is supplied to the vessels at 8s. a tun, including boat-hire; beef and mutton, 4d. per lb.; vegetables abundant and cheap; ship chandlery, carpenters, caulkers, and blacksmiths always to be obtained. Several vessels have been hove down here and caulked—cargoes are landed and shipped in efficient surf-boats—and should a stranger require a pilot, one will be sent off on the customary signal being made.

There are no port charges of any description.

A new water-company has recently been started, and a new boat, schooner-rigged, built at an expense of about 1500*l.*, has been launched; she is capable of carrying about 30 tons of water, so that it is hoped to be able to supply vessels with any quantity of water. It may also be mentioned, that some spirited individuals have purchased a hulk, and intend to use her for the purpose of heaving down vessels that require repairs; they have been to some expense, with the intention of making her thoroughly efficient for the object they have in view.

These and many other improvements which might be alluded to, will give a pretty good idea of the progress made at this port in the last few years, and will, perhaps, eventually be the means of securing for Port Elizabeth the position she is entitled to, as the only port of refuge from N.W. gales on the whole line of the Cape Coast.

In case of accident, there are life-boats, lines, rockets, and blue-lights stationed here, all under suitable regulations, so as to preserve life and property as much as possible.

BIRD ISLANDS.—These are a cluster of low rocky islands, the largest of which is only two-fifths of a mile long from north to south, and 33 feet high. This, which bears the name of Bird Island, is covered to the depth of several feet with an inferior kind of guano. No water is found on it save what little is left in the hollows of the rocks after rain. Eggs are abundant at seasons, and a very palatable vegetable, not unlike spinach to the taste, grows on it. Fish may be had in plenty. The only building upon it is a lighthouse 45 feet high, which stands on the south side of the island; it is of wood, pyramidal in form, and painted white, with a broad black band in the middle. It exhibits *two fixed* lights at 51 and 61 feet above high-water mark, visible in clear weather from a distance of 10 miles. These lights are 18 feet apart in horizontal distance, and when in one bear N.E. $\frac{2}{3}$ E. and S.W. $\frac{2}{3}$ W.; consequently, they lead over Doddington Rock, which bears from the lighthouse S.W. $\frac{2}{3}$ W. $1\frac{1}{10}$ mile. The position of the lighthouse is Lat. 33° 50′ 27″ S. and Long. 26° 17′ 13″ E.*

* In the Admiralty Sailing Directions for the south-east coast of Africa it is mentioned that "The upper lantern of the lighthouse on Bird Island has a shade on the north or in-shore side, which renders the light invisible between N. by E. $\frac{1}{4}$ E. and E. by N. $\frac{1}{3}$ N. from the lighthouse. This should not be, since it is of importance that the light be seen from the anchorage as well as by vessels in-shore; added to which, the intensity of the light to seaward would not be diminished by substituting a sheet of glass for the iron plate now there, and the light thus shown would be sufficient for what is required of it by vessels in-shore."

At about ¼ of a mile northward of Bird Island there are two islets named *Stag* and *Seal*, of which the latter is the westernmost. These at low water form one island, but at high tide boats can pass through the narrow channel separating them. From the west end of Seal Island, but separated from it by a very narrow boat channel, a ledge of rocks extends nearly half a mile, and is then succeeded for about a quarter of a mile by five black rocky islets, called the Black Rocks. From the lighthouse on Bird Island the outermost of these Black Rocks bears N.W. ⅓ W. 1⅓ mile, and vessels may generally avoid them without difficulty, their position being well shown by heavy breakers, except in the finest weather.

The edge of the reef connecting the Black Rocks with Bird Island is usually shown by breakers, and also that between the rocks and Seal Island.

At nearly half-a-mile north-eastward from Seal and Stag Islands, and nearly parallel to them, are three ridges of rock, the central of which, named *North Patch*, is above water; the others have a depth over them of 2 to 3 fathoms. There are soundings of 6 fathoms at ⅕ of a mile northward of these, which rapidly increase to 8 and 10 fathoms.

West Rock, Doddington Rock, and East Reef.—At a mile south-westward from Bird Island and the reef extending from that island to the Black Rocks, and almost parallel thereto, there are three very dangerous rocks, named West Rock, Doddington Rock, and East Reef; the last, as its name implies, being the easternmost. The bearing of these from the lighthouse on Bird Island is as follows:—West Rock, W. ⅓ N., nearly 1½ mile; Doddington Rock, S.W. ⅔ W., nearly 1¼ mile; and East Reef, S.S.W. ½ W., 1¼ mile. From West Rock the Black Rocks bear N.E. ½ N. about ¾ mile, and Doddington Rock S.S.E. ¾ E. one mile. From East Reef Doddington Rock bears N.W., northerly, about ½ a mile. As these reefs are all steep they require the utmost attention to avoid. From Doddington Rock the two lights on Bird Island appear in one.

West and Doddington Rocks are awash with the surface of the water, and East Reef probably has a depth over it of 2½ fathoms; close round them are soundings of 10 to 12 fathoms, which deepen rapidly seaward to 20 and 30 fathoms; hence, when passing them it is recommended to keep at least 3 miles from the lighthouse, by which a depth of 40 to 35 fathoms will be maintained. Their position is generally indicated by breakers. East Reef has an extent of nearly ¼ of a mile.

Northward of West and Doddington Rocks and East Reef, between them and Bird Island with its surrounding reefs, the bottom is very irregular, as the soundings vary from 5½ to 10 fathoms. During heavy weather, a tremendous sea rolls over the whole of this space, producing a surf truly terrific, the sea breaking in 8 and 10 fathoms water all around the group to seaward.

"The position assigned to a rock upon which it was supposed the *Doddington* struck is S.W. ⅔ W. nearly 6 miles from the lighthouse. This spot and the ground in its vicinity have been carefully examined and thoroughly sounded over, but no signs of rock or rocky ground could be discovered, the depth of water being 40 to 45 fathoms, upon a bottom of sand, broken shells, and decayed coral. In fact, no danger has been discovered outside a radius of 1½ mile from the lighthouse.

"Caution is necessary to give the Bird Islands group of dangers a wide berth in passing, for should a vessel get among them she might run into certain destruction while trying to avoid a seeming danger, since it is difficult to distinguish between

the sea that breaks in 10 fathoms and that which rolls over the reefs, and nothing of human build could hold together half an hour on any part of the cluster during a gale. Altogether, this is one of the most dangerous parts of the coast, especially to a stranger.

"The Bird Islands group affords anchorage on the northern side, but the holding ground is not good, and the bottom is uneven. The best anchorage is with the lighthouse in line with the North Patch, in 8 to 10 fathoms water.

"With S.E. winds, the lighthouse in line with the boat passage between Stag and Seal Islands, in 10 or 11 fathoms, is a very good spot for shelter, but should the wind come strongly from the westward, it will be found necessary to shift berth to the east, anchoring with the Black Rocks about in line with Stag Island, or a little open on either side of it, in from 8 to 10 fathoms. From this latter position H.M.S. *Geyser* drove to sea in a heavy W.S.W. gale, which shows the holding-ground to be bad, as she had 75 fathoms of cable out at the time.

"Vessels that load here with guano usually anchor in this last position, as it is more convenient for their boats to come off with cargo. It frequently happens that there is no landing, the rollers setting in during calm weather as well as in a gale. After these have subsided, care is necessary in landing, as the sea sometimes breaks heavily and unexpectedly right across the entrance to the space between the islands. The boat must be kept well to the eastward, clear of the shoal off the east end of Stag Island. The lighthouse in line with the first or western rock that shows on the white guano patch at the east end of Bird Islands, is the best line to pull in upon, as it leads between the breakers on the spit and those off the end of Bird Islands.

"In the vicinity of the Bird Islands no regular tidal stream was found, but a regular rise occurs. At the anchorage northward of the group the current sets in generally eastward, and at one time, during a strong westerly gale, it ran east at the rate of $1\frac{1}{2}$ knots an hour. It was, however, upon two other occasions of westerly gales, found setting to windward. It is very seldom that anything drifts on the islands, which is singular, especially as Woody Cape is covered with drift-wood and the remains of wreck."*

Point Padrone.—From Woody Cape the coast trends S.E. by E. $\frac{1}{4}$ E. about 8 miles to Point Padrone, and is very similar in appearance to that westward of the cape. Point Padrone is difficult to recognise when viewed from the offing, as there is nothing to distinguish it from the land in its vicinity except when seen from a berth close in with the shore. A bed of rocks, over which, at times, the sea breaks with great fury, projects from it nearly a mile to seaward. At 2 miles E. by S. $\frac{1}{2}$ S. from the point there is a low sandy point, off which, to the distance of a mile, heavy breakers have been observed. These are the only outlying dangers, the other part of the coast being approachable, even to the back of the surf, in 7 or 8 fathoms; the soundings decreasing regularly towards the shore.

From Point Padrone the coast trends 36 miles in an almost due East direction to Great Fish Point, immediately northward of which is Waterloo Bay, and is almost unknown, an examination not having yet been made of it. The general features of

* "Africa; South and South-east Coasts of." Published by the Admiralty, 1861.

the country are not dissimilar in appearance to those of the shore westward of the Bird Islands; it has, however, been stated that the sand-hills are higher, and are collected in great square patches. At 3 miles eastward from Point Padrone there is a hill 990 feet high; succeeding this, are the rivers Bushman, Kareenga, Kasuga, and Kowie, the latter leading to the town of Bathurst. The mouth of the Kowie River is in about Long. 26° 51′ E., and known among the coasters as Port Francis; we possess no description of it further than the following, upon which, probably, but little dependence should be placed.

PORT FRANCIS.—Port Francis is formed by the outlet of the river Kowie, a barred stream, but possibly deep enough at high tide to admit small craft. The river receives its waters into a sandy basin, from which it forces its way through a narrow channel on its eastern side, not wider at low water than 20 yards.* The surf was observed to break across a bar about a quarter of a mile from the entrance, but not violently. The water appeared deep close to the shore. Some rocks, named Cook, are situate about 2 miles E.S.E. from the entrance to the river, and from the appearance of the water were judged to be extensive. In 1847 there was a large house on the starboard side of the river, having near it a flagstaff.

The following remarks on Kowie River are by Mr. William Smith, surveyor, 1841. We find it impossible to recognise the various objects alluded to in the existing charts of the coast.

"The entrance to Kowie River is in about Lat. 33° 35′, and Long. 26° 45′. It lies about S.S.E. and N.N.W., so that vessels may enter at a proper time of tide with the wind from W. round by S. to nearly E.N.E. Should a vessel approach from the westward, with a westerly wind, she must haul up for the western pier, which, when carried out to the extremity of the rocky point, she may boldly approach to within a ship's length; and if she enters with a flowing tide (which she ought to do), should the wind be too much ahead of her to lie up the channel, she may take in all sail. If she cannot cast a warp on the pier, she may drop her anchor, and she will swing up the river, and the moment she passes the pier-head she is in smooth water, when she may either kedge up the river, with her own anchor trailing on the bottom, or she may be dropped up the river by a warp from the western shore. Should she touch in swinging round, there is nothing to hurt her but sand.

"If she comes in with a fair wind with the flood-tide, she must take care to shorten sail the moment she is between the piers, or she will be up to her berth before they will be able to stop her way. She will then require check-ropes to stop her, and must be dropped into Mary's Cove very carefully, as the tide at the entrance of the cove runs with great rapidity both ebb and flood.

"Should she come in with a north-easterly wind, she must enter with a flood-tide, and if she can only fetch into the channel, even with the western pier-head, should down all sail, and drop her anchor with a very short range of cable, so that if

* "The Kowie, the so-much desired port of Albany, forms a little estuary, where the tidal waters, entering by a narrow channel, spread over a flat of some acres in extent; above this the river is continued in many beautiful reaches, with, however, very little current, and the tide, which here rises about 5½ feet, ascends to a distance of 8 or 10 miles. The position of the Kowie for a port is an admirable one, and for a certain class of small vessels safe accommodation might perhaps be afforded at a very small outlay."—*Nautical Magazine*, October, 1854.

she trail round with her stern to the westward, she may not trail on the bank.

"Should any vessel come in with a fair wind and ebb tide, they need not be in a hurry to take in sail, as they will require it all to stem the ebb tide, which is very strong all the way from the entrance to Mary's Cove.

"These are general instructions for entering under sail, but should moorings be laid down off the mouth of the river, as it is intended, and a warp be stretched from thence to the pier, or to an anchor in the channel, then, if the wind be scant or right ahead, a vessel may boldly work up to the moorings, and either lie there for a fair wind, or warp into the river at the top of high water. As far as it is known, I believe, the roadstead is clear of hidden danger, both east and west of the river's mouth, at least to some distance, for a vessel to beat up to the moorings should the wind be off shore. Vessels coming from the east or west, running for the port in the night, or laying to, so as to be as near as prudent off the port in the morning, will be in some danger of the Fountain Rocks, and the only security at present for this is, I should suppose, attention to the lead and a good look-out, keeping in a certain depth of water beyond them.

"It is my opinion that steam-vessels, drawing six and eight feet of water, may enter this place when completed, at almost any time of tide, and run up right alongside the wharf or quay, which is intended to be erected in Mary's Cove, at once, without having to use their anchors at all; and, indeed, it will be seldom that any vessels will have to use their anchors in this port, if they are cleverly managed. One great advantage of this place is, that the passage from Mary's Cove to sea is one straight course, so that if a vessel have a fair wind to start with, it is fair the whole way out.

"I have no doubt that vessels drawing eight feet may enter at high water, spring tides, without any danger; and I expect that vessels of from ten to perhaps twelve feet water will be able to enter, but this will be a work of time; and as the importance of the port progresses, means will be made use of to increase the depth, and enlarge the capacity of the port. But at present the large quantities of sand, which are carried during the ebb tide, must necessarily leave a considerable deposit, causing the entrance to be much more shallow than it will be when the sand is all or nearly all out.

"I have said nothing about going out. All that is required is a good leading wind to enable the vessel to surmount the surf, and there will be nothing to hinder any vessel going out at a proper time of tide. The *Africaine* came in under every disadvantage. Her captain had never seen the place before; a dead calm, neap tide, and not high water either; but she went out in the most gallant style with the wind W. by S., under a good press of canvas, and in ten minutes from the time she cast off her moorings, she was out to sea clear of all danger, passing the rollers of the surf without one breaking over her."

From the Kowie River eastward to Great Fish River the coast has a more verdant aspect than it has between the former and Sunday River in Algoa Bay, the sand-hills being covered with luxuriant bushes; but there is not an inlet or curve of any sort that offers shelter for ships, and the surf breaks heavily on the shore. At about midway between Port Francis and Great Fish Point, some rocks close to the shore, named *Black Rocks*, form an excellent land-mark, which is distinctly visible from a

distance of three or four miles; they are three in number, the centre one is shaped like a wedge, the others are round at the top.

Immediately northward of the Black Rocks is the outfall of the river Monden, which is probably dry, except in the rainy season. This river is said to enter the sea by three channels, which are accessible only at high spring tides.

WATERLOO BAY.—Great Fish Point is estimated to be in Lat. 33° 30′, Long. 27° 7′ E., and northward of it, about three miles, is the entrance to Great Fish River; the coast then trends round to the north-eastward, and forms, with Great Fish Point, what is known by the coasters as Waterloo Bay. The landing at the river is only tolerable, and it is considered a most unfit place at which to discharge a cargo, there being almost constantly a heavy sea breaking on the beach. The bay is said to afford no shelter, and to be unsafe with any winds but those which come off the land.*

The position of Great Fish River may be easily known in fine weather by some distant undulating hills, which, on a N.N.W. bearing, appear between the ravines through which the river flows. The stream passes through an open country in the immediate vicinity of the coast, which is intersected with picturesque ravines, generally clothed with bushes. From the south-west side of the entrance a sand-bank projects within twenty yards of the north-east side, which contracts the channel; part of the ebb is thereby thrown back on the flat beach, runs to the westward, and finds an outlet close to the rocks on the western side. At this spot the water appeared deep, and the sea did not break successively for the space of ten yards, there being at times an interval of five minutes, when a boat could easily have landed; when, however, the sea did break in this space, it was with treble the violence of the constant rolling surf along the sand before the mouth of the river. The river at particular seasons swells to a considerable height, and then, from the violence of the stream, no vessel can possibly enter; but when the causes that filled its bed have ceased, it becomes a mere brook.

In 1847, H.M.S. *Apollo* anchored in nine fathoms off the mouth of the river, in what was considered by those residing at the port to be the best position for riding. The marks were, Great Fish Point W. ½ S.; Black Rocks under the flag-staff N.W. by W. ½ W.; landing-place N. by W.; and the eastern extreme of land East. While running for this anchorage from Kowie River, a strong current setting westward and W.S.W. was encountered; the rate was probably three knots an hour. In the same year Rear-Admiral Davies, Commander-in-Chief at the Cape of Good Hope, caused two anchors of 30 cwt. each, with suitable cables, to be laid down as single anchor moorings, with the view to decrease the damage and difficulty attending the communication with the shore, owing to the heavy surf which usually prevails upon the beach, and the rocky nature of the bottom snapping the cables of vessels waiting to discharge their cargoes.

From Waterloo Bay the coast trends eastward about 50 miles to East London, and includes within it several rivers, of which that named Keiskamma is the chief. All the rivers are fronted by bars upon which a heavy surf constantly breaks, and they are so much alike in appearance that it is difficult for a stranger to distinguish one

* Commander Radcliffe, R.N., describes the bay as being *no* bay, but nearly a straight line of coast. He also says that the bottom is rocky, and the anchorage unsafe.

from the other. The coast from Great Fish Point to Cove Rock, in Lat. 33° 6′ and Long. 27° 52′, is even and sandy, and offers nothing remarkable by which a ship's position may be ascertained.

River Becca.—The first river eastward of the Great Fish River is that named Becca. This stream is not more than 35 or 40 feet wide at the entrance, and the current outwards is at times very rapid, and the water apparently deep. When visited by Captain Moresby the breakers were not more than would be expected at a depth of 8 or 10 feet, and resembled those seen at the mouths of rivers known to be navigable; it may perhaps, therefore, be capable of admitting coasting vessels.

Keiskamma River.—The entrance to this river is about 24 miles eastward from the Great Fish River, and is about 1 mile wide from point to point, but widens within, and forms a basin or lake, which receives the inland waters; this basin is full only during the rainy season. Captain Moresby says, "It was nearly high water when I visited the Keiskamma, and the mouth was then about 70 or 80 yards across, and the stream was running South into the sea, strong and deep. Part of the stream was forced back along the shore, similar to that at Great Fish River, but the greater part ran close along the low rocky shore which forms the north-east point, and there, the breakers not being constant, afforded a hope that there might be a channel at high tides for small vessels; but the wildness of the coast, with a flat running out 1½ to 2 miles to seaward, precluded every reasonable expectation that this river could ever be opened to the most enterprising trader. It probably can never be the resort of large ships, the tides being too feeble, and of too little elevation, the highest tide observed by marks on the shore being only 7 or 8 feet, and at low water the river did not exceed 40 yards in breadth.

"The ravine through which it winds extends in a N.W. and S.E. direction, and the entrance may be known at sea, in clear weather, by a range of mountains in the interior, one being an insulated cone flattened at the top, with a high mountain a short distance eastward from it having three distinct elevations; when these mountains bear N.N.W. they are in one with Keiskamma River. The north-east point of land, close to which the river flows into the sea, is low and rocky, projecting from a remarkably green hillock, detached from the one where the bank begins to rise; the south-west point is a sandy hillock. Along the coast the sandy soil is covered with bushes, through which, at various places, the sand is visible."

From Keiskamma River to *Cove Rock* the distance is 19 miles. This rock is joined to the shore by a narrow sandy isthmus, over which the sea breaks heavily after southerly gales; hence it is easily recognised by vessels running closely along the coast from Waterloo Bay, as it then appears like an island, but when viewed from a distance in the offing it is not so easily distinguished; it is quite black and bare of vegetation, and forms a good mark for Buffalo River, 8 miles eastward from it. Hence to East London the country bears a different aspect to that westward of Cove Rock, as it is green, and grass grows to the water's edge. When abreast of the rock the houses of East London and two flagstaffs can be seen over Hood Point, a low projection of the coast 2 miles westward of Buffalo River.

Hood Point must always have a good berth given to it—a mile is perhaps as near as it should be approached. A reef extends from it, and outside this is a dangerous

patch upon which the sea generally breaks. The point and its surrounding dangers have not been examined.

BUFFALO RIVER.—The entrance to this river is in Lat. 33° 0′ 40″ and Long. 27° 58′ 30″, that being the estimated position of the flagstaff on its south bank. It is not very wide, the distance from shore to shore probably not exceeding $\frac{1}{6}$ of a mile, and the stream at low water has a breadth of less than a cable's length, and a depth of only 3 to 8 feet.

Light.—A lighthouse has been erected on the reef at the south side of the entrance to the river, at 391 yards E. by S. $\frac{3}{4}$ S. from the flagstaff previously mentioned. Its base is square, 12 feet in height, and constructed of rubble masonry; the superstructure is of timber, built in the form of a truncated pyramid, weather-boarded, and painted in alternate red and white bands. The light, *fixed*, is 45 feet above the level of high water, and visible in clear weather from a distance of 11 miles.

Vessels anchor outside the river in 7 to 10 fathoms of water at about $\frac{3}{4}$ of a mile E.S.E. from the flagstaff; the marks are:—Cove Rock, just shut in by Hood Point, and the River open. It is recommended when landing troops to lie with a good scope of cable out. The port office is in possession of Marryat's signals, by which any communication can be made. Should the weather be fine and the bar passable, the surf-boats will probably be at the outer buoy, from which to the ship it will be necessary to run a hawser, as the current at times sets so strongly that it is quite impossible to tow vessels against it. It would also be advisable to send a boat's crew to assist in warping the surf-boats from the outer buoy to the ship.

When the bar is passable, a red flag, with a white square in its centre, is hoisted at the lower flagstaff; when it is dangerous, it is hoisted to half mast; and when it is impassable, it is not hoisted. The bar should never be attempted by ships' boats, however smooth it may appear.

When approaching Buffalo River from the westward it is recommended to leave Algoa Bay at such a time that the latter half of the passage can be performed by daylight; but should the weather be fine, and Cove Rock not visible before dark, it would be better for a steamer to anchor off the coast in about 12 fathoms, with her steam up, or nearly so, in preference to lying-to for the night, as on one occasion H.M.S. *Penelope* was set 80 miles to windward against a strong S.W. gale in twenty-four hours. Mr. Luke, of H.M.S. *Boscawen*, recommends sailing vessels to secure a latitude half way between Cape Morgan, in Lat. 32° 43′, and Buffalo River, because of the constant south-westerly current.

When H.M.S. *Penelope* was at Buffalo River she anchored on one occasion with Hood Point bearing W. by S.; the upper flagstaff W. by N. $\frac{1}{2}$ N.; peak east of the river N.W.; and a sand-hill, a high peak bare at the top, N.E. $\frac{1}{2}$ N. In this position the vessel rode out two heavy gales from the S.W. at single anchor, with 100 fathoms of cable, and steam up, which is believed to be preferable to letting go a second anchor.

The *Penelope* always experienced a strong current setting along the coast in a westerly direction at the rate of from 2 to 4 knots per hour. This current probably strikes against Great Fish Point, which sets it off from the coast in a southerly direction. On the last visit of that vessel to Buffalo River, a very variable current prevailed at the anchorage; so much so that the ship swung round her anchor half a

dozen times in an hour. This, however, is an exceptional case, and may be attributed to the strength of the stream running out of the river after heavy rains and meeting the coast current at right angles.

It is the opinion of coasting captains that the westerly current runs at the rate of 5 to 6 knots an hour in strong westerly gales, and from 2 to 3 knots in moderate weather. An easterly current is seldom known, but on occasions it does exist, and only in very fine weather.

From Buffalo River, the coast runs easterly 27 miles to *Cape Morgan*, and includes several rivers, of which those named Kahoon, Geneka, Gonubie, Kwelegha, Bulugha, Kintza, Kwenugha, and Ikuko are the principal. At nearly $2\frac{1}{2}$ miles from East London there is a remarkable sand-hill, sufficiently high to be seen at a considerable distance; it is easily recognised by the bushes on its summit, which have the shape of a horse-shoe. Another conspicuous sand-hill is in Lat. 32° 52′. Cape Morgan is a low point, but the land behind it rises into a somewhat remarkable hill, covered with grass and bushes intermixed; it presents a similar appearance whether viewed from the N.E. or S.W.

RIVER KEI.—At about 2 miles N.E. by E. from Cape Morgan is the River Kei, a stream which brings down a great quantity of water during the rainy season. It has a very narrow entrance, and a depth at low tide of less than 10 feet; hence it is of but little commercial importance. Immediately within the sand-spit on the south side of the channel the river becomes wider and shallower. In consequence of the want of depth, only vessels of the smallest size can enter, all others being obliged to anchor outside.

In 1857, the entrance to the River Kei was examined by Mr. Skead, master, R.N., and described in the following terms:

"On the south bank of the river, and very near to the sea, there is an isolated hill covered with dark bush. From the foot of this hill a long, broad spit of sand stretches in a northerly direction to within about 100 yards of another dark bluff hill, situate at the north bank of the river. This narrow space is the river-mouth, at its narrowest and deepest part. From the dark bluff at the north point of entrance to the river, the shore extends in a south-east direction three-eighths of a mile, terminating in a low ledge of sunken rocks. Between this rocky shore and the breakers on the bar (which are 30 or 40 yards only to the southward) the channel into the river is formed.

"From the north extreme of the sand-pit, which partly forms the river's mouth, the breakers extend seaward in a S.E. direction nearly a mile. These breakers are caused by a bank, formed by a deposit of sand from the river which the tide does not carry away.

"While sounding the channel, the least depth found was 7 feet at low water, at the distance of about 30 yards from the rocky point which projects southward, midway between the outer point and the mouth of the river; but between that spot and the point 14 feet was found.

"From the anchorage a remarkable sand-patch is seen on the face of the dark hill on the north shore of the entrance to the river. This serves as a guide to the entrance, as the low ledge of sunken rocks above-mentioned is nearly in line with it, and it is from this point the river must be entered. If it is attempted to enter the river by the channel, a fair opportunity must be waited for, keeping a good look-out

on the rocky ledge, over which the sea breaks furiously; and, when a favourable chance offers, pull in, keeping the rocky shore so close as to leave just sufficient room for the oars. The breakers on the bar extend to the rocks only during heavy rollers, when, of course, the channel is impracticable.

"If landing is decided upon, and the bar prove impassable, it may be effected more conveniently than on any other part of the adjacent coast at a sandy spit, which is sheltered in some degree by a patch of sunken rocks southward of it. These rocks lie about a cable's length off shore at nearly a mile southward of the outer entrance of the River Kei, and the sea breaks violently over them.

"During flood tide the stream sets northward close in shore, and southward during the ebb. Care must be taken, in landing on the spit, that, while waiting for a smooth, the boat be not swept too far north, for it was found on one occasion, when a whale-boat of H.M.S. *Geyser* was swamped in endeavouring to pass through the surf, that the boat was not thrown on the spit by the rollers, but carried northward by the flood tide into the breakers on the bar, thence into the river, through the channel, and was not recovered until twelve hours afterwards. On the other hand, during the ebb tide, equal care is necessary that the boat be not drifted southward, where the surf is so much heavier and the beach rocky.

"S. by W. $\frac{1}{2}$ W. about half a mile from the river-mouth, and N.E. by E. $\frac{1}{2}$ E. rather more than a mile from Cape Morgan, there are three low, rocky islets, the southernmost and largest of which, called the Snag, is rendered conspicuous by a singular water-worn rock, which rises 20 to 25 feet above its level surface, and has the appearance of the inverted roots of a monster tree. All round these islets the sea breaks heavily; but this does not shelter the main beach, which is of little consequence, as it is all rocky.

"The *Geyser's* anchorage was in $9\frac{1}{2}$ fathoms, with Cape Morgan W.S.W.; Snag Rock, West; and the sandy patch at the river's entrance, N. by W.

"Without a regular surf-boat establishment to ensure the good order and security of the surf-warps and boats, there seems very little probability of this river ever being available as a landing-place, either for troops or merchandise.

"At nearly a mile from the shore, in the neighbourhood of the Kei, the current was found invariably to set to the S.W., at the mean rate of $1\frac{1}{2}$ knot an hour. At the first quarter ebb the stream from the river reached as far to the S.E. as the anchorage, where it joined the coast current, and both ran to the S.W. together. During flood tide the influence of the stream was not sufficient to alter the general direction of the ship's head."

From the River Kei, the coast continues 12 miles in a north-easterly direction to a low point, named in the charts *Sandy Point*, and is throughout of an inhospitable appearance, and extremely difficult to land upon in consequence of the heavy surf that almost constantly prevails. Sandy Point is low, and remarkable from having upon it three or four hummocks, and about a mile inland two large trees: also from arches formed by the sand near the cliffs, with dark bushes near the centre. *Bashee Point*, in or near lat. 32° 16′, has a ledge of rocks extending from it about $\frac{1}{4}$ of a mile, upon which the sea breaks heavily; a landing may be effected at this point with some difficulty, and there is also moderately good anchorage at a short distance from it.

Hence to the rocks called *Hole in the Wall*, in lat. 32° 3′, the coast maintains its north-easterly direction. At *Rame Head*, 18 miles beyond Hole in the Wall, and

situate in about lat. 31° 48′, there is, at about $\frac{3}{4}$ of a mile from the shore, a little westward of the head, a shoal of 8 to 10 fathoms; the headland itself is a bold rocky point, sloping gradually, and with a small rock at its extremity. Immediately under Rame Head is the small River Tata. At 5 miles northward of Rame Head is *Brazen Head*, a bold rocky projection of the coast, which, viewed from the offing, has the appearance of two densely-wooded points; thence to the river St. John, or Umzimvubu, the distance is 13 miles, and at nearly midway is a small stream named Gaziana.

RIVER ST. JOHN, or UMZIMVUBU.—This is a large and rapid river which falls into the sea in Lat. 31° 36′ 50″ and Long. 29° 33′ 20″, that being the geographical position of a house on the western side of the entrance. The breadth of the stream between the points of outlet is not more than a cable's length, and the bar is said to shift considerably after strong freshes from the river, and to vary greatly in depth, hence the assistance of local knowledge is necessary to carry vessels in; the usual depth on this bar is from 8 to 12 feet.

The entrance to the river St. John was surveyed in 1857 by Mr. F. Skead, master, R.N., assisted by Mr. M. P. Auret, R.N. The following remarks are based upon this survey:—

"The appearance of the land at the mouth of the river St. John from seaward is so remarkable, that any one having once seen it, or even a sketch of it, cannot fail to recognise it again. A lofty table-topped mountain, 1200 feet in height, appears to have been cleft to its base, leaving a wedge-shaped gap in the centre, through which the river flows to the sea. The upper part of this table-land, called St. John's Gates, is bare, stratified, sandstone rock, like Table Mountain, but at 200 feet below a dense forest covers the cliffs to the water on the river banks.

"The Gates are $1\frac{3}{4}$ mile from the entrance to the river, which is in the bight of a westerly indentation in the coast line, lately named Gordon Bay. Cape Hermes, the southern horn of this bay, is distinguished by a round, grass-covered hill, 420 feet above the sea; and the northern horn has a similar hill over it, but neither so large nor so high as the other. The depth of the bay, westward of a line joining these hills, is scarcely half a mile.

"At the left or eastern point of entrance to the river, there is a low grassy hill, named White's Hill, presenting to the south-west a face of dark cliff, fringed with a rocky reef. This is called Porpoise Rock. At 180 yards to the W.N.W. of the northern extremity of the cliff lies the outer point of a sand-spit, which at present forms the western point of the entrance to the river. This is at its narrowest and deepest part.

"From Cape Hermes the coast to the distance of 800 yards N. by W. is all rocky; it here joins a sandy beach, which runs north for 1300 yards, to the spit of the river entrance. At the junction of this rocky and sandy coast there is a small nook, called Paul's Cove, where the boats of H.M.S. *Hermes* effected a landing when the bar of the river seemed impracticable from the heavy surf upon it.

"The direction inland of the river from its mouth is N. $\frac{1}{2}$ W., one mile of which was sounded. The average depth of water found was 15 feet at low tide, and the width of the river averaged 300 yards, above a cliff on the western bank, called the Needles. This cliff rises N.W. by N. 3 cables' lengths from Porpoise Rock. Below

the Needles Rock to the river entrance, the water increased in depth to as much as 35 feet.

"The channel into the river over the bar at the time of the visit of the *Hermes*, in May, 1857, was found to be S. ½ E., 430 yards from Porpoise Rock; its probable width being 2 cables for a distance of 100 yards, over which a depth not less than 8 feet was found at low water. On both sides of this channel there are heavy breakers, and at the time of the arrival of the *Hermes* the sea broke across the entrance for four or five successive days. It must be noticed, however, that a strong gale from W.S.W. had been blowing some days previous to her arrival, which had raised the rollers far above their usual height.

"The bar of this river, like all such deposits, being subject to a change of position, small vessels which enter the river with merchandise are guided over it by a shifting mark upon the shore, at the back of a hut, which is built near the end of the spit, at the west point of the river-entrance. This hut at the time of the survey stood 150 yards from the spit-point, but the owner, Mr. White, who built it in the month of November, stated that, during heavy rains in the December following, the flood from the river cleared away the sand-spit to within 4 or 5 yards of the hut, leaving a depth of 12 feet water close to the edge of the sand. The channel into the river at that time changed its position to the rocky shore, which extends seaward from Porpoise Rock. The same authority also stated that, as the dry season advances, the channel moves to the westward until June or July, when it gradually begins to resume its former position near the Porpoise Rock, which it reaches in the month of December. In June, whilst the bed of the channel is to the westward, there is less water over the bar than at other times of the year.

"There is a trading station about 9 miles from the mouth of the river, to which place the vessel employed as a trader carries her inward cargo. A surf-boat and surf-warps are employed in communicating with this vessel when outside the bar.

"From the shortness of the stay of the *Hermes* it was not possible to report positively upon the capability of this river for navigation by small vessels, but a favourable impression in this regard has been left upon the minds of those officers who had an opportunity of seeing it. The accounts given by practical men who have crossed the bar at favourable times render it necessary that before any positive statement be made respecting it a regular series of observations should be carried out upon the effect produced by the outset during the rainy season, which prevails from October to April, when it is so great as to produce the changes in the direction of the channel already mentioned. A corresponding set of observations during the opposite season would enable a clear idea to be formed as to the facilities afforded by this river as a place of traffic for coasters. The mild disposition of the natives, and the presence of European traders, with whom they are upon friendly terms, are very favourable for carrying out the observations alluded to.

"Should the place ever become a trading port, two moveable beacons for leading vessels over the bar could easily be erected, and no difficulty experienced in recognising them, as their distance from the shoal part of the bar will scarcely ever exceed 800 or 900 yards.

"During the unfavourable part of the year for vessels entering the river, it appears, even from the accounts of those who have frequently crossed the bar, that except during very boisterous weather the river is always practicable for surf-boats, pro-

vided with the necessary warps and buoys. It has been also reported that a depth of not less than 12 feet is to be found as far as the trading station, 9 miles within the river.

"From the straight course of the river, which allows the ebb tides and freshets to exert their full scouring power in passing to seaward over the bar, it is more than probable that an artificial reef run out from Needles Point, as far as the outer bar, would tend to remove it by carrying the sand of which it is composed into deep water, where it would be borne away by the ocean current; the channel would then undergo no change in the different seasons. The eastern shore of the river being rocky, no artificial work is necessary to confine the water on that side. An inexhaustible supply of durable rock for such a purpose lies close at hand. Needles Rock itself, and the immediate vicinity, contains all that is required for such a work, and very little labour would be necessary for transporting the stone.

"There is plenty of good timber and abundance of limestone on the St. John.

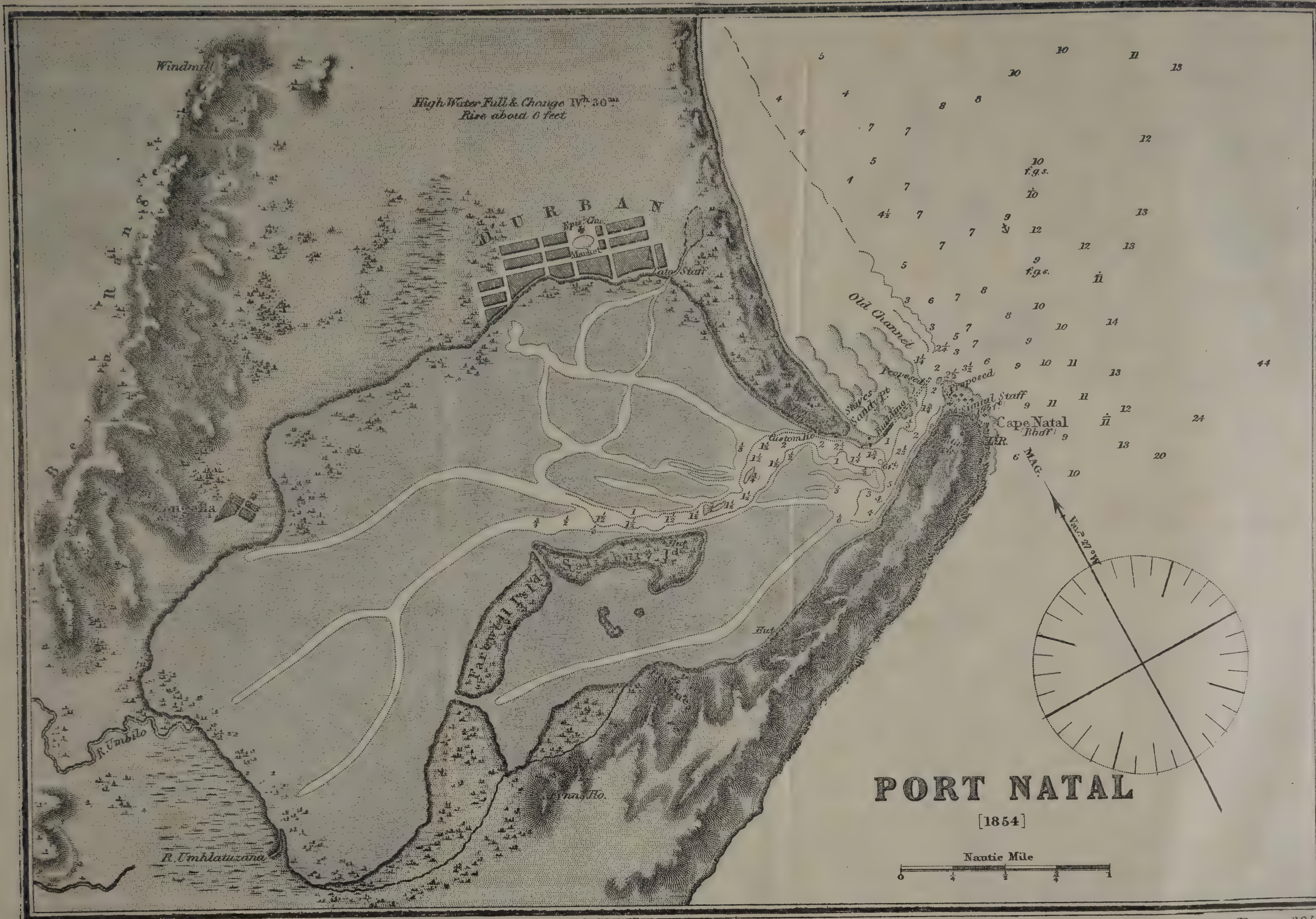
"The anchorage of the *Hermes* in 13 fathoms with Cape Hermes N.W. by W. $\frac{1}{2}$ W. $\frac{3}{4}$ of a mile, and Porpoise Rock N. by W. $\frac{1}{2}$ W. $1\frac{1}{4}$ mile, was found to be good, but a closer berth would probably be better. With Cape Hermes W.S.W. $\frac{1}{2}$ a mile, and Porpoise Rock N. by W. $\frac{1}{2}$ W. 6 cables' length in 8 fathoms, more shelter from the westward would be obtained; but in both positions the bay is exposed from E. by N., round southerly, to W. by N.

"Neither tide nor current was experienced at the anchorage, but close in-shore, during the flood-tide of the river, which runs regularly, a strong current was found setting to the S.S.W. along the sandy shore inside the breakers, and to seaward along the rocky shore in the direction of Cape Hermes. This has, doubtless, scooped out the sand at its junction with the rock, and formed Paul's Cove. The current should not be forgotten in attempting to land with a flood-tide, for upon one occasion it was found so strong that a cutter could barely stem it, and should a boat be swamped in the surf it would be almost impossible for the crew to reach the shore, and sharks are numerous and ravenous, both outside the surf and inside the river-mouth."

ALIWAL SHOAL.—From the River St. John the coast continues to trend north-easterly to Port Natal, and includes many rivers, of which those named Penchat, Beesan, Fongo, Slanyan, and Bloody, are the principal; all have bars at their mouths, and are represented to be inaccessible to vessels. This coast is almost unknown, and should consequently have a wide berth given to it, especially with a wind blowing strongly from the eastward. In Lat. 30° 15′ and Long. 30° 50¼′ there is a dangerous reef, known by the traders to Port Natal as the Aliwal Shoal. It is a mile in extent, has upon it a depth of only 2 fathoms at low tide, and is steep, there being as much as 15 to 11 fathoms close to it on all sides; at 4 miles eastward from it there is no bottom at 40 fathoms. It is $2\frac{1}{3}$ miles from the nearest point of land (a green grassy point), and the depth between averages 15 to 12 fathoms, the latter being immediately off the shore. From it Cape Natal bluff bears N.E. by E. 25 miles; the mouth of the Umcomass River North 4 miles; and the mouth of Bloody River W. by N. 4 miles.*

* The *Impulse* is said to have struck in 1860 on a reef 22 miles from the land, in Lat. 30° 19′ and Long. 31° 12′. The report is considered very doubtful.

Sheet 5



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PORT NATAL consists of a bay about 3 miles in extent, which is almost wholly dry at low tide. It is formed on its south side by a high wooded tongue of land, the summit of which is 250 feet above the sea at high water; as this bluff is the boldest land on this part of the coast, and the shore north of it is low for several miles, it is a very conspicuous landmark, and readily recognised from a distance. The north point of the bay is low and covered with bush; it is visible from seaward only when approaching it from eastward and north-eastward, as the high bluff of Cape Natal hides it from vessels making the bay from southward. The position of the Custom-house jetty on the north point of the bay is estimated to be Lat. 29° 52′ 48″ and Long. 31° 2′ 49″.

A sandy spit juts out from Cape Natal in a northerly direction $\frac{1}{6}$ of a mile, and nearly meets a sandy flat extending out from the shore of the north point of the harbour about half a mile. In the channel between this spit and flat there is usually a depth of 9 to 14 feet at low tide; but this depth cannot be depended upon, as strong easterly gales interrupt the flow of water from the bay and cause a deposit of sand on the bar. Efforts are being made to improve this channel, and it is hoped that large vessels will be able ultimately to enter.*

On the heights of Cape Natal there is a signal staff, and westward of this, close to the shore, are two beacons used as marks for the bar. There are also two beacons on Sandy Point, the north point of the bay.

The town of D'Urban is in the north part of the bay, and is a thriving place, as it is the only seaport town in the province of Natal. Supplies of all kinds required by vessels can readily be obtained from it, and fresh water is furnished to ships in the roadstead by means of large boats. The chief exports are wool and ivory.

Directions.—When approaching Port Natal from the southward, the coast in its vicinity will be observed to be of moderate elevation near the sea, and broken in several places by the mouths of rivers and streams; the hills inland rise to a considerable height, and the landscape strikes the visitor who is familiar with the white sands and stunted brushwood of South Africa, as one of great richness and fertility. Northward of the cape the coast is low, but the character of the country is very similar, although somewhat more thickly wooded.

The following remarks on Port Natal, by Captain Haddon, are extracted from the *South African Commercial Advertiser* of March 26th, 1836:—

"When leaving Algoa Bay steer out from the anchorage S.E. $\frac{1}{2}$ S. 40 miles, and then E.S.E. 160 miles; you will then be out of the stream, which sets at the rate of

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* The works in progress are under the direction of Mr. Milne, the colonial civil engineer. They were commenced in March, 1850, and their cost is estimated at 100,000*l.*, of which 10,000*l.* had been expended up to August, 1854, by annual grants. Their object is to confine within certain limits the body of water which is forced out by the ebb tide, and to bring its whole power to bear upon one channel, by artificially blocking up the two other tributary ones now in existence; to effect this, a solid stone pier is being run out from the sandy point on the north side of the entrance, towards the bar. The dimensions of the pier are 6 feet wide at top along its whole length, and 50 feet at the base close in shore, widening to 250 feet at the outer end; it will be 4 feet above the sea level at high water, and its total length will be about 2300 feet. On the opposite side of the entrance, and across the rocks projecting from the base of the bluff of Cape Natal, a wall is to be built, with a harbour light on its end. The width of entrance on the bar, between the ends of the piers, is intended to be 500 feet, and the quantity of water to pass through at each ebb tide is calculated to be sufficient to maintain a depth of water of 28 feet at high water spring-tides, assuming a tidal velocity of only 2 knots per hour. In August, 1854, about 1000 feet of the solid pier were completed. The material of which it is built is a red sandstone, procured from a quarry on the bluff nearly opposite the works. It is also, we believe, proposed to erect a lighthouse on Cape Natal.

3 to 4 knots per hour W.S.W., and have a little help from a current which sets N.E. (for in that part I was laid to with the *Dove* 36 hours, and only drifted 17 miles). Then shape your course to bring you into Lat. 29° 30′, and Long. 31° 30′ or 32°, when you will be north-east of Natal, and with a N.E. wind will soon be carried to it. The port is easily known from the northward, as you can see the entrance better than from the southward.

"If the wind is very strong from the S.W. you should only run to lat. 30°, and the same meridian as before; but do not keep too close in-shore, as the wind dies away very suddenly, and the strong current which inclines towards the shore may endanger the ship and lives.

"The Bluff Point is easily known by the back-land running in a sloping direction, and several flat tops notched here and there. It is also very thickly wooded, while the other shore is low, and consists of a sandy shore covered with bushes at a few yards from the beach.

"If the wind is from N.E. keep your ship under canvas, but with her head off shore, and anchor in 9 fathoms, with the bluff bearing S.W. ½ S. The bar consists of ridges. A S.W. wind causes the deepest water to be close to the reefs, and a N.E. wind makes its deepest in mid-channel. The surf is always worst at high water, and it is seldom that you can pass it in a small boat without risk. If there is not sufficient water at spring tides to permit your vessel to cross the bar, moor with open hawse to the N.E.

"The winds blow strongly at times, but seldom last longer than 24 hours, and then there is not such a heavy sea as at Algoa Bay, and the ground is equally good. The cutter *Circe* rode out the heaviest gale ever recollected there for four days.

"If compelled to discharge cargo outside the harbour, land it on the beach immediately north of the bar, because in fine weather and with off-shore winds it is very smooth for about half a mile northward of the bar.

"When crossing the bar with a vessel drawing from 8 to 10 feet, if with a good commanding breeze, let hands stand by the braces, as the tide is strong, and in shallow water a ship will not answer her helm quickly enough without the help of bracing about the yards as required. In coming in, the depth shoalens from 8 fathoms. It gradually shoalens to 2 fathoms on the bar, and with good way you have not time to get a second cast on it. You then gradually deepen to 7 fathoms, and when abreast of a large sand-coloured stone, haul sharp up and steer for the sandy shore, and hug it as closely as you can,—the tide will keep you from getting on it.

"A ship will not take any hurt by lying aground inside the harbour, it being as smooth as the London Docks even during the strongest winds. She should not, however, be a sharp-built vessel."

Port Natal was visited in 1843 by Lieut. Nourse, R.N., and described as follows:—

"The harbour, though apparently of several miles extent, is in reality confined to a narrow channel of from 14 to 20 feet depth at low water, the remaining part being sand-banks left uncovered when the tide is out. The islands in it are principally mangrove swamps. The almost invariable winds are from W. to S.S.W. and N.E. The strength of tide varies, at springs from 2½ knots up the harbour to 4½ where it is confined at the entrance.

"A reef runs off from the point of the thickly-wooded promontory which forms the southern shore; this reef forms one side of the bar, while the opposite side is a bank

of sand. The bar varies both in position and depth; from October to February, during which period the most rain falls, it is forced farther out and deepens, while in the dry months, when the N.E. winds prevail, the sand accumulates. We found a depth on the bar of 17 feet at high-water spring tides.

"When the bay is approached from the northward, the south point of Port Natal is most conspicuous, and by its projection a bay is formed, where a vessel may anchor with a S.W. wind in 9 fathoms, sandy bottom, the point bearing S.W. by S. 2 miles; the northern extreme N. 52° E.; and the extreme of the bay S. 70° W. Variation 28° 45′ W."

Port Natal was surveyed in 1854 by LIEUT. DAYMAN, R.N., and a chart of it, the result of the survey, was published by the Hydrographic Office of the Admiralty in 1856. The following remarks are based upon this examination of the bay by LIEUT. DAYMAN:—

"A vessel intending to enter the port and in want of a pilot, should anchor in the road in from 9 to 9½ fathoms, sandy bottom, when the flag-staff on the cape or bluff bears S.W. 1 mile. A signal being made, a pilot will be sent off from the port office, or, if the surf on the bar is too heavy, it will be communicated by signal from the flag-staff on the cape.

"The anchorage in the road is safe so long as the wind does not blow directly on the shore, which is seldom the case; but H.M.S. *Southampton* drove, and was nearly wrecked here during a gale from E.S.E., and it is recommended that, when the wind is inclined to freshen from that quarter, with a long swell and high barometer, a ship should go to sea as soon as possible. If, through any cause, the mariner should be forced to attempt the bar without a pilot, the following may be of service:—Keep the two staves on Sandy Point in one till the marks on the cape or bluff are in line, then haul up for the latter until the bar is crossed; after which, being in smooth water, the vessel may be anchored near the bluff-marks and wait for a pilot.

"A vessel drawing more than 10 or 11 feet should not attempt to enter the port without a pilot, nor at any other time than about high water.

"The bar of sand which crosses the mouth of the port is subject to change, being raised by the swell of the ocean, and scoured out by the force of the ebb, which has been found sufficient to deepen the water 12 inches in one tide.

"In the port, the velocity of the ebb at springs is about 3½ knots per hour, and between Sandy Point and the bar about 2 knots.

"In the roadstead outside the bar the stream of flood sets to the S.W., and of ebb to the N.E."

For a general description of the Winds, see page 70.

A Lighthouse is being erected on the bluff on the S. side of entrance to Port Natal; it will exhibit a *revolving* light, visible 30 miles.

Coast.—From Natal to Cape St. Lucia the coast trends E.N.E. *easterly* about 110 miles. There are many small rivers between the two points, but very little is known respecting them.

Morley Bank extends nearly the whole distance between Natal and Cape St. Lucia, and in some places fully 18 miles off shore; the soundings vary from 20 to 60 fathoms, bottom muddy, and of a lead colour. In Lat. 29° 31′ S., at 1¾ miles from the coast, the soundings are 27 fathoms. On the seaward edge of the bank, and about 13 to 18 miles from the shore, fish are abundant and good.

Coast.—From Cape St. Lucia to Cape Vidal the distance is 25 miles, bearing N.E. $\frac{1}{8}$ E.; the coast between curves inwards, and is low near the sea. From Cape Vidal to Inyack island the land trends N.E. by N. for 130 miles, and the coast is a continuous line of sandhills varying from 60 to 500 feet high.

Off Cape Vidal, at the distance of 5 miles, there are soundings in 27 fathoms; north and south of the cape, and at the same distance off shore, the soundings are deeper.

DELAGOA BAY, formerly called Lorenzo Marques, is a frequent resort of South Sea whalers. Its entrance extends from Cape Inyack to Cutfield hummock, a distance of 25 miles; but along this extent it is more or less obstructed by a bar, varying in depth from 7 to 2 fathoms at low water. The general breadth of the bay is 15 miles, with depths varying from 6 to 12 fathoms; the upper part is merely a shallow lagoon, intersected by two or three deep channels. Three large rivers empty their waters into this bay—Mapoota, English River, and King George. ENGLISH RIVER forms at its mouth a good land-locked harbour, and the bar has 14 feet at low-water springs, 25 feet at high-water springs; when inside, there is anchorage in 9 fathoms. These places require a special chart.*

Coast.—From Delagoa Bay to Zavora Point the coast trends eastward for the distance of 160 miles.

The Lagoa shoals are a continuation of the bar of Delagoa Bay, and extend 4 or 5 miles off shore; but there are also other shoals fringing the coast here and there. Off Zavora Point there is a bank of soundings southward and westward, varying in depth from 22 to 80 fathoms; but it is supposed that, in some places, the depths may be less.

From Point Zavora to Cape Corrientes (Lat. 24° 7½′ S. Long. 35° 30½′ E.) the distance is 26 miles N.N.E.-ly; the cape is bold, and has a conspicuous black islet off it, and the coast so far as known is safe to approach at the distance of a mile.

From Cape Corrientes to Cape Bazaruto the trend of the coast is still N.N.E.-ly, and the distance is about 156 miles. Between these points, Cape Wilberforce and Cape Lady Grey project slightly to the eastward; the coast line is irregular, and alternately bluff and low, with here and there dangerous outlying shoals of coral or sand, one of which (the Zambia) is nearly 4 miles off shore.

INHAMBANE BAY, a few miles north of Cape Wilberforce, is fronted by reefs and shoals, on which the water breaks, and the bar is 4 miles off shore. Inside, the bay appears to be clear of danger, with good holding ground; and the river Inhambane is an excellent harbour for small ships.† *Supplies* of cattle, poultry, fruit, vegetables, coffee, sugar, &c., may be procured here.

Coast.—From Cape Bazaruto to Sofola the coast trends Northerly, and then E. by N. from Sofola to Angoxa river, forming a considerable bend to the westward; in the intervening space are the mouths of the Zambesi and the river Quillimane. The coast line from the Quillimane to the Angoxa is fringed with islets and dangerous reefs and shoals, some of the latter being found 30 miles and upwards off shore, but gradually approaching it off Macalonga point, and thence northward.

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* See Admiralty Plan of Delagoa Bay, and of English River.
† See Admiralty Plan of Inhambane River.

Coral knolls are also found at intervals between Angoxa river and Mozambique, extending from 3 to 8 miles off shore.

MOZAMBIQUE harbour is a deep inlet of the sea $5\frac{1}{2}$ miles wide by 6 long; it is a safe anchorage, being protected by the island of Mozambique, and several islets, reefs, and shoals; it cannot, however, be entered without a special chart.* It must be borne in mind that the current on this part of the coast runs to the S.E.-ward from 2 to 4 knots. *Provisions*, and *water*, and *coals*, may be obtained here, but they are dear.

The coast in the vicinity of Mozambique is low, but to the northward of it, inland, Pao mountain, and the flat-topped Table mountain, in Lat. 14° 41′ S. Long. 40° 40′ E., are conspicuous objects to make.

Coast.—From Mozambique to Cape Delgado the coast is in some places low, and in others moderately high, with here and there an inlet or river entrance. North of Pemba Bay the outlying dangers are numerous, consisting of coral shoals and patches, with a few islets; some of these are from 10 to 20 miles off shore, and as the coast is generally low, it cannot be seen from outside the reefs.

CAPE DELGADO (Lat. 10° 41′ 12″ S. Long. 40° 39′ 51″ E.) is low, and not easily distinguished; it has a coral reef before it, a large portion of which dries at half tide.

Coast.—From Cape Delgado to Pouna point the coast trends N. to Keelwa harbour, and then N.N.E. Reefs and shoals along the coast are very numerous from Keelwa to Pouna point. There are also several river entrances, and off one (the Lufijy) stands Monfia Island, 28 miles long from N.E. to S.W., based on coral, but lofty, fertile, and visible 15 miles.

Latham Island and Bank is 23 miles from Pouna point; the island is 10 or 12 feet above high water, but totally destitute of vegetation; the bank extends from 1 to 2 miles off, surrounds the island, and is generally steep on its outer edge.

ZANZIBAR island is 46 miles long, and 18 miles wide across its broadest part; but its average breadth is from 9 to 12 miles. Its general height is 100 feet, though some hills at its southern part may be from 300 to 400 feet high. It is very fertile, and rich in spices and fruit.

The following observations on Zanzibar and Pemba are from the "African Pilot."† The reefs and shoals around and in the vicinity of both islands are too numerous to give in detail, but they are laid down on the Admiralty charts, with which it is necessary to be furnished when bound to either place.‡

Zanzibar Channel, although nowhere less than 16 and generally exceeding 25 miles wide, is rarely navigated by anything larger than the native dhows, except in the case of vessels proceeding to Port Zanzibar, and these keep between Zanzibar and most of the outlying reefs.

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* See Admiralty Plan of Mozambique Harbour.

† "The African Pilot for the S. and E. Coasts of Africa," by CAPTAIN ALGERNON F. R. DE HORSEY, R.N., an excellently arranged work—partly the result of the Captain's own observations and partly compiled from records in the Hydrographic Office. Every trader on the coast should have it.

‡ See Admiralty Charts:—E. coast of Africa, sheet x.; Zanzibar, S.W. coast and harbour; Cockburn, George, and Chakchak Ports.

The main channel is obstructed by reefs extending 10 miles westward of Zanzibar, and by others near the coast. There appears to be soundings everywhere, but sometimes exceeding 30 or 40 fathoms; and as this channel has not been minutely surveyed, it is probable that reefs exist of which we have no knowledge. If overtaken by night in the Zanzibar channel, every endeavour should be made to obtain an anchorage. The soundings appear to be more regular off the coast of the mainland than near Zanzibar, and anchorage may doubtless be obtained anywhere off the former.

Kizimkas Head, the southernmost point of Zanzibar, is a rocky bluff cliff, well wooded, and visible at 18 miles; it may be recognised when bearing N.N.W. 12 or 15 miles by a high tope of trees appearing above the others. The shore is lined with a reef which extends from half to one mile. There appears by the chart to be soundings with the deep sea lead at 2 or 3 miles from shore, and an 8-fathom patch (Kizimkas patch) on this bank, at 2 miles from shore. The use of the deep sea lead may therefore give warning of too near an approach, but it is recommended to give this point a good berth at night, on account of the strong northerly current, which varies from one to as much as four knots. Kizimkas head is in Lat. 6° 27¾′ S. Long. 39° 32′ 57″ E.

East Coast.—From Kizimkas Head the coast trends N.E. by E. 5 miles, then N. by E. 2 miles, and here the south-east cliff ends; its north extreme being in Lat. 6° 22′ S., Long. 39° 36′ 42″ E. From the south-east cliff the coast takes a N. ½ W. direction to Chuaka Head, a distance of nearly 20 miles, with a sandy beach all the way, covered by a reef which extends about a mile from shore, and which dries in places at half-tide.

Chuaka Head is the northern extremity of a small peninsula, about 1⅓ miles wide at Chuaka head; but at its gorge, about 3 miles south of the head, it is hardly half a mile wide. Chuaka head is of moderate elevation, and faced with cliffs. Lat. 6° 3′ 18″ S. Long. 39° 30′ 48″ E.

Chuaka Bay, bounded on the east by Chuaka head, is 4 miles deep and nearly 3 miles wide, open to the north, and very shallow—on which account even small vessels should not enter it without much care.

Coast.—From Chuaka bay to Ngoowy point the shore is unbroken, except by an intermission of cliff and sand beach, the whole covered by the coast reef, which (except Muemba reef) never dries.

Muemba Island is low, white, and sandy, with high trees on it, apparently casuarina trees. An extensive reef surrounds Muemba, except on its west side; this reef extends full 1½ miles to the north-east of the island, inside and to the westward of which there is apparently good anchorage. The eastern part of Muemba reef is full 2½ miles from the coast of Zanzibar.

There is said to be a clear ship channel between Muemba and the shore of Zanzibar, but too narrow to be taken by choice.

Ngoowy, or Hog Point, in Lat. 5° 42′ 48″ S. Long. 39° 20′ 39″ E., is the northern extreme of Zanzibar; it is a low wooded point, covered by a reef which extends about a mile from shore. This reef shows, and the point may be rounded at 1½ miles distance.

H.M.S. *Gorgon* anchored in 12 fathoms under the lee of the reef off Ngoowy point for the night, during the southerly Monsoon. H.M.S. *Helicon*, in rounding

Ngoowy point from the eastward at 1½ miles' distance, got a few casts of 7 and 8 fathoms; the soundings then deepened to 25 fathoms.

Leven Bank.—H.M.S. *Leven* anchored in 8 fathoms about 4⅓ miles off Ngoowy Point, with the east extreme of Zanzibar S. ½ E., and the north extreme of Moina S.W. ¼ W.; the angle subtended between them being 53°. H.M.S. *Menai* anchored on the bank in 6½ fathoms. It does not appear to be extensive, and has very deep water all round it.

Moina is a small wooded island to the northward of Tumbat. Its north point is in Lat. 5° 45′ S. Long. 39° 15′ 18″ E.

A reef extends to the northward of Moina nearly three-quarters of a mile. It may generally be rounded by the eye, but otherwise give the north point and west side of Moina a berth of a mile. You will be to the westward of Moina reef when the west coast of Tumbat is all open.

Tumbat Island is 5 miles north and south. Its eastern side is 2 or 3 miles from Zanzibar, but its south point is not more than a mile from the cliffy point between Kokotoni and Oswawemba.

The western shore of Tumbat is a rocky cliff, which is quite clean, there being deep water close to it, and good anchorage may be obtained at from half to one mile west of the island in 20 to 24 fathoms, mud; taking care to give the south-west end a good berth, to be clear of Kokotoni sand.

Tumbat bank, with 5½ to 7 fathoms on it in places, commences 1½ miles W. of the N. point of Tumbat, and probably extends to Alek patch, a knoll with 7 fathoms.

The Chart already mentioned (p. 339) shows all the known dangers in Zanzibar Channel, and they must never be approached too closely.

PORT ZANZIBAR.—Pilots do not usually come off to ships approaching Zanzibar, but will probably do so if you obtain an anchorage outside one of the passes and make the signal for one. As a rule, not much confidence is to be placed in Arab pilots, but they are, perhaps, better at Zanzibar than at other places.

Directions.—*From the Southward*, vessels bound to Zanzibar must be careful not to be set past the island by the northerly current, which near Latham bank sets from 1 to 2 knots, or even 3 knots, during the Southerly Monsoon. If you have not sufficient daylight to reach an anchorage in the Zanzibar channel, it is best to endeavour to obtain an anchorage on Latham bank, which may safely be run for, even at night, on most bearings, and by starting from whence in the morning, you will have all the day before you to reach Port Zanzibar.* But, if not intending to anchor on Latham bank, keep well inside it to make the land about Pouna point, the land about there and at Kinbijy head being visible at a considerable distance.

Having made Kizimkas head, steer to pass a mile to the westward of Kwaly and Kiseewa islands, and after passing the latter, Choomby will be seen.

Directions.—South Pass: To enter by this pass, steer for Choomby, bearing about N., opening it on the starboard bow so as to pass at a distance of a quarter of a mile or more. When past Choomby, bring it to bear S. by W., and keep it so until the Ukomby islands just touch S. 25° E., and Maja (a low rocky cliff) bears about East, then alter course to N.N.E. ½ E., and when Chukwany (the northernmost cliff) bears about E.S.E., shape a course to round Shangany point, at a

* *See* Admiralty Plan of Zanzibar, South-west Coast, and Port Zanzibar.

quarter of a mile or as convenient, hauling into the anchorage to the northward of the fort.

Or:—When past Ariadne shoal, bring the western extreme of the town on with the centre of Chapany island, N. by E. $\frac{3}{4}$ E. With these marks on, you will pass to the westward of Choomby and of Maja shoal, and to the eastward of South Larkbree shoal, but rather close to the two latter. Observe, however, that, owing to the distance and occasional mirage, it is not easy to distinguish Chapany when approaching from the southward.

The French survey of 1858 gives the following mark for South pass:—Keep a small white house with porticos near the beach on with a minaret (the only one) in the town, N. 24° E. This mark, however, appears to pass very close to Maja shoal.

In going through South pass it is advisable to look out aloft for South Larkbree shoal, as it dries at low water, and is generally visible at other times. Maja shoal does not show well except under favourable circumstances.

Directions.—*From the Northward:* When bound to Zanzibar from the northward, run for Ngoowy point, which may be rounded at $1\frac{1}{2}$ miles; then round Moina at a mile, and steer to pass Oswawemba point at half a mile; from whence the coast may be followed southward at half a mile distance or more, but do not increase your distance from the coast to more than 3 miles, on account of some dangerous 2-fathom spots in the vicinity of Baudin rock.

Directions.—English Pass: This is the best known and safest of the northern approaches to Port Zanzibar. To enter this pass from the northward, and being half a mile or more from shore, steer for Mtony (a small village with a large white house in the centre of it), until the white round tower of the fort, or its flagstaff, comes on with the centre of a white house, bearing S.W. $\frac{1}{4}$ S., when steer on this course; and as soon as the three islands are in one, or begin to come open of one another, haul more to the westward, about W. by N. $\frac{1}{2}$ N., to avoid a shoal which extends 3 or 4 cables from the Zanzibar shore when Chapany bears about N.N.W.

Two *white nun* buoys have been placed about a cable apart off the eastern extreme of Chapany Spit in 7 fathoms, in lieu of the one which used to be there; but the maintenance of the buoys in their proper position must not be depended upon; on two occasions of visiting Zanzibar in the *Brisk*, we found no buoys.

For a stranger the best guide is the eye, from the fore-yard, passing the islands when in one at one-fourth of the channel's width from the Zanzibar shore, and when the islands begin to open increasing your distance from shore to half a mile.

The bank on the Zanzibar side of English Pass extends farthest from shore when Chapany bears N.N.W.; but here, at its farthest point, the 5-fathom line does not extend more than 4 cables from shore. The 2-fathom line is about $1\frac{1}{2}$ cables from the beach, when the three islands are in one bearing N.W. by W.; and about 3 cables from shore, when the west extreme of Chango bears N. 50° W., and the east extreme of Chapany N. by W.

Directions.—French Pass: The passage between Chango and Kebandiko, called French pass, is only 2 cables wide. No marks can be given for this, except to keep nearer to Chango than to Kebandiko. At low water the channel is well defined, the reefs being then almost awash, and in many parts dry.

Directions.—Grand Pass: The only known dangers between Chango and

Bawy besides the respective reefs of those islands are Morgan patch, Chango knoll, and the 3-fathom knoll off Bawy.

To enter by Grand pass bring the centre of Bawy to bear S. 39° W., if intending to pass on the east side of Morgan patch, or S. 16° W., if intending to pass on its west side; and when Chapany opens to the southward of Chango steer to pass one mile to the eastward of Bawy, bringing the north extreme of Bawy to bear N.W. by W. $\frac{1}{2}$ W., which will lead clear to the southward of Chango knoll: you may then steer for the anchorage.

The **Anchorage** off the town of Zanzibar is well protected by the surrounding islands and reefs. You may anchor anywhere; the *Brisk* laid about 3 cables from shore in 10 fathoms, with Shangany point S. $\frac{1}{2}$ E.; west extreme of Bawy W. by N. $\frac{1}{2}$ N., and the middle of Chango N. by W. $\frac{1}{4}$ W.; this is a convenient berth for men-of-war. Merchant ships and the Zanzibar men-of-war, generally lie farther to the eastward. Vessels should moor here on account of the tides and varying winds.

The Town of Zanzibar is situated on a low peninsula of sand, which is almost insulated by the shallow dhow harbour on the east and south sides of the town; this harbour dries to a considerable extent at low water.

The fort is not very conspicuous amongst the houses, and cannot be distinguished at all when approaching from the southward. The streets of Zanzibar are narrow and dirty, and thickly populated.

Trade of Zanzibar.—The consular reports received at the Foreign-office in 1865 include one from Lieutenant-Colonel Playfair on the trade of Zanzibar in 1863. The Custom-house returns exhibit only the exterior trade of the island of Zanzibar, and do not include the lucrative trade carried on at Lamoo and other northern ports of the Sultan's dominions. The British trade at Zanzibar is carried on almost entirely through India; it amounted in 1863 to about 200,000*l.* in imports, being nearly two-thirds of the aggregate amount of the imports into Zanzibar from all foreign nations; the exports were about 300,000*l.* in value, half of them to India. Piece goods, of the value of $839,716, were imported in the year 1862-3. At one time the market was largely supplied with piece goods of American manufacture, but since the war, English cloth has taken its place, and American merchants have even imported Manchester goods from America into Zanzibar. Beads manufactured at Venice are imported, and taken into the interior of Africa, where they form one of the principal articles of barter for slaves and ivory. Cowries are collected on the mainland, brought to Zanzibar in native boats, and exported to the west coast of Africa by Hamburg merchants, and to India by Indian traders; but this trade is falling off, owing to the more extended use of the precious metals as currency. Oil and oil-seeds of the value of $158,116 were exported in the year 1862-3. There is an increasing trade in sesamum seed, which has within these few years been grown on the east coast of Africa, and is exported to France and Hamburg. About 7,000,000 lb. of cloves, valued at 85,000*l.*, are generally produced at Zanzibar, and they form a considerable article of export; but the crop was a failure in 1863, and it is hoped it will soon be superseded by sugar, for which the soil of Zanzibar is eminently adapted; labour is cheap, ground rent very low, and every condition seems to exist for securing an ample return for capital sunk in a sugar factory. The revenue of the Sultan is derived mainly from the import duty of 5 per cent., which is farmed out to an Indian firm at $190,000 a year; but there is a subsidy payable

to Muscat State, and as the income really leaves no margin at all for works of internal improvement, and the Sultan is debarred by treaty from imposing any export duties or harbour dues, or increasing the import duties, he has, at Colonel Playfair's suggestion, had recourse now to a modified system of land-tax—a charge of two pice, or $\frac{3}{4}$d. a year, on every mature cocoa-nut tree (the estimated annual produce of which is a dollar), and also 5 per cent. of all the cloves grown in his dominions. These taxes are estimated to produce about $40,000; the people have hitherto been entirely exempt from taxation, and this amount will hardly be felt. This report says nothing of the slave-trade except in its commercial aspect. It is gratifying to find that the imports of slaves show a marked decrease year by year.

Supplies.—No spars or material for ship-building can be obtained here. Bullocks, sheep, fowls, sugar, coffee, and rice, are to be obtained, and fruit is very abundant. A small quantity of salt provisions and biscuit can generally be purchased.

Coal may sometimes be obtained at Zanzibar. The red mangrove wood is very plentiful on the adjacent islands, and answers tolerably well for steaming purposes. The wood boats brought us 40 tons in a week, but might have supplied it more rapidly had they been pushed to do so.

Water.—There are two watering places for ships, one at the old palace of Mtony, 2 miles N.E. of the town; and the other (the best one) about 2 miles to the northward of Mtony, and one mile beyond Cliff-end point.

Water taken from Mtony always produces sickness: it is worthy of remark that formerly the crews of all vessels, after watering at Zanzibar, have been subject to dysentery and fevers; but good water may now be obtained at Bubooboo, great care having been taken to bring it down pure. It passes through several troughs and clearing pools, and falls into the sea from two large wooden spouts, at a convenient height for getting either casks or a boat underneath, according to the tide.

Directions, *leaving* **Zanzibar.**—In the southerly Monsoon it is best for sailing ships to go in by the South channel, and out by the North channel, and the reverse in the northerly Monsoon; but if it be desirable to go out by the South channel during the southerly Monsoon, leave in the afternoon, when the wind is well to the eastward, and in two tacks you will be outside South pass, and had better anchor for the night.

When proceeding out northward, during the southerly Monsoon, start early and anchor off Tumbat, starting again with the land wind the following morning, by which means you will get a good offing before the sea breeze sets in. It is useless to start with the sea breeze on account of the strong northerly current, which will probably oblige you to bear up through the Pemba channel, as H.M. ships *Eurydice*, *Narcissus*, and several others have had to do; even under steam you must make a liberal allowance for the current, which sets about N.N.W. into the Pemba channel. During the southerly Monsoon the simplest way to go out is through the Pemba channel, taking day time for this navigation: even if bound to the southward you will not lose more by this course than by trying to beat out to windward of Pemba.

For Seasons, Winds, and Climate, see Part I. p. 71.

PEMBA ISLAND, known by the Arabs as Ul Huthera, or Green Island, is about 35 miles long, N.N.E. and S.S.W., by 9 or 10 miles wide, including the

islands on the west side, which form the harbours. It is of moderate elevation, not being more than 200 feet above the sea in any part; of coral foundation, but covered by a most productive soil, yielding luxuriantly every kind of produce, especially rice of the finest quality; this island, in fact, being the granary of the neighbouring coast. There is excellent ship timber on the island.

Said Point (the southern point of Pemba), in Lat. 5° 29′ 18″ S. Long. 39° 42′ 9″ E., is about 25 miles from the north end of Zanzibar. The south end of Pemba is surrounded by a dangerous coast reef, with no anchorage off it. The current to the southward of Pemba sets into the Pemba channel at the rate of 2 or 3 knots.

The East Coast of Pemba is rather low, and should be approached with care at night, but there do not appear to be any dangers beyond the coast line of reef, which nowhere extends more than a mile from shore, and is steep-to. We approached the shore within two miles without any appearance of soundings.

The current in December off the east coast of Pemba was three-quarters of a knot northerly, but it much exceeds that during the southerly Monsoon.

The West Coast is lined with a succession of islands, which enclose fine sheltered ports between them and the main island; these islands and reefs appear to be quite bold on their west sides.

CHAKCHAK BAY.—Good anchorage may be obtained to the southward of Mesal island without entering any of the ports, but if intending to bring up here, or to enter Chakchak, take care not to be set past your port by the northerly current. In H.M.S. *Brisk*, when approaching from the southward, we rounded Soteman and Brisk islands and the reef on which they stand by the eye, the reefs showing well, and anchored in 7 fathoms with Mesal island N. 7° E.; the south point of Chakchak creek N. 51° E.; Cocoa-nut point S. 19° W.; and Brisk island S. 56° W. This is a good smooth anchorage, but there appeared to be several shoal sand patches inshore of our anchorage, and the inner part of this bay has not been examined; care is therefore requisite if proceeding to the eastward of the above position.

Port Chakchak,* the southern one of the several ports, is a safe harbour, but the soundings are inconveniently deep for anchoring in some parts. H.M.S. *Espiègle* anchored in 9 fathoms, with Mesal island N.W. by N. A spit, with not more than $2\frac{1}{4}$ fathoms on it, runs out from the Pemba shore more than $1\frac{1}{2}$ miles when Mesal bears N.W. $\frac{1}{2}$ N. The village is situated up a creek about E. by S. from Mesal island. The shores of this creek are lined with reefs, but there is a narrow and deep channel. The watering place is up this creek.

Mesal Island is about three-quarters of a mile in extent east and west, by rather more north and south; its S.W. point is in Lat. 5° 15′ 42″ S. Long. 39° 40′ 27″ E. A reef extends nearly a mile S.W. by S. from the south point of Mesal, but the discoloured water shows the extent of it.

PORT COCKBURN, and also Port George, to the northward of it, are apparently clean, with good depths for anchoring in places, but rather deep water in others. These ports must be approached from the southward through Port Chakchak, unless there be any good pass among the several gaps between the islands, of which we are not aware, as there are no soundings given in the gaps in the plan. Mr. R. A. Newman, Master of H.M.S. *Espiègle* in 1822, states that there is no passage

* *See* Admiralty Plan of Cockburn, George, and Chakchak Ports.

out between the islands, but his report is previous to the sketch survey of LIEUTENANT NASH.

Off **Kegomachy Point,** the north-west extreme of Pemba, there is anchorage on the western side abreast of a small sandy bay: the north side of the point must be given a wide berth to clear a reef which extends more than 2 miles, on which there is a long spit of sand, which dries at low water. Kegomachy point is in Lat. 4° 52′ S. Long. 39° 43′ 51″ E.

Cape Hay, the north-east extreme of Pemba, appears to be fronted by a continuation of the coast reef from the east coast, and according to the chart this reef ends a mile or less to the northward of Cape Hay, forming an anchorage to the westward of the reef. This anchorage, called Port Wanyeeka, appears by the chart to have good depths in it, and to be well sheltered during the southerly Monsoon, but we have no information about it. Cape Hay is in Lat. 4° 54′ 12″ S. Long. 39° 52′ 57″ E.

Pemba Knolls. — The north side of Pemba forms a shallow bay about 9 miles wide between Cape Hay and Kegomachy point. This bay has numerous anchorages for dhows during the southerly Monsoon, but it apppears to be full of dangerous reefs, the northernmost of which, called the Pemba Knolls, extend 5 or 6 miles from shore. OWEN describes these as a complete labyrinth of coral rocks.

A bank of soundings extends 10 or 12 miles to the northward of Pemba, where anchorage may be obtained in some places to the northward of Pemba Knolls, but this bank must be approached with caution, as it scarcely appears to have been examined at all.

Pemba Channel.—The navigable part of this channel is contracted by the Waseen reefs and North Head reefs to 25 miles at the south end, and 15 miles at the north end, but between Pemba island and these dangers it is said to be all clear with no soundings.

It is not recommended to run through this channel at night, even with a commanding breeze, as the strength of the current is very uncertain, and the wind frequently drops after midnight. But if obliged to bear up through this channel when unable to pass out to the southward of Pemba, (which frequently happens to ships leaving Zanzibar with the sea breeze,) take a good departure from the south end of Pemba, and keep nearer to the island shore than to the main, the former being the boldest. CAPTAIN MORESBY, in 1822, when passing through Pemba channel, reports having got soundings in 7 fathoms when the north end (Kegomachy point?) of Pemba bore S. 20° E., and immediately before and afterwards no bottom at 80 fathoms, but it is not stated at what distance from shore.

The CURRENT sets about N.N.W. into the Pemba channel, and afterwards appears to set right through, rather inclining to the main. In August we found it running between 2 and 3 knots, but it not unfrequently exceeds this in strength, causing a great ripple near the island shore, which gives a false appearance of breakers.

The Waseen Reefs consist of a line of sand and coral reefs parallel to the shore, and at a distance of 4 or 5 miles from it; these have good depths inside them, but are nearly unfathomable on their seaward side. Of the North Head reefs we have no information, but the chart places them 7 or 8 miles from shore at the north end of Pemba channel.

The Coast of the main inside Pemba is low, but well wooded, and apparently fertile. The shore is sandy, with, in places, a small intervening cliff of coral; but it is unsafe of approach, on account of the Waseen reefs before described. Although the coast is low, there is a range of hills in the background, and occasionally in the distance may be seen curiously isolated mountains, which present a remarkable contrast to the general flatness of the country. One of them, called Waseen peak, is about 2500 feet high, and can be seen distinctly from Pemba island.

Except in one part, where the coast is a kind of putrid marsh, the shores are lined with villages which are always conspicuous by a lofty grove of cocoa-nut trees, in the midst of which they are built.

Along the remaining part of the coast there are a few towns where trade is principally carried on by native dhows, and rarely visited by European vessels, except cruisers. South of the Equator there are Mombaza, Melinda, Lamoo, Patta, and the Dundas or Juba islands; at some of these, bullocks and provisions may be procured, but water is generally scarce and brackish. This part of the coast is more or less fringed with islets, reefs, and shoals, but not extending a great way from the main. North of the Equator to lat. 2° N., the coast is free from outlying dangers, and appears to consist of sand-downs, covered here and there with a stunted vegetation. Warsheek bank in Lat. 2° 20′ N. extends $1\frac{3}{4}$ miles from the shore, and Ternate shoal in 3° 15′ N. projects 2 or 3 miles from a low point of land destitute of distinguishing marks.

The Coast between Ternate shoal and Assoad point is generally low, with soundings close to the shore.

ASSOAD POINT, or Rás Assoad, or Black point, in Lat. 4° 34′ 12″ N., Long. 48° 0′ 39″ E., is a point of low black cliffs projecting from the sand hills over the beach.

RAS AWATH, in Lat. 5° 32′ 48″ N., Long. 48° 39′ 57″ E., and 71 miles from Assoad point, is fronted by a reef. The coast between these headlands forms a slight concavity, and has soundings of from 20 to 40 fathoms at from 6 to 9 miles from shore.

The Coast from Awath point to Cape Khyle, about 146 miles, is generally low, and has soundings of 18 to 10 fathoms at several miles from shore, and 25 to 40 fathoms at 9 miles or more.

From Cape Khyle to Cape Mabber, 125 miles, the coast is a rocky shore, from 200 to 400 feet high. Soundings may be obtained all along this part of the coast at some distance from shore, until you come to a point about 24 miles southward of Cape Mabber, where there is an indentation which is very little known.

RAS MABBER (or Cape Stand-off) in Lat. 9° 29′ N., Long. 50° 50′ E., is fronted by a reef, and the land in its vicinity is generally low.

The name of the cape indicates the customary practice of the Arab coasters bound to the northward during the southerly Monsoon, who always stand well off from this point in order to round Cape Hafoon.

Coast.—From Rás Mabber to the south-east point of Rás Hafoon, the distance is

63 miles. Soundings of from 20 to 30 fathoms appear to extend a considerable distance from shore in the bight between these capes.

RAS HAFOON (or Cape Orfui) is a peninsula of table land about 8 miles north and south by 10 east and west, from 400 to 600 feet high, rising from the sea in steep cliffs, and joined to the main land by a narrow low sandy ridge covered with bushes; it is bold of approach on all sides. On its eastern face there are soundings of 20 fathoms close to the shore, deepening to 50 fathoms at 5 miles distance. The eastern extreme of the Cape is in Lat. 10° 27′ 48″ N., Long. 51° 21′ 51″ E.

From the north-east cape of Hafoon to Cape Jerdaffoon (Guardafui or Rás Asir) the distance 82 miles, is free from outlying dangers, and safe to approach by the lead, the soundings shoaling generally from 100 fathoms at 15 miles to 10 fathoms at one mile from shore; but it is deeper than this off the headlands, and shallower in the bays.

CAPE SHENAREEF is a bluff headland rising from the sea in four steps to a height of 2500 feet, and is about 11 miles S. by W. $\frac{1}{4}$ W. from Cape Jerdaffoon. Cape Shenareef is generally called by the natives Ras Jerdaffoon, which name is probably indiscriminately applied to the whole promontory.

CAPE JERDAFFOON, or Rás Jerdaffoon, (also called Rás Asir, and Cape Guardafui,) the easternmost point of Africa, is in Lat. 11° 50′ 40″ N., Long. 51° 19′ 39″ E. It is a precipitous rocky cape 900 feet high.

Soundings deepen from 20 fathoms near the cape to 70 and 120 fathoms at 18 miles to the eastward, where the bank appears to terminate; but to the northward of Jerdaffoon the bank of soundings does not extend more than 2 or 3 miles.

There is good anchorage with southerly winds in 6 to 14 fathoms, sandy bottom, at a mile from shore, and about 3 miles to the westward of Jerdaffoon. The natives will bring bullocks, sheep, and firewood here from the fertile valley of Wahdy Tohum, which is about 7 miles to the southward of Jerdaffoon. Excellent water may also be obtained from there, but the carriage is expensive.

The trading places north of the Equator are, Brava, Marka, Magadoxa; and Hafoon (North and South) Bays; but along some part of the coast the natives are not to be trusted. Water is scarce and brackish until you approach Hafoon and Ras Jerdaffoon.

ISLANDS AND SHOALS IN THE MOZAMBIQUE CHANNEL.

EUROPA ISLAND,* about 5 miles E.N.E. and W.S.W., by about 3 miles wide, is from 50 to 80 feet high, and its centre in Lat. 22° 22′ 30″ S., Long. 40° 24′ 9″ E. (Owen.) It is sandy, and for the most part covered with dwarf trees, bushes, and rushy grass, with here and there a few small *casuarina* trees. The

* Europa Island is the Bassas da India of Horsburgh and the late E.I. Co. Commanders, and the Baxos da Judia of the Portuguese discoverers. The name Bassas da India is now applied to the Europa *rocks* or *shoals* of Horsburgh. The change was made at the suggestion of Capt. Owen, R.N., who surveyed the coast of Africa, &c.

anchorage is unsafe ; vessels may let go their anchor on the edge of the coral reef to leeward of the island, but without room to swing in case of a shift of wind. The island is uninhabited, but there are some large goats and plenty of fine turtle to be procured.

The east side presents low perpendicular cliffs, and is apparently steep to—with no reef off it and no anchorage; off the N.E. point, however, the reef extends half a cable, and there are 12 to 18 fathoms a cable beyond it (Mr. R. Beecroft, R.N., 1825).

On the north side the coral flat, which dries at low water springs, extends about a quarter to half a mile from shore; the reef terminates towards the N.W. point of the island, where there is a small extent of steep beach, with good landing in moderate weather. The coral flat is steep to, but it shows well towards low water; at other times it must be approached with care, for there is no bottom at 30 fathoms within a cable's length. Inside the coral flat the shore forms a deep bight, with a large lagoon at the N.E. end of the island, extending nearly across to the south shore; it is not more than 4 or 5 feet deep at low water, and abounds with fish (Hon. H. Rous, R.N., 1818).

The west side is rocky, with a considerable surf on the beach; it is apparently steep, but landing may be effected in places between the rocks.

The N.W. point is sandy, with low bushes; it runs off shoal and rocky from 1 to 2 cables; a ship might anchor a little to the southward of this point in 7 to 11 fathoms, but close to there is a depth of only $2\frac{1}{2}$ fathoms.

The south side of the island is low, and being the weather side is unsafe; and the reef on the S.W. side has no soundings close to it, and must not be approached (Mr. R. Beecroft).

BASSAS da INDIA (or Europa rocks), discovered by the E.I.Co.'s ship *Europa* in 1774, is a dangerous reef of rocks 7 or 8 miles in diameter; the east end being in Lat. 21° 29′ S., Long. 39° 40′ 39″ E.; the N.W. end in Lat. 21° 26′ 30″ S., Long. 39° 32′ 39″ E.; and the south end in Lat. 21° 32′ S. (Owen.) The greatest extent is from E.S.E. to W.N.W. Rocks of various sizes, looking like hay-ricks, extend to the N.E., while its S.W. extreme consists of a long sandbank, dry at low water; the sea breaks heavily all around it, and is very dangerous to approach.

PILOT SHOAL was discovered by Captain White,* of the American whaling barque *Pilot*, who places it in Lat. 21° 10′ S., Long. 38° 57′ 30″ E.; he states it had not more than 3 fathoms on it, that he could see the bottom very distinctly, and at the same time observed several patches to windward which looked much shoaler: the whole extent of the shoal appeared to be from $1\frac{1}{2}$ to 2 miles, and it bears N.W. by W. $\frac{3}{4}$ W (? true) from Bassas da India, distant 35 miles. The existence of this shoal has since been confirmed by several captains, but uncertainty respecting its precise position makes it the more dangerous when passing N.W. of the Bassas da India.

JUAN de NOVA ISLAND, $2\frac{1}{2}$ miles long, is low, flat, and sandy, with a covering of shrubs and bushes; it should be carefully avoided at night, as the first

* Nautical Magazine, 1850, p. 339.

intimation of its proximity might be the noise of breakers; its centre is in Lat. 17° 3′ 30″ S., Long. 42° 47′ 27″ E.* (Owen). Off the east end a shoal extends 4½ miles, on which the sea breaks heavily; and off the west end a reef with breakers is variously estimated to extend half a mile to 1¾ miles. The island appears to be the rendezvous of aquatic birds, which are also very numerous in its vicinity.

According to Mr. Beecroft, R.N., a bank with depths of from 8 to 12 fathoms extends 3 or 4 miles on the north side of Juan de Nova, and affords very good anchorage during the S.W. Monsoon under the lee of the eastern end in 7 to 10 fathoms, clean sandy bottom, at 1½ or 2 miles from shore: this bank shows well by the discoloration of the water; it terminates abruptly from 12 fathoms in most places, and its boundary is everywhere coral.

Juan de Nova bank is apparently quite distinct from the Great Pracel bank, with a space of about 20 miles between their margins.

CHESTERFIELD ISLAND, near the northern part of the Pracel bank, is (its centre) in Lat. 16° 17′ 30″ S., Long. 43° 55′ 33″ E.—(Owen.) According to Capt. D. Cowan,† it is about a mile in extent (north and south), and 15 or 20 feet above the sea. The N.W. end of the island consists of a black mass of rock, with a reef extending about a mile from it; on the west side a reef extends about 3½ or 4 miles, on which a heavy sea breaks, consequently this side may be considered very dangerous to passing ships. The south end and east side appear clean and bold; approaching from the southward the soundings are very regular, shoaling from 13 fathoms at 6 miles to 10 fathoms at about 1 mile off; bottom, sand and mud.

Chesterfield island may be avoided at night by keeping off the Pracel bank; soundings of 15 to 22 fathoms have been found to extend several miles in all directions, and to the westward of the island as far as 40 to 45 miles.

GRENOUILLE BANK.—The *Grenouille* navigating the Mozambique channel from Nossibe to Menabe, January 26th, 1851, being in Lat. 15° 42′ S., Long. 44° 31′ E., sounded in 4¼ fathoms, bottom of broken coral and plainly visible; the ship's course was W.S.W. by compass, and the bank extended 12 miles, east and west, on which were soundings of 4¼, 6, 8, 14, and 29 fathoms.‡ This may possibly be a part of Chesterfield bank, and caution is requisite in approaching the vicinity.

Caution respecting the **West Coast of Madagascar.**—It is dangerous at all times to make too free with the West coast of Madagascar, especially between Lat. 22° S. and Cape Ambre, the north point of the island; from Cape St. Vincent (or, say Lat. 22°) the coast is fringed with reefs and shoals, which, as far as 20° S., extend in places 15 to 20 miles seaward; then come the Barren Islands, where the bank of soundings extend fully 20 to 25 miles off shore; more to the northward still, on the parallel of Juan de Nova and Cape St. Andrew—shoal casts of 12 and 18 fathoms are found 45 and 75 miles respectively from the main—this is the Pracel bank.

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* Mr. Beecroft, R.N., in 1825 made its Long. 42° 49′ E.
† Mercantile Marine Magazine, vol. x. p. 163.
‡ Annales Hydrog., vii. p. 6–7.

LAZARUS BANK.*—In 1737 the *Dorset* is said to have obtained soundings of 12 to 18 fathoms in Lat. 11° 56′ S., Long. 41° 45′ E. (or 1° 10′ E. from the main), reporting that to the southward it appeared much shoaler; in 1757 the *Edgecote* had soundings in 10 to 12 fathoms in Lat. 12° 4′ S., Long. 41° 55′ E. (or 1° 12′ E. from Quirimbo); and in 1784 the *Raymond* sounded in Lat. 12° 13′ S., Long. 41° 10′ E. (or 33′ E. of Cape Delgado). These are among the early records of a bank in this part of the Mozambique channel.

In 1833 the *Reliance* grounded on a shoal which the master placed in Lat. 12° 23′ S., Long. 41° 20′ E.; and he describes it as being from 15 to 18 miles across, in a north and south direction.

In 1857 the French barque *Charles et George* grounded on a bank of gravel and coral in Lat. 12° 12′ S., Long. 41° 50′ E., and by laying out an anchor in 17 feet water she was hove off.

In 1859 the barque *Empress*, when in Lat. 12° 3′ S., Long. 41° 35′ E. at noon, observed no appearance of soundings; ship's course true South, at about 2 knots per hour. At 1 P.M. water discoloured, sounded in 7 fathoms; bottom of coral, plainly visible in white and dark patches, with an appearance of shoal water all round; carried this depth about 1½ miles; at 1h. 45m. P.M. in 15 fathoms; at 3h. P.M. in 15¾ fathoms. At 5h. P.M. in 17 fathoms, strong ripplings, Lat. 12° 13′ S., Long. 41° 35′ E.; at 6h. P.M. 35 fathoms, white and red coral, with broken shells. At 7h. P.M. no bottom at 45 fathoms in Lat. 12° 17′ S., Long. 41° 35′ E.

In 1864 the French ship *Duc de Malakoff*, being in Lat. 12° 9′ S., Long. 41° 20′ E., a bank was observed and soundings taken in 19 fathoms, the ship steering true South about 2 knots an hour; in a short time soundings were again taken, which gave 13 fathoms, and decreasing; for two miles the soundings then continued at 10½ fathoms, bottom of broken shells, and white and brown coral, the shoal extending some distance east and west; at noon, being in Lat. 12° 16′ S., Long. 41° 21′ E., the depths had increased to 16 and 19 fathoms, and shortly afterwards to 27 and 30 fathoms; this bank appeared to be steep-to on its north and south sides.

CAPTAIN OWEN, R.N., searched for these shoals and could not find them.

In 1851 H.M.S. *Penguin*, in Lat. 12° 16′ 30″ S., Long. 41° 32′ E., struck soundings in 17½ fathoms, coarse sand and broken coral; from thence she proceeded S.S.E. 6 or 7 miles, with 17 to 19 fathoms; then no bottom at 100 fathoms.

In 1855 H.M.S. *Frolic*, when a little to the westward of a position marked "doubtful" on the chart, was suddenly surrounded by a shoal of sharks, and immediately afterwards coral bottom was distinctly visible; a cast of the lead gave 10 fathoms. Rounding-to, anchored in 9 fathoms, when the ship tended to a S.W. current of 2 knots. Ahead (N.E.) and on each bow, the boats found 10 fathoms for about a quarter of a mile distance; astern and on each quarter the depth decreased pretty regularly to 7 fathoms at about 1 mile from the ship; one boat in a more southerly direction had casts of 6 fathoms, and two of 5½ fathoms. Lat. 12° 9′ 12″ S., Long. 41° 23′ 39″ E. (or 0° 35′ east of St. George island, Mozambique). From this spot weighed and stood S.W., and shoaled very gradually from 9 to 7 fathoms in running 1 mile; thence the soundings increased regularly to 20 fathoms, very

* DALRYMPLE; HORSBURGH; Naut. Mag., 1840, p. 513; Annales Hydrographiques, 1858, 1860, and 1864; Mercantile Marine Mag., 1859, p. 188; COMMANDER M. S. NOLLOTH, R.N.; CAPTAIN W. I. S. PULLEN, R.N.; Naut. Mag., 1857, p. 143.

shortly after which there was no bottom in 100 fathoms, when the patent log showed 1·8 mile from the place of anchorage.

In 1861 H.M.S. *Cyclops*, when steering S. by W. ½ W., struck soundings in 17 fathoms, then 9 fathoms, and immediately anchored in 10 fathoms, hard sand, Lat. 12° 3′ 28″ S., Long. 41° 25′ 31″ E. The water was very clear, and the bank appeared to extend far in all directions when seen from aloft; thence the *Cyclops* weighed, and proceeded S.W. ½ W., obtaining soundings as follow—9, 8, 10, 13, 14, and 25 fathoms; having run 6·2 miles from her anchorage, no bottom was got at 100 fathoms.

These observations tend to prove that the dangerous part of the Lazarus bank, as far as at present known, lies between Lat. 12° 2′ and 12° 20′ S., and between Long. 41° 20′ and 41° 40′ E.; over this area the depth varies from 7 to 20 fathoms; but there is one dangerous patch of 3 fathoms or under, probably in Lat. 12° 10′ S., Long. 41° 23′ E.—(a mile or two more or less in both lat. and long.) The lead will most probably give ample warning of this dangerous patch during the day, if a good look-out is kept; but, during the night, large ships would do well in avoiding the locality. Should, however, their reckoning mislead, then as soon as they strike soundings, it would be advisable to round-to and anchor until daylight.

On most charts Lazarus bank is delineated as extending from Lat. 11° 48′ S. to Lat. 12° 16′ S., and between Long. 41° 29′ E. and 42° 22′ E.—thus omitting the most dangerous part, which is more to the westward by 7 or 8 miles; as regards the more easterly portion, H.M. ships *Lyra*, *Wasp*, and *Gorgon* have crossed and re-crossed it, sounding frequently with no bottom at 40 and 50 fathoms; in 1862 H.M.S. *Gorgon*, in particular, ran from Lat. 11° 54′ S., Long. 41° 42′ E., to Lat. 12° 16′ S., Long. 42° 7′ E., trying for soundings without obtaining any at 60 or 80 fathoms.

KAUNITZ BREAKERS.—The ship *Kaunitz*, in 1791, is said to have seen breakers at a distance of 9 miles, the land to the westward being visible at the same time; these breakers were *said to be* in Lat. 11° 3′ S., Long. 42° 25′ E. If for Lat. 11° 3′ S. we read 12° 3′ S., we have the position (approximately) of Lazarus bank; but nothing is known of Kaunitz shoal in the position assigned above, although H.M. cruisers on the east coast of Africa have frequently traversed its vicinity.

VAILHEU SHOAL, to the westward of the S.W. point of Comoro, is in Lat. about 11° 49′ S., Long. about 43° 16′ E., with the (*visible*) extremes of Comoro N. 31° E. and S. 76° E.; a town on the mountain side N. 64° E.; and Mantzeza hill (sometimes called Round hill, or the ploughed mountain) East, distant about 10 miles.

Of the existence of this shoal there can be no doubt; the *Charles et George*, a regular trader in the Mozambique Channel, has frequently reported it; it has been seen by H.M.S. *Brilliant*, and passed over by the *Sparrowhawk;* it was also reported by H.M.S. *Nerbudda*, which ship observed heavy breakers in about the above assigned spot, but night coming on, with a heavy sea, they had no opportunity of further examination. Mr. Sunley, H.M. consul for the Comoro islands, also reports that he has passed over this shoal.

The shoalest spot is reported to be from 4 to 6 fathoms, but there may be less water. Of its extent, nothing is known with any accuracy; accounts vary in stating

it to be from 2 to 12 miles long. Captain Polkinghorne, who passed over it in H.M.S. *Sparrowhawk* in 1826, says the western extreme bore N.W. by W. or W.N.W. from the S.W. end of Comoro. The *Sparrowhawk* appears to have been steering S.E., and obtained from 6 to 4½ fathoms; the water was of a light green colour, and showed at 4 or 5 miles' distance from the foreyard.

Thus there can be no doubt Vailheu shoal is dangerous in places for very large ships; and report says vessels have been nearly lost here when returning from Bombay to England. Comoro native accounts, however, describe it as not dangerous for vessels of ordinary size.

Large ships passing through this part of the Mozambique channel at night should, on approaching the parallel of the south end of Comoro, keep to the westward of the 43rd meridian, in order to avoid the vicinity of Vailheu shoal.

Manoel Pimental records a shoal, but no breakers, 9 miles from the S.W. point of Comoro; this shoal is 15 to 18 miles N.W. and S.E.; the south part at half-flood has 6 fathoms on it, and at the N.W. point 4 fathoms. Nine miles off Comoro island would place this shoal half way towards Vailheu shoal—they are probably one and the same.

COMORO ISLANDS.*

The COMORO ISLANDS, four in number, lie at the north end of the Mozambique channel, nearly midway between the north extreme of Madagascar and the African coast; they are all high, and of volcanic origin; and with the exception of Mayotta, are generally safe of approach—with clear passages between them.

The reefs and shoals between these islands and the coast—on each side—are dangerous, and require caution when in their vicinity, but they are sufficiently apart from one another to render the navigation of this part of the Mozambique channel perfectly safe, with ordinary precaution and a good look-out.

COMORO (also called Angazecha), is the northernmost and least known, although the largest and highest island of the group; it is about 35 miles north and south by about 12 miles east and west; but, possessing no harbour, nor a single good anchorage, it is rarely visited.

Comoro Mountain is situated at the south part of the island, its highest part being about 8 miles from the southern extreme. The mean of our observations gave its height to be 8526 feet. The summit of this mountain is smooth and dome-shaped, rising so evenly from the sea on its south side as to give a deceptive idea of its height when close to; its stupendous height will show better at the distance of 25 or 50 miles, and in clear weather it may be seen at over 100 miles distance. This mountain is the more remarkable from the absence of any land of equal height on the eastern coast of Africa, and also on account of its being the highest mountain in the world *as compared with the size of the island,* although we believe to this day unnoticed by geographers in their comparative tables of mountains.

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* The remarks on the Comoro Islands and their vicinity are derived from the observations of Capt. Owen, R.N.; Capt. F. Moresby, R.N.; Commander M. S. Nolloth, R.N.; Mr. J. Richards, R.N.; the French Surveys; Vicomte F. de Langle, of the French Imperial Navy, "Campagne de la *Cordelière*;" and especially Capt. G. F. R. de Horsey, R.N.; Horsburgh; the Mercantile Marine Mag.; the Nautical Mag.; the Jour. of the Roy. Geog. Soc.; and the Annales Hydrographiques.

Comoro mountain, like the whole island, is volcanic, and eruptions are very frequent. In 1858 the lava flowed out of the side of the mountain into the sea on the west coast, between the towns of Maroni and Itzanda, which, being only 3 miles apart, thus narrowly escaped destruction.

The natives of Comoro are Mahometans, of Arab descent, with an intermixture of Madagascar blood; altogether a fine, tall race, and hospitable.

The South Coast of Comoro is rocky and steep-to. The S.E. point, in Lat. 11° 53′ 23″ S., Long. 43° 35′ 21″ E., has a rugged hill at its extreme,—the termination of an irregular ridge descending from the smooth-topped mountain.

The S.W. point is low, but rises gradually and without a break to the top of Comoro mountain. Round hill, two or three miles to the northward of the point, appears as an island from the distance, showing over the low extreme of the S.W. point. There is a village close to the sea a little to the eastward of the S.W. point.

The East Coast is said to be bold-to, with neither soundings nor anchorage off it. A small island with a reef outside it, but apparently close to the main island, is stated to be about 5 miles southward of the N.E. point.

The North Coast is rocky, high, and apparently safe; but the N.W. point must be avoided, for it is surrounded by reefs apparently extending 3 or 4 miles (or more) from shore; here is the town of Mouchamouli, $1\frac{1}{2}$ miles westward of which, in 30 or 35 fathoms water, at two cables from the breakers, is an anchorage visited by the French man-of-war *Prudente*, in 1843; but it cannot be recommended. It is opposite a small sandy beach.

On **the West Coast,** which is said to be bold of approach, there are two anchorages, Maroni and Itzanda, and several villages. Approaching Maroni from the S.E.-ward, Round hill (or Mantzeza) will be seen over the low extreme of the S.W. point of Comoro; it is about 3 miles N.N.W. of that point, is about 700 feet high, and juts out into the sea, presenting a bluff face to seaward; a reef extends about a mile from it. Seen from the westward, the appearance of this hill is completely altered, being under the new aspect an oblong mountain, with small ravines from top to base. The town of Mantzeza is on the S.E. side of the hill.

Iconi hill, about 3 or 4 miles northward of Mantzeza, also juts seaward; seen from the southward it is saddle-shaped and steep, but on nearing it a low point of small extent will be observed running out from its base, and just to the southward of and under the hill will be seen the town of Iconi. From the westward this hill shows as two peaks with a deep hollow between them; there are the ruins of a white stone building on the apex of the northern peak.

About a mile to the northward of Iconi hill a low point projects; above this point some way up the side of the mountain there is a large walled town. About 2 miles to the northward of Iconi hill, another low point will be observed with two or three large trees on it; round this point is the bay of Maroni. Between Maroni and Itzanda, a distance of about 3 miles, the coast is rocky and steep-to: about a mile to the northward of Maroni a low black point projects, now forming the northern extreme of Maroni bay; this point was produced by an eruption of lava in 1858.

Maroni Bay is a slight indentation of the shore, with a small cove and a rocky islet in it, in Lat. 11° 40′ 44″ S. (Langle). This cove is shallow, but affords good landing at its head. The town, at the head of the cove, is large, and the Sultan of Maroni is the chief of most influence in Comoro.

The anchorage for ships is in 25 fathoms, at about 1½ cables from the rocks; and the bank of soundings is so limited that it is necessary to anchor with precision in the right depth, for which purpose a boat should be sent in previously to find out the berth. H.M.S. *Brisk* laid in 25 fathoms, with the low rocky islet in the north part of the cove on with a notch in the high land, with a tree in it bearing S.E. by E. ½ E., and the extreme point to the southward S.W. ½ S.; in this position, with 60 fathoms of cable, there was only good room to swing clear of the rocks.

Iconi hill, projecting into the sea, affords shelter from southerly winds; but if the wind comes from the westward, and especially during the N.W. Monsoon, this is a very dangerous anchorage.

Supplies are cheap and plentiful, particularly cattle. Water, however, is very scarce, and said to be so all over Comoro. The natives say there is a fishing-bank 3 or 4 miles westward from Maroni; but nothing more is known about it.

Itzanda, 3 miles northward of Maroni, resembles it both as regards the bay, and the walled town. The anchorage is very indifferent, being deep and close to shoal water, but ships may anchor in 20 or 25 fathoms water, about midway between the extreme points of the bay. At the head of Itzanda cove, near a tree of very large girth, there is good landing.

MOHILLA, 25 miles S. by E. from Comoro, and 22 miles W. of Johanna, is the smallest and least elevated of the Comoro islands, being about 15 miles N.W. and S.E. by 7 or 8 miles wide at its broadest part. It is well wooded, and on the east side the land is low near the sea, rising gently to the mountainous ridge running along the middle of the island, which has no peaks, and appears capable of cultivation to its summit, 1900 feet.

White Rock, a remarkable islet, N. 76° E., nearly 4 miles from the S.E. end of Mohilla, is upwards of 100 feet high, flat topped, with steep sides, but has a low flat projection on its west side. From a distance it has the appearance of being bold-to, and there is a good channel inside it. There are several other islets off the S.E. end of Mohilla, the outermost of which is about 1¾ miles from shore, but these are neither so high nor so remarkable as White rock, which is conspicuous even at night.

The N.E. Coast has soundings of 8 to 14 fathoms at 1 to 1½ miles off shore, and 14 to 17 fathoms at 1½ to 2 miles; but it should not be approached within a mile.

Douany is a walled town close to the beach, a little to the southward of the N.E. extreme of Mohilla, and shows a battery of guns along its sea face. The Queen's house is near the north-west corner of the town, facing the beach, and has rather the appearance of a casemated barrack; it is in Lat. 12° 17′ 43″ S., Long. 43° 46′ 42″ E. The inhabitants are friendly; the population is not large. The island is very fertile; cattle are good and cheap, and water is abundant.

During the Southerly Monsoon the anchorage off Douany is good, but at times there is more swell than might be expected under the lee of the island: during the N. E. Monsoon the anchorage is not safe. Large ships may bring up in 9 or 10 fathoms, sand and shells, at about a mile from the landing-place, with the centre of the town S. 35° W., and the extreme of Mohilla S.E.; inside this berth the soundings shoal quickly to 7 and 6 fathoms; and though there may be good anchorage in those depths, it cannot be recommended for large ships.

From the anchorage off Douany, the following bearings were taken:—

White rock	S. 47° E.
Bluff head at S.E. point	S. 42° E.
Extremes (visible) of Comoro	N. 4° W. to N. 21° W.
North extreme (visible) of Johanna	N. 82° E.

Douany Cove, frequented only by small dhows, is formed by the coral reefs; its entrance is narrow and obstructed by a central coral shoal, close to which there are 5 or 6 fathoms water. The landing-place is in this cove, but it is inconvenient at low water, owing to the sandy beach running out so very flat; at low water boats cannot approach within 250 yards of the dry beach. The entrance to the cove is plainly seen when there is much surf on the reef; but, if only breaking, occasionally some care is necessary not to miss it; a drop in the high land forms a good leading mark.

The Watering Place is about a mile to the south-eastward of the anchorage, and is not convenient.

The North and West Coasts are scarcely known; between Douany and the north point of Mohilla reefs project, here and there, some distance from the shore. Off the N.W. point, distant about 2 miles, there is a black rock always above water; when passing this rock at 2 miles' distance there is no bottom at 40 fathoms; a reef of dry rocks also projects a quarter of a mile from the N.W. point, but at $1\frac{1}{2}$ miles from these there is no bottom at 30 fathoms.

Captain Wilson, of the *Suffolk*, when off the northern end of Mohilla in 1756, brought up in 24 fathoms, small stones, shells, and coral, three-quarters of a mile from shore, the N.W. point bearing W.S.W., the eastern extreme of land E. by S. $\frac{1}{2}$ S., and a town S.S.W. In a small bay near this town, a supply of good water was obtained 200 yards from the beach in a ravine about 12 feet deep; the casks, when filled, were rolled with ease over a soft sandy beach. A reef of rocks across this bay prevents watering-boats working between last quarter ebb and first quarter flood. On the north shore of Mohilla the flood sets to the westward, but changes before the water has done rising, as does the stream to the eastward before low water.

Off **the South Coast** of Mohilla, towards its western part, a chain of volcanic-looking islands extends upwards of 3 miles from shore, having good anchorages inside, with from 26 to 35 fathoms, sand and shells; these islands are for the most part surrounded with reefs, but may be approached on their northern sides within one or two cables.

Approaching from the westward the fourth or fifth island, called Choa-Sauzi, has an islet at its southern extreme perforated with round holes, which at a distance appears like the Needles rock; this may be closely rounded; you will then perceive a small but rather high island (Choambouhou), with a rock which covers at high water at its south point; give this a berth of 2 cables, and you may then haul in and anchor.

Numa-Choa Harbour, N. by W. $\frac{1}{4}$ W. from Choa-Moa island, is formed by sand and coral reefs on each side, which are mostly dry at low water. The anchorage is in from 8 to 10 fathoms, sand and mud, with Numa-Choa point N.W. by W. $\frac{1}{2}$ W., and the extremes of Choa-Moa S. $\frac{1}{4}$ E. and S.S.E. $\frac{1}{2}$ E.—(*French Survey.*) This port appears to be a good place of shelter during the bad weather season.

Approaching from the eastward, if bound to Numa-Choa, pass the S.E. end of

Mohilla at 2 or 3 miles, and follow the south coast until you bring the Sail rocks (off the south-west extreme of Mohilla) open to the southward of Choa-Moa island N.W. by W. ½ W. Choa-Moa is a small but high conical island with a flat top, and is the easternmost of the group, except a small islet near the shore. This mark clears the reefs which extend from the S.E. end of Mohilla westward to a point which is about 2 miles East of Choa-Moa: when this point bears N. by E. you may haul in to pass to the northward of Choa-Moa; and if bound into Numa-Choa harbour, the point of that name (on which the town stands), N.W. by W. will lead in. The town is in Lat. 12° 26′ S.—(*French Survey.*)

Water.—There are several convenient watering-places on the south side of Mohilla; one of them is situated at the head of Numa-Choa harbour.

The S.W. Point of Mohilla is surrounded by a coral reef extending nearly ¾ of a mile from shore; on this reef, at rather less than a quarter of a mile from shore, are two rocks with perpendicular sides, called from their appearance the Sail rocks; they are visible 9 or 10 miles.

Miremani Bay, half a mile to the eastward of the Sail rocks, is a well-sheltered anchorage in 10 to 20 fathoms, sand and mud, being protected on each side by coral reefs; about ¾ of a mile to the S.E. of the entrance to this bay there is a patch of rocks (Flat rocks) above water.

JOHANNA is next to Comoro in size and in height, but far surpasses it in beauty and fertility: in form it is triangular, the east side running about north and south, and the north side forming a deep bay, in which is situated the town of Johanna. As seen from the westward, it appears as a succession of peaks, one rising behind the other, and all, including Johanna peak, being wooded to the top. Like the other Comoro island, Johanna is volcanic, but not actively so now.

Johanna is governed by an independent Sultan, who resides at the town on the north side. The natives are hospitable and well disposed to Englishmen; they are of Arab origin, but the lower orders are much intermixed with the African race.

The climate of Johanna is on the whole healthy, the shores being nearly everywhere free from mangrove swamps; and the cruisers on this station generally consider this island a sanitarium as compared with the other parts of East Africa.

Johanna Peak, near the centre of the island, is 5177 feet above the sea, and in about Lat. 12° 14′ 17″ S., Long. 44° 27′ 34″ E. This peak, of conical form, and probably a thousand feet higher than any of the others, is frequently obscured by clouds, so that it is rarely seen except in the early morning. From the peak a spur of mountainous land projects towards each of the three ends of the island.

North Coast.—The N.E. point of Johanna is in about Lat. 12° 4′ 54″ S., Long. 44° 29′ 57″ E. According to Captain le Vicomte de Langle, the reef off it extends 2 or 3 cables to the W.N.W. of the point, outside which the soundings are regular; but Mr. Olive, master of H.M.S. *Brilliant*, reports it to be shoal for 1½ miles from the point. It is possible that the appearance of reef, which by some authorities has been described as even 3 miles from shore, is caused by tide-rips; but nevertheless give the N.E. point a good berth, for it is generally the weather side.

The N.E. point when on with Saddle island (near the N.W. point) bears S. 82° W., the two being about 15 miles apart, and the coast between forming a large deep bay,

in which is situated the town. The north shore is bounded in most places by a reef extending from 1 to 2½ cables. For 4 miles eastward of Saddle island the reef may extend nearly half a mile off shore, but it then becomes bolder, and the whole way along this shore at half a mile distance there are no soundings with the hand line; the green line of reef shows at high water, and at about half tide the reef breaks everywhere, except in very smooth weather.

Saddle Island, 400 feet high, near the N.W. point of Johanna, is small, bluff, and saddle-shaped; its N.W. extreme is in about Lat. 12° 9′ 30″ S., Long. 44° 15′ 17″ E. There are two or more islets inside and to the southward of Saddle island, connected by reefs, with boat channels between them. Saddle island is apparently bold on its N.E., N., and N.W. sides, but from the N.W. point a reef extends about S.W., which, increasing its distance from shore to full one mile, then trends to the S.E., and forms the reef which lines the S.W. shore of Johanna.

Off Saddle island, as well as off the other extremities of Johanna, tide-rips give an appearance of shoal water beyond the reef to an extent of a mile or two, arising probably from the rocky and uneven bottom; but these appearances of broken water have been passed over without obtaining soundings, and possibly no dangers exist beyond the reef, which is plainly visible except at high water.

The old town of Whani is situated about 3½ miles to the north-eastward of Johanna town. About 6 miles westward of Johanna town there is a small deep bay to the westward of a bold bluff called Assombe; this bight is open to the eastward, and has at its mouth a remarkable group of black rocks, with anchorage for small craft inside them.

About three quarters of a mile to the westward of Johanna town the soundings deepen regularly from shore to 20 fathoms, increasing afterwards to 42 fathoms at half a mile; beyond this the depth increases to 350 fathoms, soft black mud, at one mile from the beacon.

Johanna Town (or Moussamoudou) is on the north side of the island in the depth of the bay, about 10 miles from Saddle island and about 6½ miles from the N.E. point. The south-west angle of the town is in Lat. 12° 9′ 50″ S., Long. 44° 25′ 51″ E. The town, which is on low ground close to the sea, is substantially built of stone, with very narrow winding streets, and is surrounded by a wall; it is overlooked by a dilapidated fort or citadel, on a height immediately at the back. The English consulate is a detached building close to the beach, about 300 yards to the westward of the town.

Directions.—During the *southerly* Monsoon, sailing ships should approach Johanna town from the westward, where a fresh breeze will often be found, whilst it is calm to the eastward; give Saddle island a berth of at least 1½ miles, as you sometimes get a considerable swell and no wind under its lee; from thence you will very often fetch the anchorage without a tack; be prepared for squalls, which occasionally come off the land in furious gusts. During the *north-east* Monsoon, on the contrary, it is best to approach from the eastward, on account of light winds and westerly currents, which may sweep you away towards Mohilla. A French vessel of war, which had been close to Saddle island, was swept away by a strong westerly set in light winds, and after being carried completely round Mohilla, did not make the anchorage of Johanna for six days.

The **Anchorage** off Johanna town and also off the watering-place is very limited in extent, and close to the shore; vessels should therefore be prepared to

anchor immediately on obtaining soundings with the hand line. The best anchorage is abreast of a cocoa-nut plantation, about $\frac{3}{4}$ of a mile westward of the town, with a small white stone beacon bearing S.E.; this beacon is in Lat. 12° 10′ 25″ S., Long. 44° 25′ 24″ E.; it was erected to mark the anchoring ground, and is about 100 yards to the eastward of the watering place, and about 200 yards westward of a round grassy hill; off here the soundings deepen regularly from the shore to 20 fathoms at a quarter of a mile distance, the bottom being dark sand with small pieces of coral and shell near the shore. H.M.S. *Brisk*, anchored in 15 fathoms, $1\frac{1}{2}$ cables from the 5-fathom line off the coral reef, with the white beacon near the watering place S. 25° E., and Black rock N. 87° E.; from this anchorage Saddle island bears N. 76° W.; the N.E. extreme N. 38° E.; Johanna peak S. 32° E., and the citadel N. 75° E.; this is a very good and convenient berth during fine weather. There is anchorage abreast, or immediately to the westward of the town, but it is not recommended, the bank here being steep: during the southerly Monsoon it is an unsafe position, as it is immediately to windward of the coral flat. Between the two mentioned anchoring grounds this coral flat, which dries at low water springs, extends about $1\frac{1}{2}$ cables from shore. This flat fronts the round grassy hill before mentioned: it commences at the beach a little to the eastward of the watering place, and terminates near Black rock, just to the westward of the English consulate. Off the edge of this flat the bottom is rocky and uneven. During the S.W. Monsoon the anchorage off Johanna town is smooth and safe; but vessels should lie with a good scope of cable, and be prepared for gusts off the land.

The Watering Place is abreast of the western anchorage as above described, and is a small stream about 100 yards westward of the beacon; it flows through the cocoa-nut plantation, and generally discharges itself into the sea in two branches. The water, which is easily obtained, is excellent, except during the rainy season, when the quantity of vegetable matter brought down from the hills renders it bad, after being kept a short time on board. In watering here a considerable length of hose is required to enable the boat to lie afloat; the beach, being composed of large round stones, is not suited for rolling casks. H.M.S. *Boscawen* obtained 100 tons in 8 hours.

There is a good stream of water close to the westward of the town, but the natives use it for bathing and washing. Another stream of water, off which there is anchorage, runs into the sea $1\frac{1}{2}$ or $1\frac{3}{4}$ miles westward of the town.

Supplies are plentiful at Johanna: the cattle are small but of excellent quality, at from $10 to $15 a head. Goats, kids, and poultry are comparatively dear. Sweet potatoes, yams, cocoa-nuts, limes, oranges, and other fruits and refreshments, are abundant.

The Trade is limited, but whalers (50 or 60 a year) often touch here for refreshments; they are charged $15 a year for recruiting and watering as often as they please. Other merchant vessels touching here pay $10 port dues.

The S.W. Coast is about 20 miles in extent; and from about 3 miles southward of Saddle island to the south point the coast is slightly concave; the extremes of land are in one S. 41° E., and although several spurs of high land approach the sea, giving the appearance of a point at a distance, no point projects beyond the line joining the extremes of the island.

The reef on the S.W. coast extends farthest seaward in the vicinity of Saddle island, elsewhere not more than a mile, and in most places not more than 3 or 4

cables. The coast is boldest to the southward of Pomony, where in places the reef terminates.

"**Pomony Harbour** is formed by coral reefs, and situated on the south-west coast of Johanna, about 8 miles from its south extreme, and about 12 miles from the north-west point of Saddle island. The landing place abreast of the middle of the harbour is in Lat. 12° 16′ 20″ S., Long. 44° 24′ 54″ E. Pomony may be known seaward by being under a saddle in the high land, and by two peaks like dog's ears, which are immediately over the harbour; also by the bright verdure of Mr. Sunley's sugar estate, and by the factory with its white square chimney, the harbour's mouth being about three-quarters of a mile north-westward of the factory.

"Pomony harbour is very small, but has good depths of from 15 to 5 fathoms, black sand, throughout. The anchoring space is 190 fathoms wide from the 5-fathom line on each side abreast of the beacon at the entrance, and 158 fathoms wide towards its head. We did not measure its exact length, but it is between $2\frac{1}{2}$ and 3 cables. The reef side is steep, and the shore side shelving. By choosing your spot, vessels may in case of necessity lie on shore here, as in the case of the I. N. steamer *Semiramis*, which was beached for repairs. This harbour will safely contain 5 or 6 small vessels if properly moored, but vessels of over 200 feet long should not enter the harbour, there not being space enough for them to moor with sufficient scope.

"**The South-east Reef** dries entirely at low water springs; at its northern extremity we placed a beacon consisting of an iron pole and basket, whitewashed; this beacon may be passed within a boat's length on its western side, but should have a little wider berth on the harbour side. There is a boat channel from the head of the harbour out to sea, or to the river off the factory, but this is practicable only when the sea is smooth.

"**The North-west Reef** only partly dries at low water springs. There is a boat channel to sea inside this reef, which is practicable in all weather, the sea in rough weather being always broken by the outer and shallower part of the reef.

"**The Coral Shoal** in the middle of the entrance to the harbour is abreast of the outer point of the north-west reef: it is about a cable in extent north-east and south-west, with depths of 5, 3, and 2 fathoms on it, except on its south-east edge, where there is only 6 feet at low water springs. A black nun buoy was placed on this spot, to be left on your port hand when entering the harbour, and this side of the shoal being quite steep, the buoy might be approached on its eastern side within a long boat's length, but we believe it has since been washed away, and not replaced. This centre shoal does not generally show well, and is very treacherous for boats, a solitary surf sometimes breaking at long intervals. Boats are frequently capsized here; on one occasion when it appeared tolerably smooth a surf rose and turned a whale boat end over end.

"**Directions.**—Two beacons were erected in 1861 to the westward of the north-west village. They each consist of five cocoa-nut trees placed together on end in the ground and whitewashed; the lower one is near the beach, and the upper one about 350 yards behind it. These lead in between the south-east reef and the centre shoal, on about a N. by E. $\frac{1}{2}$ E. course, and render the channel perfectly safe for vessels which answer their helm properly. The beacons are visible 8 or 10 miles at sea. To enter:—When within a mile or so of the shore bring and keep the beacons

in one about N. by E. ½ E., which will take you in the fairway, passing the centre shoal on your port hand, and the beacon on the reef end on your starboard hand. When abreast of the *reef* beacon, haul sharp round to the south-east into the harbour. The channel between the south-east reef and the centre shoal is about 100 yards wide. There is also a deep channel between the shoal and the north-west reef, but it is very narrow, and should not be used except on emergency. Observe that when there is much swell the surf rolling over the reef into the harbour causes a considerable outset in the channel.

"The harbour being very small, care is required not to enter with too much way, so as to be able to turn short round at the reef beacon. It is desirable to moor about mid-channel between the shore and the reef: for this purpose observe a diamond-shaped beacon on the beach near the factory; this beacon brought on with a remarkable and outermost cocoa-nut tree (also on with a small rock on the beach at the head of the harbour) denotes the middle line of the harbour.

"Vessels should moor with open hawse to the S.E. or N.W. according as it is the southerly or northerly Monsoon. We generally moored with 50 or 60 fathoms each way, and put on the mooring swivel, particularly during the north-east Monsoon. When moored in the harbour the south extreme of land bears S. 32° E.; the sugar factory S. 41° E.; the south (visible) extreme of Mohilla West; and Comoro mountain, just open of the north-west extreme of land about N. 49° W.

"During the N.E. Monsoon the harbour is quite smooth, and at low water it is as smooth as a dock at all times of year; strong gusts of wind come down occasionally off the land; but light land and sea breezes generally prevail, and occasionally shift from one to the other several times during the day; care is therefore required in entering Pomony under canvas, although in case of necessity you may anchor in from 12 to 17 fathoms inside the coral shoal: outside it there is no anchorage, unless it be on the outer part of that shoal in 4 or 5 fathoms coral. At this time of year there is no difficulty in going out under sail if you choose your time, but do not attempt it unless the land wind is steady.

"During the S.W. Monsoon the harbour is generally smooth enough for all purposes, but when strong southerly or south-westerly winds occur at spring tides, although all heavy sea is broken by the reefs, sufficient swell rolls in at high water to cause a confused boiling sea, and to make dry landing impracticable; if it were to blow really hard from that quarter at high water springs we should call the harbour unsafe, unless special precautions were taken, such as placing an anchor close over to the weather side of the harbour, so as to lie with a whole cable scope; but the S.W. Monsoon rarely blows home with force, and we have no reports of its ever having amounted to a gale. Whilst, therefore, the harbour may be considered tolerably safe and available at all times of year, vessels lying here in the strength of the S.W. Monsoon during spring tides will do well to be prepared.

"Sailing vessels at this season will frequently have to wait some days for an opportunity of going out.

"Water.—There is a very good watering place at a stream which runs into the sea near the factory; here the water is excellent and may be made to run of its own accord into the boat by placing a starting hose a little way up the rocks past the bridge. In smooth weather boats can proceed across the reef from the harbour and enter the river towards high water, but when there is any swell they have to lie outside the surf with a great length of hose and must return to the harbour by

the ship channel: of course when there is much surf, landing at the river is impracticable, but this is of rare occurrence.

"There is also a stream running into the sea at the northern part of the harbour, with a deep pool inside: this is very convenient for washing clothes or a ship's company's blankets and bed-ticks, but it comes from marshy ground and is probably not wholesome for drinking.

"SUPPLIES.—A supply of provisions and coal is kept at Pomony for the use of H.M. ships on this station. Cattle and fresh supplies are plentiful, the latter being brought round from Johanna town when required in any quantity.

"Pomony Outer Anchorage.—There is good anchorage about $\frac{3}{4}$ of a mile to the south-eastward of Pomony harbour, with Mr. Sunley's factory chimney bearing N.E. by E., on which bearing you will be at right angles to the sea face of the building and be able to see through its two doors. Anchoring here in 14 fathoms you will be about a $\frac{1}{4}$ of a mile from shore, and have room to lie with a whole cable if desired: there is also said to be anchorage in 30 fathoms at half a mile from shore.

"Strangers approaching this anchorage should run for the factory on about the given bearing, as on the north-west side the reef extends 2 or 3 cables from shore, and on the south-east side there are some detached rocks, the largest of which only covers at high water.

"This anchorage being immediately abreast of the river is very convenient for ships calling for water during the N.E. Monsoon; at the other time of year vessels will generally find this anchorage practicable, but they should be prepared to slip on appearance of strong winds or heavy swell.

"About a mile to the south-eastward of Mr. Sunley's factory there is a bay (unexamined) apparently free from reefs, at the northern extreme of which is a stream of good water. There is another bay about a mile to the north-westward of Pomony harbour, and here again there is a stream of good water. About 5 or 6 miles to the north-westward of Pomony there is another harbour formed by the reefs, somewhat similar to Pomony, but only fit for dhows."

The South Point of Johanna is bluff and of considerable height; it is in about Lat. 12° 21′ 16″ S., Long. about 44° 31′ E. This end of the island does not form an acute point, but is 4 or 5 miles across; in rounding it, several points will successively appear. The southern extreme of Johanna is surrounded by a reef which extends from three-quarters to one mile; there are two islets close to the shore about a mile to the eastward of the southernmost part. During the southerly Monsoon there is occasionally a very heavy sea off this point.

East Coast.—From the southern extreme of Johanna the land trends N. 15° E., about 7 miles to a bluff point, and thence N. 4° W., about 10 miles to the N.E. point. The east coast is high and rocky, near the sea, with scarcely any indentations; although apparently steep-to, it is not desirable to approach too close, since it is usually the weather side of the island. Coral reefs line the coast in places, with channels between them for boats and small vessels. The small harbour of Demony is scarcely known. Between Demony and the N.E. point where the reefs cease, the coast is very steep. The soundings on this side of the island have not been examined.

Seen from the eastward, distant 50 miles, the island makes with two peaks—the higher to the northward, with the land gradually sloping towards the south.

MAYOTTA, to the S.E.-ward of Johanna, and next to it in size, is the eastern-most of the Comoro islands. It is 21 miles long from north to south, with an average breadth of 6 or 7 miles; but if the dangerous reefs which surround the island be included, the whole occupies a space of 30 miles north and south, and 24 miles east and west, between Latitudes 12° 34′ and 13° 4′ S., and between Longitudes 44° 59′ 15″ and 45° 23′ E. The horizontal form of the island is very irregular, and owing also to very uneven surface, it presents a remarkable aspect from all points. Mavégani, the highest mountain, is situated 7 miles from the southern extreme of the island; it has two peaks close together, of which the westernmost is the highest, being 2164 feet above the sea. Uchongui, a sugar-loaf peak, at less than 3 miles from the southern extreme of the island, rising to a height of 2105 feet from land of inconsiderable elevation.

Mayotta, when seen bearing west, at about 40 miles distance, makes like two islands, the highest part appearing to the southward; when seen from the southward, Uchongui mountain will rise before any other part. The channel between Johanna and the outlying reefs of Mayotta, is 29 miles wide.

Mayotta is now a French colony, a small military and naval establishment having been formed at Zaudzi. The island is fertile, but not very healthy, for the shores of the main island are lined in places with mangrove swamps, which uncover at low water. The inhabitants are similar to those of the other Comoro islands.

Pilots.—Two Government pilots reside on Pamanzi island, and one will generally come off to ships about to enter by the Bandéli passage, if the signal is made. For the other passages no pilot can be procured, as they are out of signal distance of Pamanzi.

Outlying Reefs.—Mayotta is surrounded by a line of reefs, extending from the main island on the north, N.E., S.E., and south sides $4\frac{1}{2}$ to 5 miles, and in some parts of the west side 8 miles. To the N.W. there is a detached reef 8 miles from Zamburu, and $11\frac{1}{2}$ miles from the main island; this reef is about a mile in diameter, with least water $2\frac{3}{4}$ fathoms, and the centre bears N.W. $\frac{1}{2}$ W. from the high part of Zamburu.

The reefs round Mayotta afford many passages, most of which are good for even large ships; the passages generally used are the Zamburu on the N.W., and the Bandéli on the east side. When inside these reefs the anchorages are spacious and sheltered in all directions, but the outer edge of the reefs is most dangerous to ships approaching the island without due caution, for besides their great distance from shore, the currents which prevail in the vicinity are uncertain, the island being to the southward of the general westerly set.

The reefs are generally visible by the discolouration of the water, which when the sea is calm is in many places the only sign of danger, their outer edges being very steep, with no bottom, at 50 fathoms close alongside. But it is said that on the western side of the island, a bank of deep soundings extends nearly two miles beyond the reefs, where, in case of necessity, vessels being drifted towards the reef might bring up. Inside the reefs the soundings on the eastern side of the island are from 15 to 25 fathoms, and from 25 to 40 on the western side.

Between Mayotta and Johanna, the current is generally to the S.W., but at times sets to the S.E. with considerable strength: during calm and variable weather H.M.S. *President* was set from the north-west to the south-east part of the island (round the east side), in two days. About the south end of Mayotta an easterly current is very common.

Zamburu, or Saddle Island, about 3 miles off the north-west end of Mayotta, is about a mile in diameter, and over 1000 feet high; its higher peak, towards the north-western part, is in Lat. 12° 38′ 20″ S., Long. 45° 6′ 45″ E. The saddle appearance of the top of the island is most visible from N.E. and S.W.; this island is somewhat similar to Saddle Island, off Johanna, but very much larger and higher. The soundings close to the reef surrounding Zamburu are from 10 to 15 fathoms. Between Zamburu and the main island is a reef, having on the extremities the two Choazil islands, one at each end; they are small, but visible 12 miles.

Zamburu Passage.*—Approaching Mayotta from the N.W., Zamburu cannot be mistaken; if approaching to the northward of the outlying shoal, keep Zamburu peak to the southward of S.E. ½ S., which will give the shoal a berth of over a mile. Bring and keep Cape Duamuni on with the second summit (the south-western peak) of Pamanzi S.E. ⅓ S., until Zamburu peak bears West, when run East from the latter until the next marks come on—viz., Point Congo on with the second summit of Pamanzi S.E. ¾ S. Observe, however, that Point Congo is not the extreme of land, as shown in sketch C on the chart; there is a point beyond it—ill defined on the chart—which a stranger is apt to mistake for Point Congo. The point which *is* the extreme land (Point Makaoen) must be made to overlap the second summit of Pamanzi as much as the second summit appears above it. This will take you in the fairway between the narrows, and continuing that course you will leave Prévoyante Shoal on your right hand (going in). When Morne hill comes on with Zamburu peak N.W. by W., steer from these last marks. You may then pass close to Aombé islet, which is steep-to on its west and south sides, and thence pursue a midchannel course into Pamanzi bay, or round to the anchorage south-west of Zaudzi. In rounding Zaudzi spit, do not haul to the southward until the four Nossi Effatsi islands open westward of Mognaméri.

Entering Zamburu passage with the leading mark on, when between Zamburu and North reef, there is a bank of 7 fathoms' soundings, apparently good anchoring ground. The French frigates *Cordelière* and *Somme* sounded on this bank; it is a mile in extent N. by E. and S. by W., lying right in the fairway with least water 4½ fathoms; at its north and south extremes there are 6½ fathoms; it may be dangerous in parts for vessels of heavy draught.

Buoys.—The edge of the shoals off Cape Duamuni, and the south point of the North-east reef opposite to it, are buoyed; beyond these buoys you will come to others on shoal patches, between which you should pass; there is also a buoy on the Prévoyante reef.

These buoys are pyramidal, but do not show well; the shoals, however, are plainly visible towards low water.

Dua Muni, or the North-east passage, appears clear for vessels of any size. To enter this pass, bring Duamuni point on with Muruamu mountain S.S.W. ⅞ W.; this will lead in between the north and north-east reefs, and when Congo point comes nearly on with the second summit of Pamanzi, proceed as directed for entering the Zamburu passage.

Choazil Passage lies with the northern Choazil island on with Morne hill, S. 86° E.; it appears to have only 5½ fathoms mid-channel, although about half a mile wide between the reefs.

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* For Mayotta Island and the passages between the reefs, it is necessary to be furnished with Admiralty Chart No. 2741.

Great Western Passage is wide and safe. To enter, bring Red mount (a hill with a red patch near the sea) on with Combani mountain E. by S. Combani mountain may be known by the sugar-loaf appearance of its summit, and by its being on the nearer range of mountains.

Boeni Bay.—If bound to Boëni bay, proceed as above until East point (on the Boëni peninsula) comes on with Uchongui peak S.S.E., you may then steer on the latter course, and when a mile or more distant from East point, haul into the bay with Caroni island S.E., which course will clear the reefs off East point. Acua point (remarkable for a small green hillock) on with the peak of Zamburu, clears you to the westward of a reef which lies W. by S. $\frac{1}{8}$ S. about 2 miles from Red mount.

Boeni Passage is half a mile wide, but its distance from shore renders it difficult to distinguish Boëni point from the other land; to enter, bring Boëni point on with the southernmost peak of Mavégani mountain bearing east.

Boat Passage is very narrow, but has water for all classes of vessels; the leading mark is Cani point (between Cani hill and Uchongui mountain) bearing about E. $\frac{1}{4}$ S.; but it should not be attempted without a pilot on account of its narrowness, and because a considerable space inside the reef does not appear to have been examined.

Saziley Passages, three in number, are divided from each other by coral flats,—the southern of the two flats being crowned by a sand-bank, which uncovers at one-third ebb. Though not much frequented, these passages have sufficient water for vessels of the largest size.

South Saziley Passage is wide and good. To enter, bring a distant tuft of trees W. by N. $\frac{3}{4}$ N. over Dapani point. Boëni island bearing W. $\frac{3}{4}$ N. will also lead in. Boëni is at the south extreme of Mayotta, and when seen from outside the passage it has the appearance of a low hill joined to the main island.

Middle Saziley Passage lies with the sugar-loaf part of Uchongui mountain just open to the southward of Morne Carré, about W.N.W. This passage has 7 and 8 fathoms water.

North Saziley Passage is very narrow; to enter, bring Morne Carré just open southward of Uchongui mountain about W. by N., but caution is necessary, for this takes you rather close to the coral reef on your port hand.

Bandeli Passage, about 5 miles to the southward of Pamanzi, is the usual one for vessels from the eastward. There is a *whitewashed obelisk* on Mavegani mountain, which serves as a distant mark, and leads to the entrance of the pass when bearing N. 72° W. To enter, bring White Rock (a mark close to the water's edge) on with a white beacon on the top of a hill called Morne X, bearing N. 72° W., taking care not to open Morne X *beacon* to the northward on first entering the passage, nor to open it to the southward at the inner end of the passage. When the sugar-loaf peak Uchongui comes on with the north end of Bandéli W.S.W. you are within the reefs, and may haul up North for the west end of the westernmost Ajangua island; pass this at half a cable or more, and then on the east side of Bouzi, giving the islet off the latter also a berth of half a cable. If preferred you may pass to the westward of Bouzi, but in this case give its S.W. end a berth of a quarter of a mile to avoid an outlying reef, and pass within a third of a mile or less of its north side to avoid the patches of coral which extend southward from Choa point.

The marks on Morne X and White rock are not very distinct to a stranger, and one being a considerable height above the other, a slight error in their being in one may be unobserved. If, therefore, entering this pass for the first time without a pilot, much care is required. In the morning when the sun is behind you, the reefs will show well, but be careful not to mistake False passage for the Bandéli, the former being about two miles to the south-westward of Bandéli pass.

Buoys.—There are four *white* buoys on the north side of the channel, and three, chequered *black* and *white*, on the south side; but it is doubtful if one can be distinguished from the other, all being rusted to the same colour. Besides these, there is also a *white* buoy to mark the western extreme of the reefs which lie to the southward of the Ajangua islands; a *black* buoy on the eastern edge of the reef off the islet at the south extreme of Ajangua bay; and a *black* buoy on the eastern extreme of the reefs off Ironi point.

Longorori Passage is a narrow cut in the reef, about $3\frac{1}{2}$ miles southward of Pamanzi; it is clear and has plenty of water, but it is winding; and when inside, the navigation is obstructed by coral patches. This passage is not recommended except for boats.

Pamanzi Island, about $1\frac{1}{4}$ miles from the eastern side of Mayotta, and within the encircling reef, is about 3 miles north and south, and $2\frac{1}{2}$ east and west; the eastern hill, on which there is a signal station, is 782 feet high; when seen at a distance, Pamanzi makes like a saddle. The reef on the eastern side of Pamanzi does not appear to extend more than half a mile, not so much in places. At the north-east extreme of Pamanzi there is a lake, apparently the centre of an extinct volcano.

Zaudzi Island, in Lat. 12° 46′ 48″ S., Long. 45° 20′ 14″ E., lies to the westward of, and is connected with Pamanzi by a neck of sand, on which a causeway has been constructed. The French establishment is on this island, and consists of a governor and colonial officers, some artificers and seamen, and about 100 soldiers, some of which are natives. There are a few substantial government buildings and storehouses, and numerous huts.

Water.—There are two wells on Zaudzi, but the water is not good. The establishment is supplied from the main island, the water being brought over in casks.

Supplies are scarce; poultry and vegetables may be obtained in small quantities only, and cattle from the main island; the latter are imported to Mayotta from Comoro and Mohilla. A government supply of provisions is kept here for the troops and for the French cruizers on this station.

Coal is kept here for the service of the French men-of-war.

Zaudzi Spit extends nearly 4 cables westward of the north end of Zaudzi; its extreme is usually marked by a *white* buoy, but is sometimes absent. To clear the west extreme of this spit open the four Nossi Effatsi islands westward of Mognaméri island.

Orestes Rock, situated just in the usual anchorage, was discovered by H.M.S. *Orestes* in 1862; lies about 3 cables from shore, with the jetty lantern on with the lightning conductor of one of the government buildings.

From the *Orestes*, when lying close alongside this rock, the west extreme of Mognaméri island bore N. 5° E., and the west extreme of Bouzi island S. 55° W. It is a cone of coral not more than 12 yards in diameter at its base, rising to pinnacles, so

institution for that class of unfortunates, and of methods pursued in their instruction. Mr. Milb the blind preacher, gives an account of his experie with oculists; M. D. Conway contributes some remi cences of the late John Stuart Mill; and James G Wilson gives a sketch of English grouse hunting. number contains also the ninth of Castelar's paper The Republican Movement in Europe; three short ries; a half-dozen poems of more than usual excelle the continuation of Charles Reade's serial; two or sketches which we have not left ourselves room to s of at length, and five well-filled editorial departm The Easy Chair is occupied again by Dr. Osgood. lished by Harper & Brothers. Received by A. liams & Co.

The *Galaxy* discusses a number of very perti topics in the various departments of thought. In s matters, we have an article on The Coming Marriag Albert Rhodes; a discussion of the question, Wil Coming American Drink? by Carl Benson; a article on Dueling by Julian Hawthorne. For his Mr. E. A. Pollard writes of the Anti-Slavery M the South, claiming that some of the most distingui Southern statesmen have held anti-slavery sentim Theodore P. Adams gives a sketch of the Carlists: Hon. Theodore S. Fay gives the second chapter o remiriscenses of the revolution of 1848 in Berlin. religion, we have an interesting account of Brahma by Mrs. Feudge; and in literature, an article on S bolism and Language by C. P. Cranch. DeFor serial is continued, as also Lady Murphy's "Wa ings"; Lucy H. Hooper gossips of Summer Da Newport; and there are several other articles of i es. The poetry is by Kate Hillard and Elizabeth Published by Sheldon & Co. Received by Williar Co.

The *Nursery*, brightest and best of the magazine the little folks, is full of cunning pictures and

THE ACTION OF TIN ON THE COMPASS.

CHICAGO, Aug. 16. 1873.

To the Editors of The Boston Journal:

In your paper of August 11 I saw a notice to mariners, giving the experience of Capt. C. D. Phinney of the barque J. S. Stone, from New York for Japan, with a cargo of petroleum in tins. Capt. Phinney is right about the great deviation of the compass caused by the tins in a cargo of oil. I experienced the same in the barque Volunteer, sailing from New York March 15, 1870, bound for Beyrout, Syria. The first two days out I had no observations, and after obtaining them, found the vessel very much farther south than the dead reckoning would place her. It occurred to me at once that the tins in the cargo had something to do with it. I tried the four compasses in different parts of the vessel, and found there was a deviation of 16° East, or say 1½ points. I placed one compass near the mizzenmast head, and one on a plank laid across the stern boat-davits; these two agreed, and by them I corrected the binnacle compass. I kept the compass on the plank at the stern, and every time the vessel's course was changed, day or night, I noted the difference between it and the binnacle compass, making corrections accordingly; for, as Capt. Phinney says, the greatest deviation was shown when heading East or West. North or South, there was none. I had no difficulty in making the land anywhere on my way, and fully understood that each tin in the hold acted on the compass the same as *a solid block of iron of the same size would*. The real danger was when I sailed and was going off the coast, for then I did not know of the deviation of the compass. If this experience is worth anything, give it to the world by means of your valuable paper, which I have seen in all parts of the earth.

STEPHEN P. BLAKE.

small that the lead can hardly be placed on them; these pinnacles have only 10 feet water on them at the lowest spring tides, with four or five fathoms all round at 25 yards distance. A buoy has been placed on this shoal, which must not be mistaken for the buoy on Zaudzi spit.

Zaudzi Anchorage is good everywhere to the southward of Zaudzi spit, by avoiding the position of Orestes rock. A good berth will be in 11 fathoms, mud, with the west extreme of Zaudzi N. by E. ½ E., and the south extreme of Pamanzi S.E. by S.

The best anchorage during the southerly Monsoon is in Pamanzi bay, which at that season is very smooth. It is all clear except a small coral shoal in the middle, on which a *black* nun buoy is moored. There is anchorage in 7 fathoms, with North point N.E. by E., and the second summit of Pamanzi S.E. ½ S.

GEYSER REEF AND ZELEE BANK.—Early voyages abound in reports of rocks and shoals to the eastward and north-eastward of Mayotta, but they are very indefinite. The *Firebras*, in 1682, is said to have discovered shoals E.S.E. from the north point of Mayotta, and distant 40 or 45 miles from the nearest part of the island; the *Devonshire*, in 1766, is also reported to have passed this danger. In 1830, the French corvette *Zélée* saw breakers in Lat. 12° 21′ S., Long. 46° 36′ E. (probably the bank now known by the name of Geyser); and 12 miles to the S.W.-ward of this spot there was an extensive bank, with the least soundings then found on it 5½ fathoms.*

More recently (1831), the whaler *Rover* announced "a large and dangerous shoal in Lat. 12° 22′ S., Long. 46° 20′ E., extending about 10 miles E.S.E. and W.N.W., 4 or 5 miles of which dries at half ebb, and the other parts are covered with high breakers: when the middle of the shoal bore N. by E. ½ E. about 5 or 6 miles, there were soundings of from 12 to 10, 9, and 8 fathoms, sandy and rocky ground." In 1832, the whaler *Borneo* struck and was lost on "an unknown coral shoal, in Lat. 12° 14′ S., Long. 46° 7′ E."†

In 1842, the *Shannon*, bound to Aden, was wrecked on a dangerous reef in Lat. 12° 24′ S., Long. 46° 32′ E.; it extended E.N.E. and W.S.W., with many rocks visible at half ebb, and most of them dry at low water. At three-quarters ebb they counted 17 rocks above water, besides some dry sand-banks; there are several swatchways between the reefs, with apparently deep water: remnants of other wrecks appeared imbedded in the sand.

In 1848 Mr. J. Richards, R.N., of H.M.S. *Geyser*, partially examined a dangerous group of rocks and sand-banks, of a crescent form, convex to the westward. The S.E. extreme is in Lat. 12° 26′ 30″ S., Long. 46° 32′ 35″ E. (or 2° 6′ 44″ E. of Johanna town); the N.E. extreme of the rock which uncovers is in Lat. 12° 20′ 45″ S., Long. 46° 30′ 39″ E., and their West extreme in Long. 46° 27′ 50″ E., but to the N.E.-ward of the North extreme a bank or shoal projects to Lat. about 12° 17′ S., curving to the eastward to Long. 46° 35′ E., thus forming a horse-shoe open to the S.E. The soundings on this bank are not given, but it is described as a barrier shoal dangerous to cross: inside the horse-shoe, approaching from the eastward, the depths are from 17 to 20 fathoms.

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* Annales Hydrographiques, t. iii. pp. 343-346.
† Nautical Magazine, 1833.

Zelee Bank is placed on the charts 14 miles S.W. of Geyser Reef, with depths varying from 30 to 5½ fathoms, the shoalest part to the southward.

It would appear certain that the *Shannon* was lost on the Geyser Reef. The *Zélée* also saw the breakers of the northern part of Geyser Reef, but whether the bank to the S.W. was more than the south-western edge of the Geyser does not appear clear from the French notice, for she had an error in her longitude. The description of the *Rover's* shoals coincides with that of the *Shannon;* but at present it is not decided whether they are all the same reef or not. Therefore, approaching this part of the Mozambique Channel either from the northward or the southward, the area included between Lat. 12° 12′ and 12° 32′ S., and between Long. 46° 11′ and 46° 37′ E., must be considered dangerous, for in fine weather, at high water, the reefs do not always break, and it is doubtful if the lead will give any warning.

A N.E.-ly current often prevails in this neighbourhood, although at no great distance off is the southern edge of the great westerly set of the equatorial current.

Bisson Shoal.—In Lat. 11° 59′ S., Long. 46° 29′ E., a shoal has been reported under the name of Bisson,—nothing more is known of it.

Richards Bank.—About 25 miles to the eastward of Geyser Bank, and in Lat. 12° 17′ S., Long. about 27° 4′ E., soundings were obtained by the *Geyser* in 16, 21, and 23 fathoms—nothing further was ascertained.

LEVEN AND CASTOR BANKS.—A bank, discovered by Capt. Owen, R.N. and named the Leven, is placed by him between Lat. 12° 21′ and 12° 44′ S., and between Long. 47° 46′ and 47° 57′ E.; on it are soundings of 40 to 20 fathoms, and 16 fathoms near the southern part.

In 1837, H.M.S. *Pylades*, in Lat. 12° 38′ S., Long. 47° 43′ E, obtained soundings in 13 fathoms.

In 1860, the French corvette *Cordelière*, in Lat. 12° 5′ S., Long. 47° 37′ E., during a calm, got no soundings with 165 fathoms of line. At another time, being in Lat. 12° 3′ S., Long. 47° 55′ E., soundings were had in 33 fathoms, and this the commander (Vicomte Langle) thought might be an extension of the Leven Bank; he also found 30 to 35 fathoms, and fixed the eastern limit of the bank in Long. 48° 5′ E., where the depth was 68 fathoms.

In 1852, H.M.S. *Castor* discovered a bank between Lat. 12° 49′ and 12° 57′ S., and between Long. 47° 36′ and 47° 46′ E., with soundings from 25 to 7 fathoms, sand and coral; the latter depth (the shoalest the *Castor* passed over) is in Lat. 12° 52′ S., Long. 47° 41′ E.; from the masthead, the sea appeared discoloured as far as the eye could see, hence it was inferred that shoaler water might exist in this vicinity; on the chart this is called Castor Bank.

Whether these observations indicated one bank, between Lat. 13° and 12° S., stretching in a N.N.E. direction, or a series of banks with deep water between them, is uncertain; as yet, the shoalest soundings appear to be on the Castor Bank, and large ships should avoid its vicinity during the night, and be watchful as they approach it by day.

Intermediate Bank.—To the Eastward of Leven Bank, between it and Cape St. Sebastian (Madagascar), a bank of soundings was found by Owen, in Lat. 12° 24′ S., Long. 48° 25′ E. Nothing more is known of this vicinity.

GLORIOSO ISLANDS, two in number, together with a small islet, and many scattered rocks and banks, appear to be situated on the same coral reef, which extends east and west about 15 miles, with a breadth of about 3 miles; there is apparently no passage into the lagoon. The sea breaks with violence on the reef, and no soundings were found with 100 fathoms of line at one mile from it. The islands, about 15 feet above the sea, are sandy, but covered with brushwood and small trees. Turtle and birds are plentiful; fresh water may be obtained, but it is scarce.

Glorioso Island, the westernmost of the group, in Lat. 11° 34′ 48″ S., Long. 47° 24′ 9″ E., is about 1¼ miles long by 1 mile broad, with a reef extending from its west end. A small basin, with 7 fathoms water, is formed in its eastern end by a curve in the sand-bank, and here a small vessel might probably find shelter, but the bottom is rocky and uneven.

Isle du Lise (the eastern island), is about a mile in length, and its eastern extreme is in Lat. 11° 35′ S., Long. 47° 32′ E., beyond which the reef extends a considerable distance to the S.E.-ward. This island, when viewed from the northward, distant 10 miles, makes like three small hummocks with cocoa-nut trees between them.

Verte Islet, on the reef between the two main islands, is more to the southward than either of them. Passing about 3 miles to the southward, Verte Islet appears as a rock with a house on it, which is apparently the highest object on the island.

Avoid the vicinity of Glorioso Islands at night; and do not approach them from the eastward by day, unless with a commanding breeze, on account of the strength of the current—which sets strongly to the westward.

ASTOVE ISLAND, the centre of which is in Lat. 10° 6′ 30″ S., Long. 47° 48′ 27″ E. (Owen), is a small low island upon which the French ships, *Bon Royal* and *Jardinière*, are said to have been wrecked. Nothing more is known about it.

COSMOLEDO ISLANDS.—A ring of coral reef, about 10 miles in diameter, with several islands on it, and enclosing a magnificent lagoon, is known as the Cosmoledo group. On the southern side there is a small patch of sand where vessels may anchor during the northerly Monsoon; but within a mile of the reef there are no soundings. There is no entrance to the lagoon. The islands are sometimes resorted to for fish and turtle, and vessels occasionally leave a few negroes here to await their return.

Wizard Island is on the S.E.-side; its north point is in Lat. 9° 43′ 12″ S., Long. 47° 45′ 21″ E.; and its south point in Lat. 9° 46′ S.

Menai Island, on the west side, is in Lat. 9° 42′ 12″ S., Long. 47° 37′ 39″ E.; it is the highest part of the group, and has on it some cocoa-nut and other trees.

North Island is in Lat. 9° 38′ 12″ S., Long. 47° 41′ 21″ E.

ASSUMPTION ISLAND is low, sandy, and covered with shrubs; the hummock near the S.E. end of this island is in Lat. 9° 46′ 18″ S., Long. 46° 33′ 57″ E. According to an old French plan (from M. Morphey), the island extends N.E. and S.W., about 7 miles; and has anchorage on its north-west side (but nearer the western extreme), in 20 to 30 fathoms; on the north and east sides the coral reef is steep-to.

ALDABRA ISLANDS.—This group of islands is about 22 miles in extent, east and west: from Hadoul point, the eastern extreme, in Lat. 9° 26′ 30″ S., Long.

46° 34′ 39″ E., a reef extends about 3 miles to the eastward. The N.W. end of the group, in Lat. 9° 21′ 30″ S., Long. 46° 11′ 57″ E., is fronted by a white beach of about half a mile in extent, and apparently clear of danger. At the SW. end of the group there is also a projecting reef.

Four principal islands almost connected with each other, and called respectively East, South, West, and Middle islands, constitute the group. They are visible at about 15 miles distance; West Island not more than 12 miles. The north and west sides may be approached with safety in clear weather. The four islands enclose a shallow lagoon interspersed with small islets and sandbanks; and on the west side is a small harbour.

South Island runs nearly the whole extent of the group, in shape like the arc of a seaman's quadrant, convex to the southward.

East Island, lying S.E. and N.W., is rather low; a hummock, near its eastern extreme, is fronted by patches of white sand; and on the north side there are several rocks close to the shore, with high breakers. This island has a beautiful appearance, and is well wooded with a forest of large trees.

Middle Island is higher than the others at its eastern end, where it is partially covered with very high trees; the rest of the island is clothed with verdure and interspersed with trees—with white sandy patches here and there. Coasting along, the beach of the island appears to be steep-to, the water not being discoloured.

West Island is low compared with the other islands, and of level appearance; although clothed with verdure, it has very few large trees; on it are several bare white patches. The coast is clear of danger.

Supplies.—From the appearance of these islands water may probably be obtained. Land and sea turtle abound, wood is plentiful, and ships in distress might probably obtain spars from the forest on East island.

The Aldabras have at different times been called Aro, Atques, and Arco Islands.

Euphrates Harbour is the name given to that part of the lagoon, enclosed by the Aldabra islands, where a barque of that name anchored in 1862; according to the captain's account, this harbour has sufficient room for many large ships, sheltered from all winds,—the best anchorage being in its widest part abreast of Mushroom islet (so called from its shape). The entrance to Euphrates harbour is between Middle and West islands, about three-quarters of a cable wide, with no dangers, and least water 13 fathoms if you keep in the dark water; but do not approach the green water, where there are rocks, some of which dry at low tide. Much care, however, is requisite to keep mid-channel on account of the narrowness of the passage and great strength of tide. If the wind is light the ship will drop in or out with her anchor dredging.*

The entrance between West and South islands has 6 or 7 fathoms water, and here also the tide runs with great rapidity. Between East and Middle islands there is a gap about half a mile wide, with apparently no passage,—breakers stretching right across.

Mota Island, said to have been seen by Aleixo de Mota in 1600, and described as small, low, and covered with trees, in Lat. 10° 20′ S., Long. 42° 29′ E., has no existence.†

Dupont Island.—About 1807, this island was reported in Lat. 10° 4′ S., Long. 46° 13′ E. We have no corroboration of the existence of an island here:

* Mer. Mar. Mag. (1863), vol. x. pp. 162, 163. † Dalrymple.

but from the similarity of latitude with that of Astove, it may be the latter island which Mr. Dupont saw; until this opinion has, however, been confirmed, it is desirable to keep a good look-out when near the assigned position.

Natal Island does not exist. On the assigned position (Lat. 8° 31′ S., Long. 46° 23′ E.) birds were seen, but nothing else to give warrant of any danger.

A **Bank** was reported in 1860 by the slave brig *Formosa Estrella*, and stated to be about two degrees eastward of Zanzibar; the vessel anchored on it. This is the only notice of a bank in that vicinity, and the report is not credited.

Bassas de Patram.—A shoal was reported by the *Pitt* in 1758, in Lat. about 4° 30′ S., Long. about 44° 40′ E. The journal states that breakers were seen from the mast-head *distant five leagues*. No other report confirms the existence of a shoal or bank anywhere near the position given.

Bassas de Ambre.—In 1760 a bank was reported by H.M. ships *Norfolk* and *Panther*, bound from Johanna towards India; its position is stated to be in Lat. about 6° 9′ S., Long. about 50° 15′ E.; extending about 9 miles, bottom sandy, and visible in several places. The *Huddart*, in 1803, reported an *appearance* of broken water in Lat. 0° 5′ S., Long. 48° 50′ E., and supposed it to be Ambre shoal. Lastly, the *Cambrian*, bound to Aden, reports as follows: Crossing the Equator, July 3rd, 1857, in 49° 45′ E., startled by the appearance of discoloured water; sounded in 15 fathoms; hauled up to eastward, and sounded again—no bottom half an hour afterwards with 76 fathoms, water not so highly coloured.* The last observation would seem to indicate the possible existence of the Ambre shoal, though it has for some time past been erased from the charts of the Indian Ocean.

SOKOTRA ISLAND AND ITS VICINITY.

SOKOTRA ISLAND is 71 miles long, east and west, and 22 miles wide at its broadest part from Rás Bashurí to Rás Kattaní; in shape it is very irregular, narrowing to a sharp point at its eastern extreme; the southern coast is rudely convex, presenting a bulwark against the swell of the ocean, whose waters are perpetually rolled against it; but the northern and western shores are indented and broken into a succession of small open bays. "The whole island may be described as a pile of mountains, of nearly equal height, almost surrounded by a low plain, extending from their base to the margin of the sea. This is of irregular width, varying from two to four miles, excepting near Rás Felink and Rás Shaab, where the mountains rise up perpendicularly from the sea, and it disappears altogether. Throughout the whole extent of this belt, with the exception of those parts which are watered by the mountain streams in their progress towards the sea, and some spaces hereafter specified, the soil is hard, and does not in its present state appear to any considerable degree susceptible of cultivation. The southern side, though considerably less fertile than the northern, is yet, in the vicinity of Rás Mom, reasonably productive; but to the westward of it is as arid and barren as the worst parts of Arabia. There the force of the south-west wind has blown the sand up

* Mercantile Marine Mag., 1859, vol. vi. p. 1.

from the sea-shore, where it is so fine as to be nearly impalpable, and formed it into a continuous range of sand hills, which extend parallel to the beach for several miles, whence it spreads over the plain, and is even in some places deposited in great quantities at a distance of 3 miles from the sea, at the base of the mountains which there form a barrier, and alone prevent it from overwhelming the natural soil of the whole island. On the northern side, the plain is stony and covered with a dwarfish bush (the metayne) about six feet in height, the foliage of which appears to be retained during the north-east season of the year, and gives to the space where it grows the appearance from a distance of being clothed with verdure. Such is the appearance and nature of the sea-coast, but the high land exhibits a great variety of soil and surface. As a general remark, it may, however, be observed, that nothing in the North-east Monsoon presents a stronger contrast than the eastern and western sides of the island. While the former is destitute of verdure, has scanty pasturage, and, with the exception of some places near the sea, has no other water than what is retained in natural reservoirs, the latter is supplied with frequent streams; its valleys and plains afford luxuriant grass, herds of cattle are numerous, and the scenery in many places is equal to that of our own country.

"Sokótra is not distinguished by any remarkable fertility of soil, yet it is so varied as to be difficult to be able to speak of it in general terms. The summit and sides of the greater part of the mountains composing the eastern part of the island present the smooth surface of the rock entirely denuded of soil, though in some places the rain has worn hollows and other irregularities, in which is lodged a shallow deposit of light earth, and a few shrubs spring forth. On the summits of the hills on the northern side of the island, and against the sides and elevated regions in the vicinity of the granite peaks, a dark rich vegetable mould is found, which nourishes a thick and luxurious vegetation. In the plain about Tamarída, and some portions near Cadhoop, are several beautiful valleys. The soil is a reddish-coloured earth, which nourishes, at certain seasons, an abundant supply of grass, and appears well adapted for the cultivation of grain, fruit, and vegetables. In the valleys through which the streams flow, not only are there extensive groves of date-trees, but the existence of a broad border of beautiful turf, occasional enclosures of dukkuw, and, though but rarely, a plantation of indigo or cotton, indicate no want of fertility in the soil. The natives themselves, indeed, are aware of this, and speak of their own stupidity and indolence as the work of fate.

"Climate.—Though Sokótra is situate only a short distance from the continents of Africa and Arabia, and is, in fact, in the same parallel with their most parched and burning plains, yet, from both Monsoons blowing over a vast expanse of water, it enjoys, at least as compared with them, a remarkably temperate and cool climate. A register of the thermometer, kept in the N.E. Monsoon from the 12th of January to the 13th of March, exhibits during that time the mean daily temperature of $70\frac{1}{2}^{\circ}$, while several streams, at but a short distance from the level of the sea, indicated the mean annual temperature at $74\frac{1}{4}^{\circ}$ (Fahr.) On the hills it is still cooler, and the great elevation of the granite mountains would enable settlers to choose their own climate. Until a few days before we quitted the island, the Monsoon blew very fresh, and at times the wind swept through the valleys with a violence which I have rarely seen equalled. The sky was usually overcast; and while in the countries of Asia and Africa, under the same parallel, some time was yet to elapse before the termination of the dry season, Sokótra enjoyed frequent and copious rains, due to

her granite mountains, the lofty peaks of which obstruct the clouds, causing them to deposit their aqueous particles to feed the mountain streams, or precipitate themselves in plentiful showers over the surrounding country.

"On our second visit, in the S.W. Monsoon, during the time the vessel remained in Tamarída Bay, we found the average temperature much higher than the above; but it should not at the same time be forgotten that we were then under the high land on the lee side of the island, and the wind became heated in its passage across it. On the windward side of the island, the summits of the mountains, and the open part of the coast between Rás Moree and Tamarída Bay, the weather was at this time also delightfully cool.

"In place of the dark cloudy weather with which the season of the S.W. Monsoon commences in India, it was here for the most part clear and cloudless, the stars at night shining forth with uncommon brilliancy. During this period also, when it was blowing nearly a hurricane, and when the gusts swept down from the mountains with a force almost irresistible, throwing up the water in sheets, and keeping our decks and masts to the height of the tops continually wet with the spray, we had, with the exception of a dense white canopy of clouds formed like the table-cloth over the Table Mountain at the Cape, before the setting in of the breeze with its utmost degree of violence, the same clear and cloudless weather. The wind when it blew strongest felt dry; and indeed, such was its siccity, that water dropped on the deck dried up instantaneously. As is usual with winds of this nature, we felt hot or cold, according to the previous state of our own skins. If we were perspiring, we felt cool; but otherwise, we felt hot, feverish, and uncomfortable. And notwithstanding the heat of the wind at Tamarída at this season, the natives do not ascribe to it any ill effects; it would merely appear from their testimony that intermittent fevers are prevalent at the change of either Monsoon, and few of the Arabs from the coast, who reside here any time, escape them."*

Productions.—The chief productions of the island for commercial purposes are aloes; the gum called dragon blood; and several varieties of hard wood, applicable for sheaves of blocks, splicing-fids, &c.

Supplies.—Oxen are numerous near Tamarída and on the mountains in its vicinity; the cows are kept mostly for their milk, from which the ghee, so much esteemed in Arabia and Africa, is made. Vast flocks of sheep and goats are found in every part of the island—the latter are so numerous that the owners keep no account of them.

Sokótra has no ports in which a vessel can ride in safety, protected from all winds; and it is only on opposite sides of the island that good shelter is found from the prevailing Monsoon.

During the N.E. Monsoon the bays and anchorages sheltered from East and E.N.E. winds are Ghubbet Kúrmeh, Ghubbet Göllonsír, Ghubbet Sháab, Bander Né, Bander R'dresseh, and Bander Fíkeh; also Tamarída, with the wind from the East, if anchored close in shore; during N.E. winds all these, with the exception of Tamarída, afford tolerable shelter,—the same remark applies (generally) to the south coast, if close in. During N.N.E. winds Ghubbet Sháab alone gives shelter, all the other bays being a dead lee-shore; at Bander Né, on the south side, the anchorage is also good, if close in.

* Memoir on the Island of Sokótra, by Lieut. J. R. Wellsted, I.N., in Jour. Royal Geog. Soc., vol. v. p. 129 et seq.

During the S.W. Monsoon, there is shelter in all the bays between Rás Kadármeh and the west end of the island,—these are Kúrmeh, Kadhúp, Tamarída, Delíshí, Garrieh, and Fíkeh; but they are subject to very strong gusts of wind that come from the mountains and through the valleys. Natives say that, at this season, the only really good anchorage is at Bander Delíshí, where a vessel can ride out the Monsoon in a perfectly smooth sea and free from the effects of wind. Good ground tackle is necessary, for the soundings deepen rapidly on the north side of the island.

Tamarida, or Hadíbu, on the north side of the island, and 30 miles from the east end, is in Lat. 12° 39′ N., Long. 53° 59′ 20″ E. It may be known by the high craggy peaks of the mountain-range, 3000 to 4000 feet high, which overhang the plain on which the village stands; or, should the peaks be clouded, by a high sand-hill (Jebel Omharí) at the N.E. extreme of the bay, and a low point (Rás Hauláf) partly sandy, partly rocky. The anchorage is indifferent, but there is no danger in the bay; the soundings gradually increase from the shore to 10 fathoms at the distance of a mile, and 20 fathoms at 2¼ miles. The landing place is a quarter of a mile from the village, close to a small stream near a grove of date-palms.

Supplies.—Good water, bullocks, goats, sheep and fish may be procured here at reasonable prices; also firewood. The natives are poor but hospitable, and ready to barter refreshments for rice. Grapes, water-melons, pumpkins, oranges, and plantains may be obtained in March and April, and dates in June.

Ghubbet Kurmeh is a large bay between Rás Kúrmeh on the east and Rás Kadármeh on the west; the soundings are regular, the 10-fathom line being nearly 1¼ miles from the shore, increasing to 38 fathoms at 4½ miles, bottom of sand and coral, with sand and shells in the offing. Rás Kúrmeh is in Lat. 12° 38′ 35″ N., Long. 53° 51′ 10″ E., and Rás Kadármeh in Lat. 12° 42′ 15″ N., Long. 53° 38′ 15″ E. The swell is considerable during the N.E. Monsoon.

Ghubbet Gollonsír, which is partially sheltered during the N.E. Monsoon, lies between Rás Gollonsír to the eastward, and Rás Bedú to the westward. The best anchorage is off the landing-place (800 yards distant), in 4 fathoms, low water, with the north peak of Rás Gallonsír bearing N.E. by E., and the mosque S.E. by E. The soundings under 10 fathoms, which are within a mile of the shore, are irregular; from 20 fathoms the soundings deepen rapidly to no ground at 100 fathoms. The shore of this bay is fronted by a rocky reef extending off a quarter of a mile, and W. ½ N. of the village, 1¾ miles from the shore, is a small patch of 2½ fathoms. There is no shelter during the S.W. Monsoon. The mosque of Gollonsír is in Lat. 12° 41′ 15″ N., Long. 53° 29′ 30″ E.

Between Rás Gollonsír and Rás Samárí to the eastward, a shoal fronts the shore in some places a mile off; near its edge are several shallow patches of 2 fathoms.

Ghubbet Shaab is a bay affording shelter from the N.E. Monsoon, but completely open to the S.W. It lies between Rás Bedú (Lat. 12° 39′ 30″ N., Long. 53° 23′ 30″ E.,) and Rás Sháab (Lat. 12° 33′ 20″ N., Long. 53° 18′ 40″ E.) The 10-fathoms line is ⅔ of a mile off shore at the eastern side of the bay, increasing to 1½ miles at the western side, bottom of sand and rock. At 7 miles from the bottom of the bay the depth is 35 fathoms, rapidly deepening to no bottom at 100 fathoms. The best anchorage is in 10 fathoms, with Rás Bedú bearing N. ¾ E., and Rás Sháab S.W. by W. ¾ W., opposite the mangrove-trees growing close to a saltwater

lagoon. About $2\frac{3}{4}$ miles eastward from Rás Sháab are two remarkable hills like ears; they are 1488 feet high, and visible from the S.W. side of the island; with these bearing S.W. by S., and Rás Sháab S.W. by W. $\frac{3}{4}$ W., there is good anchorage in 10 fathoms, bottom white sand. This is $\frac{3}{4}$ of a mile off shore, and the water is smooth during the N.E. Monsoon.

Ras Shaab is the western extreme of the island: it is a fine bluff cape, terminating the sloping side of a mountain, off it a reef extends 300 yards. The coast thence trends S.E. for 18 miles, off which, for the greater part of the distance, is a $6\frac{1}{2}$ fathoms bank, 1 mile off shore; inside there are soundings of 8 or 9 fathoms, and outside there are regular soundings of 20 to 25 fathoms about 5 or 6 miles off shore; this bank is not more than half a mile wide.

Ghubbet Ne, or **Bander Ne,** is the name given to the part of the coast between Rás Sháab and Rás Kattání, in Lat. 12° 22′ 20″ N., Long. 53° 32′ 10″ E. The anchorage inside the $6\frac{1}{2}$ fathoms bank affords good shelter during the N.E. Monsoon.

The coast on each side of Rás Kattání for a distance of 6 miles east and west is rocky and precipitous; thence a chain of mountains under different names stretches to the east end of the island: these mountains rise wall-like from a low plain (2 to 4 miles broad), which forms the sea margin of the island on the south side. The whole of the coast from Rás Kattání to Rás Felink is bold to approach, the 20 fathoms line being 4 to 8 miles off shore, but in some places there are overfalls of 2 and 3 fathoms. A vessel, during the fine season, may anchor in 9 to 12 fathoms, bottom of sand and coral.

Ras R'Dresseh, in Lat. 12° 34′ 15″ N., Long. 54° 30′ 50″ E., is the eastern extreme of the island, and forms in two small rocky points a mile distant from each other; a reef extends 600 yards off each, and at a distance of $1\frac{3}{4}$ miles to the eastward and northward there is no bottom with 100 fathoms. The strong rippling produced by the tides leads navigators to suppose the reef off the cape extends farther than it really does.

Bander Ras R'Dresseh is an anchorage to the S.W.-ward of the cape of that name, between the low point and the three dry patches of rock that lie off it. A vessel may bring up here in 9 fathoms, sand and rock, in tolerably smooth water, during the N.E. Monsoon, with the outer small patch of rocks bearing E. by S., the low point N.E. $\frac{1}{2}$ E., and the high bluff of Moín W. $\frac{1}{2}$ N. The channel formed between the outer rocks and the reef projecting from the point has depths of 6 to 9 fathoms, but it is less than half a mile wide, and the overfalls and strong currents make it dangerous. Half a mile to the N.E.-ward there is no bottom at 80 to 90 fathoms.

Ras Mom, in Lat. 12° 34′ 10″ N., Long. 54° 27′ E., is the extreme eastern bluff terminating the range of mountains already referred to; being 1920 feet high, it is a conspicuous object before the low land of Rás R'Dresseh is visible.

Islands and Bank of Soundings between Sokotra and Cape Guardafui (or Ras Asir).

Jezirat Saboynea, in Lat. 12° 39′ 30″ N., Long. 53° 9′ 20″ E., is a small white rocky islet, forming in three peaks; it is 800 yards long by 150 yards broad, and visible 25 or 30 miles; from Gollonsír mosque it bears W. $\frac{1}{2}$ S. 18 miles, and from Rás Sháab N.W. $\frac{1}{2}$ W. westerly 9 miles. In the channel between Sokótra and Saboynea there is no danger; and $\frac{3}{4}$ of a mile off the islet there are from 25 to 30 fathoms water.

Jezirat Darzi, the easternmost of two islands frequently called the Brothers, is $3\frac{3}{4}$ miles in length, by $1\frac{1}{6}$ miles in width at its widest part, near the centre; it rises perpendicularly from the sea to an elevation of 970 feet, except on the northern side, where the north point of the island projects about 700 yards from the base of the hill. The east end of the island bears from the western point of Sokótra South (westerly) distant 27 miles. Soundings extend from the S.W. part of Sokótra to Darzí, varying from 15 to 20 fathoms, until near the latter, when they become deeper; on the north side of the island a small bank extends $1\frac{1}{4}$ miles, at which distance there are 13 fathoms water, decreasing gradually to the shore, and increasing to 127 fathoms at $4\frac{1}{2}$ miles distance, from which the edge of the bank of soundings runs to the northward towards Jezírat Saboynea; on the south side depths varying from 20 to 30 fathoms extend to a distance of 10 miles off shore, whence it rapidly deepens off the bank. The southern edge of the bank is nearly due East and West. The eastern bluff off Darzí is in Lat. 12° 6′ 20″ N., Long. 53° 17′ 30″ E.

Jezirat Samheh, the westernmost of the Brothers, bears from Darzí W. by N.; it is nearly $6\frac{1}{2}$ miles long, by 3 miles in breadth at its eastern end; at its western end it narrows to a point. The highest point of the island is elevated 2440 feet above the level of the sea; its shores are rocky, and the south side rises in perpendicular cliffs from the sea. A reef extends half a mile off the western point, and another from the N.E. point to the same distance; and there are two small rocky islets off the south-east side. In the channel between Samheh and Darzí, which is 9 miles wide, there is no danger—the soundings varying between 20 and 25 fathoms, with bottom of sand and shells, occasionally patches of coral. E. by N., $1\frac{1}{2}$ miles from the N.W. point, is a small bank of 13 fathoms; on the south side the bank of soundings extends 17 miles; and to the westward, soundings extend to Abd-al-Kúri, increasing midway to 145 fathoms, and decreasing again towards the latter island, near which the water is very deep. The west point of Samheh is in Lat. 12° 9′ 20″ N., Long. 52° 58′ 30″ E.

Abd-al-Kuri is a long narrow island between the west end of Sokótra and Rás 'Asír, but nearer to the latter; it is 20 miles in length, by nearly 4 miles in width at its widest part. Two ranges of hills, separated near the centre, occupy the whole length of the island, and from a distance it appears as two islands. The eastern range is 1670 feet above the sea at its western extreme, while the western range is only 500 feet high at its highest part. The northern coast is chiefly a sandy beach, with a few rocky points; but the southern coast is composed of cliffs rising abruptly from the sea. The bank of soundings extends from 1 to $2\frac{3}{4}$ miles to the northward, and 4 miles to the southward of the island. The inhabitants are few, and very poor; and they are seldom visited by strangers, for the island is entirely destitute of cultivation, and the water is very indifferent.

Bacchus Bank.—To the north-eastward of the N.E. point (Rás Anjíreh), Bacchus Bank extends over 3 miles, on which the depths vary from 3 to 12 fathoms, rapidly deepening off the bank to the northward, where the edge of the bank is only distant one-third of a mile; a strong ripple is created on this bank when the tide is setting in opposition to the wind.

The depths off the eastern end of the island are 40 fathoms at $2\frac{1}{4}$ miles, 50 fathoms at $3\frac{1}{2}$ miles, and 55 fathoms at $6\frac{1}{2}$ miles distance, from which it suddenly deepens into 100 fathoms. The width of the channel between the east end of Abd-al-Kúri and the west end of Samheh is 35 miles, in which there are no

dangers except Bacchus Bank. The N.E. point of Abd-al-Kuri is in Lat. 12° 11′ 15″ N., Long. 52° 22′ 20″ E.

The western extremity (Rás Khaisat-en-Kaum) of the island forms in two sharp rocky points, bearing north and south of each other, half a mile distant; from the northern point a reef of rocks extends west half a mile. The soundings off the west end of the island are very deep, there being 25 fathoms water 1 mile, and 20 fathoms 2 miles distant, sand and coral bottom. The south point of the western extreme is in Lat. 12° 13′ 20″ N., Long. 52° 2′ 45″ E. W.N.W. of this extremity of the island, and distant 9 miles, is a coral bank, 24 to 40 fathoms water, with deep soundings of 60 to 180 fathoms all round it.

On the south coast the water is deep, there being 18 to 20 fathoms close to the cliffs, and increasing to 100 fathoms at 4 miles distance. The cliffs are abrupt, with here and there a rocky islet.

Bander Saleh, or Leven Bay, is on the south side of the island, being a concavity in the coast line, immediately to the westward of the extreme of the high mountain. The anchorage is very good in from 6 to 10 fathoms water, coral bottom, $\frac{1}{4}$ to $\frac{1}{2}$ a mile from the shore, affording shelter during the N.E. Monsoon; but no supplies of any kind are to be procured. This is the narrowest part of the island, being only one mile across, and formed of elevated sand-hills. The sandy beach of Leven Bay is in Lat. 12° 10′ 20″ N., Long. 52° 12′ 40″ E.

From the south-eastern point of Leven Bay the coast to the eastern extreme of the island is convex, formed of steep cliffs, with from 10 to 12 fathoms water close to them. The edge of the bank of soundings is 4 miles distant from the shore.

Kal Farun, or **Salts' White Rocks,** 12 miles north of the west end of Abd-al-Kúri, are about three-quarters of a mile long by 200 or 300 yards in width; they consist of two rocks divided by a narrow channel filled up with sunken rocks, and are situated on the northern side of a large bank of soundings 10 miles in length N.E. and S.W., by 6 miles in breadth. The eastern rock, which is the largest, has one peak 282 feet high, and two smaller ones; the western rock has also one large peak of the same elevation, and one smaller one. They form from different points of view in two to five peaks, and are well covered with guano, which gives them a snow-white appearance on all sides; their only occupants are birds, which flock here in great numbers. These rocks are visible, in clear weather and during the day, about 20 miles; but at night they are difficult to distinguish, owing to their colour. On the northern side the soundings only extend a short distance, increasing from 16 fathoms close to the rock, to no bottom at 100 fathoms at the distance of $1\frac{1}{2}$ miles; to the southward there are from 5 to 10 fathoms for a distance of $1\frac{1}{2}$ miles, from which they gradually increase to 25 fathoms at $4\frac{1}{2}$ miles, and thence suddenly drop off the bank into no ground at 120 fathoms; to the east and west of the rocks the edge of the bank is distant about 2 miles.

Oliver Bank was discovered by the E. I. Co.'s steamer *Semiramis*, on her passage to 'Aden, in 1845. On sounding during the night, one cast of 17 fathoms was obtained, and immediately after no bottom. On the return voyage the vessel was steered for the spot, when the same soundings were obtained. An examination of the spot was subsequently made by Lieutenant Grieve, Indian Navy, in the *Palinurus*, without, however, any success in finding it; it is probably, therefore, very small. The position given is Lat. 13° 51′ N., Long. 54° 5′ E.

THE SOMALI (OR N.E.) COAST OF AFRICA, FROM RAS 'ASIR TO BURNT ISLAND.

From Rás 'Asír to Rás Alúleh the coast trends in a W.N.W. direction, in a nearly straight line, for 30 miles; there are a few projecting points, but no dangers exist. In the bay immediately to the westward of Rás 'Asír is good anchorage, and protection from southerly winds, but more to the westward the ground is rocky from the shore to the 10-fathoms line, a distance of 1 mile. The soundings rapidly increase in depth from 10 fathoms to the edge of the bank, which off Rás 'Asír is distant $2\frac{1}{2}$ miles, increasing to $6\frac{1}{2}$ miles off Rás Búah, and decreasing again to 2 miles off Rás Alúleh.

Ras Alulch, in Lat. 11° $59\frac{3}{4}'$ N., Long. 50° $46\frac{1}{2}'$ E., is a very low, sandy, but prominent point, near the extremity of which is the narrow entrance to an extensive lagoon.

The small village and anchorage of Alúleh lie on the west side of the point. The anchorage is on the edge of a narrow ledge of coral, 350 yards from the shore, and is sheltered from N.E. winds. The water at the village is bad, but cattle and abundance of firewood may be procured.

From Rás Alúleh the coast trends to the W.S.W. 15 miles, as far as Rás Fílúk, when it turns to the S. by W. 7 miles to Marayeh. The shore, with the exception of Rás Fílúk, is low and sandy, with an elevated stony plain between it and the mountain range in the interior. The bank of soundings extends but a short distance from the shore, being 5 miles in width to the northward of Rás Fílúk, and only $1\frac{1}{2}$ miles at Bander Fílúk; the depths increase rapidly from the shore, to 100 fathoms at those distances.

The Auckland Bank, in Lat. 13° 13′ N., Long. 50° 9′ E., was discovered in August, 1841, by Lieutenant Hewett, I.N., who reported it as an extensive bank having overfalls on it from 17 to 13 and 22 fathoms.

Ras Filuk (or Rás-al-Fíl), in Lat. 11° $57\frac{1}{2}'$ N., Long. 50° 38′ E., is a prominent hill 800 feet high, projecting far into the sea, 9 miles W.S.W. of Rás Alúleh, and whether viewed from the eastward or westward has the appearance of an island, the land about it being low; it may be seen at the distance of 40 miles in clear weather. The water is deep off it, there being 18 and 20 fathoms within a $\frac{1}{4}$ of a mile. In the valley to the eastward is a lagoon of salt water and the bed of a water-course; and to the westward is a small but deep bay, with good anchorage in from 8 to 10 fathoms water, where shelter may be found from easterly or southerly winds.

The low sandy point 6 miles to the S.W.-ward of the above-named point, is also called Rás Fílúk.

The small fort and village of Fílúk is situated close to the beach, 5 miles southward of the low point of Rás Fílúk, off which is a coral bank with 3 to 10 fathoms water on it; and immediately to the north of the village is the entrance of an extensive lagoon.

Marayeh is the principal town on this part of the coast, in Lat. 11° 43′ N., Long. 50° 28′ E.; it is situated close to the beach, 7 miles southward of the village of Fílúk, and is defended by forts. The anchorage off the town is good, in from 5 to 10 fathoms water, the soundings increasing gradually to 20 fathoms at $1\frac{1}{4}$ miles

distance from the shore, after which they become irregular with overfalls; the edge of the bank lies 5 miles from the shore.

SUPPLIES.—Good water may be obtained from a well two miles inland; bullocks, sheep, and firewood may be procured in abundance.

From Marayeh to Rás Gorí, a distance of 47 miles, the coast trends in a general W. by S. direction, but slightly concave, with small projecting rocky points. The soundings are deep, and the shore bold to approach, there being no dangers except off the town of Khór, where a bank of 3 fathoms extends off shore to the N.W. and West one mile. The edge of the bank of soundings varies in distance from the shore from $1\frac{3}{4}$ to 6 miles; bottom of sand.

Ras Gori, in Lat. 11° 30′ N., Long. 49° $43\frac{1}{2}$′ E., is a high rocky cape, 60 miles W.S.W. of Rás Fílúk, being the termination of a high range of lofty table mountains, which stretch away to the E.S.E. The soundings off the cape are very deep, and the 100 fathoms line is only distant from the coast 1 mile.

Ras Antareh, in Lat. 11° $27\frac{1}{2}$′ N., Long. 49° $35\frac{3}{4}$′ E., is a high rocky cape 9 miles W. by S. from Rás Gorí, and is the termination of another range of lofty mountains; the shore between the two capes is sandy and covered with bushes; the soundings extend off shore 3 miles.

From Rás Antareh the coast trends W.S.W. 16 miles to Rás-al-Hamr, and is divided into two shallow bays by a rocky point called Rás Abúrgabeh, $6\frac{1}{2}$ miles S.W. of Rás Antareh. The shores of both bays are sandy, and behind them is a range of hills from 800 to 1500 feet high. Close to the westward of Rás Abúrgabeh are two small villages. With the exception of a small 2 fathoms bank half a mile north of the westernmost of the villages, the soundings are regular, and there are no dangers; the depths increase gradually to 20 fathoms, from which they rapidly deepen into no bottom at 120 fathoms, at the distance of 2 to 6 miles from the shore. The general nature of the bottom is sand. In the bay westward of Rás Abúrgabeh there is very good anchorage in 9 and 10 fathoms $1\frac{1}{4}$ to $1\frac{1}{2}$ miles from the shore, but it is open and unprotected.

Ras-al-Hamr, in Lat. 11° $20\frac{3}{4}$′ N., Long. 49° 20′ E., is a prominent rocky point, about 300 feet high, terminating a narrow ridge of hills. The soundings off the point increase from 6 fathoms close to the point, to 10 fathoms at $1\frac{1}{4}$ miles distant, and 100 fathoms at $2\frac{1}{2}$ miles.

From Rás-al-Hamr, the coast runs in a general West direction for 40 miles to Rás Hadádeh; it is slightly concave, forming a bay, generally low, with occasional hills, and backed by a high mountain range (Jebel Wursúngeli), averaging 6500 feet in height, without any prominent peaks, being perfectly level along the summit. The range extends as far west as Meyet. The soundings on this portion of the coast appear regular, but deep; the 10 fathoms line is from $\frac{1}{2}$ to 1 mile distant from the shore, and the edge of the bank of soundings is from $1\frac{1}{2}$ to 4 miles, being very steep, —in some parts falling suddenly from 20 to 100 fathoms. The bottom is rocky inshore; sand, and sand and shells farther out.

Ras Hadadeh, in Lat. 11° $20\frac{1}{4}$′ N., Long. 48° $40\frac{1}{2}$′ E., is a rocky point about 300 feet high, backed by a cluster of hills 600 feet in height.

From Rás Hadadeh to Rás Galwóni the coast trends W.S.W., a distance of about 47 miles. It is low near the sea, with an occasional hill, but bounded in the interior by the lofty range of Jebel Wursúngeli. The soundings on this part of the coast are irregular, and the bank extends off shore from $1\frac{1}{2}$ to 4 miles. Indifferent and

unprotected anchorage may generally be found in from 5 to 10 fathoms water close in to the shore; bottom of sand and rock.

Ras Galweni, in Lat. 11° 8′ N., Long. 47° 57′ E., is a low sandy point, to which a spur of the mountain range slopes.

From Rás Galwéni the coast trends West 9 miles, to an unnamed point; whence to Rás Súereh, a distance of 15 miles W. ½ N., it is concave, forming a bay 3½ miles in depth. The shore is low and sandy the whole distance, and thinly covered with bushes at a short distance from the beach, behind which undulating hills stretch to the range of mountains in the interior. The edge of the bank of soundings is at an average distance of 2½ miles from the coast, except at one point, E. by N. of Rás Súereh, where it is 6 miles distant. The 10 fathoms line is about ¾ to 1 mile off shore, from which the depths rapidly increase to 100 fathoms. The bottom is generally sand and coral, occasionally shells;—and towards the edge of the bank, mud.

Ras Suereh is a low bluff point, from which the slightly convex coast line trends to Rás Katíb, in a general W. by S. direction, for a distance of 22 miles; the range of undulating hills, mentioned above, still continue to bound the coast, with occasional spurs from them approaching the sea.

Ras Katib is also a low rocky bluff point, off which the soundings are very deep, there being 22 fathoms water close to it, and to the westward of it the soundings do not extend beyond a mile.

Ras Hambais, 8 miles E.N.E. of Rás Katíb, is a low sandy point, and may be known by a single large tree on the beach.

Burnt Island, or **Meyet,** in Lat. 11° 13′ N., Long. 47° 14′ E., is a barren rock, 430 feet above the sea, and perfectly white, being covered with guano. It lies 5⅓ miles from Rás Hambais, the nearest point on the mainland, which bears from it S. by E. ¼ E.; Rás Katíb bears from it S.S.W. ¾ W. A reef projects about 200 yards from its western extreme, with a sunken rock having only 2 fathoms water over it. The soundings in the channel between the island and the main, in which there are no dangers, are very irregular, varying from 13 to 22 fathoms, and to the south-eastward to 78 fathoms. The depths close to the island are 13 to 19 fathoms. The edge of the bank of soundings is 3 miles distant to the northward of the island, and the same to the westward; to the north-eastward it is 5½ miles distant. The bottom is chiefly coral,—occasionally sand, or sand mixed with shells.

No water is to be found on Burnt Island except in rainy weather, which lodging in pools on the summit of the rock, percolates through, and finds its exit close to the water's edge.

On the south side of the island is a remarkable cove or natural dock, capable of admitting a ship of 300 tons by clenching the ends of a cable through the holes in the rock: the remains of two clenches of cables were found affixed to the rock in 1801. In October, 1844, the remains of a hempen cable were found, which had been apparently rove through a hole in the rock.

From Rás Katíb the coast runs S.W. 8 miles to Jebel Meyet (1200 feet high), which terminates on the coast at a small rocky point. The coast for 4 miles from Rás Katíb is composed of low cliffs, after which it becomes sandy. The soundings are very deep, and the edge of the bank is only 1½ miles distant from the shore, affording no safe anchorage.

From Jebel Meyet the coast trends west for 4 miles, where it forms a low, round,

sandy point called Rás Jalbú, off which the soundings are still very deep, extending off shore only half a mile. S. ½ W. from Rás Jalbú the high mountain range of Jebel Wursúngeli terminates in a lofty pyramidal peak, 6170 feet above the sea; and 11 miles to the eastward of the peak is the loftiest part of the range, 7150 feet high.

For vessels bound to or from the Red Sea, the only real dangers in the Gulf of 'Aden are—(1), the reefs in the vicinity of Zeyla, on the African coast, which are so placed as to render it almost impossible to give a satisfactory and clear description of them; and (2), the extensive bank of broken ground between Rás Kaú and Rás 'Arah on the Arabian side; but with ordinary precaution—with a good look-out, the regular use of the lead, and with occasional night observations, all these dangers may be avoided.

1. *Dangers on the African side,* in the vicinity of **Zeyla :—**

At the distance of 92 miles from Berberch and on the parallel of 10° 59′ N., is the small inlet of the sea called Khór Karangarít, off which, bearing E.S.E. 5½ miles from the entrance, is Shab Karangarít, a dangerous rocky patch, just awash at low water, and distant from the coast line 2 miles. It has 10 and 11 fathoms water close to it all round, and 40 fathoms at the distance of 5 miles to the N.E.-ward.

Shab Maduji is a dangerous rocky shoal, 1½ miles in length N.W. and S.E. by ¾ of a mile in breadth, and distant from the nearest land 2¼ miles. On the south-western side is a small sandbank, which covers at high water springs. The centre or dry part of the shoal in Lat. 11° 3⅓′ N., Long. 43° 38¾′ E., bears from Khór Karangarít N.N.E. 4¼ miles; and from Sháb Karangarít N.W. by N. 7¼ miles. To the N.W., N.E., and S.E. of the shoal, the soundings are regular, there being 10 and 11 fathoms water at a distance of 1¼ miles, increasing gradually to 40 fathoms at a distance of 9½ miles from the shore; but between the shoal and the shore the soundings are irregular, there being a bank with 2 to 3 fathoms water on it, on either side of which there are 7 and 8 fathoms.

N.E. by N. 1½ miles from Khór Madúji (another small inlet of the sea, and 7¼ miles N.W.-ward of Khor Karangarít), is a bank with 1 and 2 fathoms water over it, on which the sea breaks heavily at times, between which and the shore the depth is 4½ fathoms, and 7 fathoms immediately to seaward.

Ras Maskan is a low, round, and slightly projecting point, off which a reef of rocks extends 1 mile. N.E. of the cape, distant 2½ miles, is a dangerous reef of rocks, just awash at low water, rather more than ½ a mile in diameter, with 5 to 9 fathoms water close to it all round: it bears from Zeyla mosque S.E. ½ S. 11¼ miles. The channel between the shoal and the reef projecting from the cape is 1¾ miles wide, with 5 to 7 fathoms water over a mud bottom.

The coast from Rás Maskan to Zeyla, a distance of 12 miles N. by W. ½ W., is low and swampy, with a range of sand-hills, from 30 to 40 feet in height, about 2 miles from the beach. It is fronted by a reef of rocks, and the following dangers known as the Sháb Sheïkh Yakúb :—

A reef of rocks, dry in some parts at low water, and about half a mile in diameter, having 6 fathoms water close to it all round. It is distant from the shore 4 miles, and bears from Zeyla mosque S.E. by E. distant 6 miles.

A rocky patch, having $2\frac{1}{2}$ fathoms water on it, and 4 fathoms close to it. It is $2\frac{1}{4}$ miles from the shore, and bears from Zeyla mosque S.E. $\frac{1}{2}$ S., distant $4\frac{1}{2}$ miles. A 5-fathom bank, 5 miles off shore, and bearing from Zeyla mosque S.E. $\frac{1}{4}$ E., distant 8 miles.

The soundings increase gradually from the shore to seaward, until a depth of 40 fathoms is reached, beyond which no soundings have been taken.

Zeyla (the mosque) is in Lat. 11° 22′ N., Long. 43° $27\frac{1}{3}$′ E., and is of some commercial importance.

Of the many reefs and dangers in the immediate vicinity of this place, it is almost impossible to give a clear description :*—

"The harbour is 2 miles wide North and South, by 3 miles East and West, having depths of 3 and 4 fathoms at low water springs, muddy bottom, the deepest water being near Sadaldín island. On the West side are a series of sandbanks extending from Rás Takúsheh, a low sandy point $3\frac{3}{4}$ miles W. by N. of the mosque, in a N.N.E.-ly direction towards Sadaldín island, having three channels between them, each about 300 yards wide, with 3 fathoms water in them at low water springs. On the North it is bounded by Sadaldín island, which is of coral formation, elevated about 20 feet above the level of the sea, and thickly covered in some places with bushes, otherwise perfectly barren. The island is 2 miles long in a North and South direction, by $1\frac{1}{2}$ miles East and West: a reef extends from it in all directions, to a distance of 1 mile from its S.E. and S.W. extremes: $\frac{1}{4}$ of a mile from its N.W. end, and $\frac{1}{2}$ a mile from its N.E. end. To the eastward of the island, and separated from the reef by a narrow channel 700 yards wide, with 4 to 6 fathoms water in it, is a reef 1 mile long, lying N.N.E. and S.S.W., dry in some parts at low-water springs: it bears from Zeyla mosque N. by E. $\frac{1}{2}$ E. 5 miles; and South of this reef nearly mid-channel is a small patch of 5 fathoms. There is a small village and tank of water at the south end of the island. On the South, the harbour is bounded by the reef, which extends from the shore $\frac{3}{4}$ of a mile, and from Rás Hamár $1\frac{1}{4}$ miles to the North and N.E. A bank of hard sand, having on it 3 and $3\frac{1}{2}$ fathoms at low water, extends from Rás Hamár $4\frac{1}{2}$ miles in a direction E.N.E., and is 3 miles in width.

"**Shab Filfil** are two sunken reefs lying off the hard sandbank which extends from Rás Hamár, with a channel $1\frac{1}{2}$ miles wide between, having 4 to 6 fathoms water in it, over a mud bottom: they are separated from each other by a channel $1\frac{1}{2}$ miles wide, with 5 fathoms water in it. The north-western reef is 2 miles long, lying W. by N. and E. by S., by $1\frac{1}{2}$ miles wide, the centre of it bearing from Zeyla mosque N. E. by E. 8 miles distant. The south-eastern reef is 2 miles long, lying North and South, by $1\frac{1}{4}$ miles wide, the centre of it bearing from Zeyla mosque E. by N. $\frac{1}{2}$ N. $8\frac{1}{3}$ miles.

"Between these two reefs, to the south-westward, is another small rocky patch, nearly dry at low water, about 300 yards in diameter, and bears from the mosque N.E. by E. $\frac{3}{4}$ E., distant $7\frac{1}{4}$ miles.

"There is also a very dangerous rocky patch, about 300 yards in diameter, having on it $1\frac{1}{2}$ fathoms at low water springs, and 6 to 10 fathoms water all round it. Between it and the reef off Ivát island, is a channel $2\frac{1}{4}$ miles wide, with depths of

* Commander C. G. Ward, I.N., from Lieutenant W. C. Barker's private M.S.; see also Journal R. Geog. Soc., vol. xviii. p. 130.

9 and 10 fathoms water in it; and between it and Shâb Filfil the channel is one mile wide, with depths of 8 to 10 fathoms water in it. This patch bears from Zeyla mosque N.E. $\frac{3}{4}$ N., distant 8 miles.

"The soundings to the eastward of Shâb Filfil gradually increase from 17 to 25 fathoms at a distance of 4 miles, then suddenly drop into no bottom at 40 fathoms: the bottom is all mud, with the exception of the bank off Rás Hamár, and the depths decrease gradually towards the harbour.

"**Ivat** or **Efat** is a low sandy island, with a few stunted bushes scattered over its surface, lying to the northward of Sadaldín island. It is $2\frac{1}{2}$ miles long in a direction N.E. by N. and S.W. by S.; the western side is steep-to, having 8 or 9 fathoms water close to the beach: a reef, however, extends to the eastward of the island $3\frac{1}{2}$ miles; and to the south-westward $1\frac{1}{2}$ miles in rocky patches and overfalls, having a channel one mile wide between it and Sadaldín island, with 5 to 7 fathoms water in it. The south-west point of the island bears from Zeyla mosque N. $\frac{3}{4}$ W., distant rather more than 8 miles. There are two rocky patches bearing from the south-west point of Ivát island as follows—viz., N. $\frac{1}{4}$ W. distant $1\frac{1}{2}$ miles, and W. $\frac{1}{4}$ S. $3\frac{3}{4}$ miles. The former has 11 fathoms water close to it on the north and west sides, and 6 fathoms between it and Ivát island. Between the latter and Ivát island the depths are 9 and 10 fathoms, and between it and the sandy spit off Rás Gomehlí, from the nearest point of which it is distant nearly $1\frac{1}{2}$ miles, there are 7 fathoms water. There is also a rocky patch, dry at low water, close to the westward of the sandbanks forming the western boundary of Zeyla harbour. Between Ivát island, Sadaldín island, and Rás Gomehlí the depths are from 5 to 7 fathoms."

2. *On the Arabian side the dangers are as follows:—*

RAS KA'U, in Lat. 12° 39$\frac{3}{4}$′ N., Long. 44° 24$\frac{1}{4}$′ E., is a projecting cape, which, from its dark appearance, is known by the name of the "Black" Cape. Three miles inland to the N.N.W. is a remarkable saddle hill (Jebel Ka'ú), 798 feet above the sea; three other small hills occur to the S.W. of it near the coast.

The coast to the eastward of Rás Ka'ú is flat and sandy for a distance of 18 miles, as far as Rás 'Amrán, forming a bay nearly 5 miles deep, with regular soundings, there being 12 and 13 fathoms 2 or 3 miles off shore, and no dangers; the bottom is principally clay and sand, with an occasional patch of rock.

KHOR 'AMRAN is a remarkable inlet, situated 17 miles W. by S. from Rás Ka'u; it is $4\frac{1}{2}$ miles long from E. to W., by $2\frac{1}{2}$ broad, and is almost land-locked by a narrow spit of sand which projects from its eastern shore, and forms its southern boundary, leaving a very narrow entrance to the westward, with only 6 feet water.

Between Rás Ka'u and Khór 'Amrán, a very dangerous sand-bank extends, at one point reaching 4 miles off shore: no vessel should approach nearer than 15 fathoms by day and 20 fathoms by night, and even then great attention must be paid to the lead; for although the limit of the bank may sometimes be seen from the masthead of a vessel, much caution is *always* necessary in approaching this part of the coast, as the water shoals very suddenly. On some parts of the bank, the water breaks at low water springs. The bank of soundings extends 20 miles from the shore, there being 125 fathoms water at that distance.

RAS 'A'RAH, in Lat. 12° 37$\frac{1}{2}$′ N., Long. 43° 53$\frac{1}{3}$′ E., and 31 miles W. by S. from Rás Ka'u, is the southernmost cape of Arabia; it is a very low, sandy, rounded point, and so difficult to distinguish at night that it is one of the most dangerous capes on

the coast, for being in the direct route for vessels proceeding to or from the Red Sea, and having a bank of hard sand extending nearly $3\frac{1}{2}$ miles off shore to the *eastward* of it, with two or more dangerous rocky patches with only 9 feet of water on them, several vessels have been wrecked in this vicinity. This bank, which extends as far as Khór 'Amrán, is the more dangerous, as the water suddenly shoals from 15 fathoms; and a ship with good headway would hardly have time to get a second cast of the lead before touching the ground: it is advisable not to approach nearer than 15 fathoms by day and 20 fathoms by night.

The whole of the coast between Rás 'Amrán and Rás A'rah is low and generally sandy, with a few bushy shrubs; but here and there a rocky point occurs.

The natives are treacherous, and not to be trusted.

Anchorage.—There is good anchorage in the small bay to the westward of Rás 'A'rah, affording shelter against the strong winds during the N.E. Monsoon: the coast immediately round the bay is rather steep.

THE RED SEA.

It does not come within the scope of this work to give directions for and a description of the Red Sea; commanders bound thither should be supplied with Capt. Elwon and Moresby's "Red Sea Directions," now published by the Admiralty.

The lights in the Red Sea are at Perim Island, on the Dædalus Shoal, in Jubal Strait, at Zafarana, and at Suez; these are fully described in the "Light List" at the end of this work.

The following general remarks on the passage of the Red Sea are by Capt. F. G. Dent, and may be of service to a commander going there for the first time:*—

"Bound to Aden during the N.E. Monsoon, after rounding the Cape of Good Hope, the middle passage is preferable, passing to the eastward of Rodrigues, say 67° E., and keeping this meridian as nearly as possible until the ship is in Lat. 8° or 9° N., then stretch over to the north-west, in order to weather Sokótra, before keeping away for Aden.

"Leaving Aden for the Red Sea during the S.W. Monsoon (June, July, and August), short tacks of two hours' duration on the Arabian side, up to Bab-el-Mandeb Peak, will be found most advantageous,—keeping clear of the overfalls between Rás Ka'u and Rás A'rah, the ripple on which can be seen by day; at night, the lead should be kept going when standing in, and do not reach inside of 17 fathoms till they are passed. On arrival at the Straits of Bab-el-Mandeb, the wind will be found blowing down the sea from about N.W. The Straits being difficult to beat through, it is advisable to dodge under the lee of Bab-el-Mandeb Peak till daylight, before making the attempt; the large strait is preferable with a loaded ship. On the last passage drawing 17 feet, drifted out on the first trial. The next morning the following plan was successful, occupying thirteen hours:—From close under the lee of Bab-el-Mandeb Peak, stood over towards Perim Island, worked short tacks under the lee of it, until nearly abreast of the bay on the south-west side of the island; from thence stood over to the African side, weathered Ras Seajarn, and the cluster of rocks to the

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* Mercantile Marine Mag., 1859, vol. vi. pp. 1-5.

north-west of it, which are visible above water, made several short tacks on the African shore (where I found the current slack) before standing to the north-east, and weathering Perim Island.

"From the Straits, past Mocha and up to the Harnish islands, the Arabian side should be kept; from thence, passing between the Great and Little Harnish, keeping to the westward of Jibbel Zoogur, Zebayer islands, and Jibbel Teer, the Arabian side is best for beating up. If bound to Cosire, Namahn island should be reached before standing over to the western side for it. Bound to Suez, the Arabian side should be kept until the island of Joubah is sighted to the north-west of Moilah, from thence stand over to the African side, work up under the lee of Shadwan Island, and watch a favourable opportunity for beating through the Straits of Jubal.

"Beating up from Jibbel Teer to Moilah on the Arabian side, two plans may be followed: First, by working short-tacks near the reefs during the day, standing well off at dusk, and tacking so as to be near the reefs again at daylight; this, with a constant look-out from the foreyard, is the safer, though more tedious way, and requires but little calculation as to the position of the ship beyond the latitude at noon. The other is, to be well in mid-channel about dusk (having afternoon observations for chronometers to be sure of the distance from the reefs), and ready for a long stretch on the port tack to the northward, as the wind at this time backs a point, sometimes two or three points, to the westward, and remains so the greater part of the night. This is the most expeditious way of turning up, but requires great attention and a good chronometer.

"On arrival off the Straits of Jubal, vessels were formerly in the habit of remaining under Ras Mahommed, for an opportunity to beat through. Ras Mahommed is low, not easily distinguished in the night, and the set of the tides varying, several ships have been on the reef at night, among them an American ship, in charge of Jerboose Serroul, one of the oldest and best Arab pilots in the Red Sea. Between Shadwan island and the Jaffatine islands, close up under the lee of the former, is now preferred by all the Arab pilots who go up with ships from Jiddah.

"The Straits of Jubal may be worked through by night, with a good moon up. If dark or hazy, it is not safe. In 1842 it was attempted by one of the E. I. Company's schooners, under the command of an officer who was thoroughly acquainted with the place, and in doing so, she got on shore on the reefs above Jubal, on the western side; the breeze was moderate, weather rather hazy, very little sea on, vessel under all plain sail, with a good look-out on both bows. In getting the stream anchor out into a boat, the tackle parted and the anchor was lost; preparations were then made to rig a raft across the two quarter boats, for the purpose of carrying out a bower anchor; before this was completed, the vessel's stern fell with the tide, and she slipped off into deep water.

"On the eastern side of Jubal Island is a *white patch*, visible on a moonlight night; from the anchorage at the south end of Shab Ally; this cannot be seen, so that in standing to the north-east on the port tack, care must be taken to go round before losing sight of it. This is an excellent and favourite mark of the Arab pilots, by one of whom it was pointed out to me. Standing to the westward on the starboard tack, the bearings of Jubal Island, and the high land of Zeitee, will indicate the time to go about. With a dark night coming on, when abreast of Jubal Island, good anchorage is to be found close in under the south side; this is preferable to the

narrows on the eastern side of the Straits, or to running back under the lee of Shadwan Island. From Toor up to Suez the dangers may be avoided with ordinary attention: the greatest difficulty is in judging the distance from the shore by the eye, when turning up at night. In this the Arab pilots are to be depended upon, from long practice. Too much dependence must not be placed even on the lead at night, as the water shoals suddenly on approaching the high land.

"The variation has decreased in the Red Sea of late years. In the lower part of the Sea, ten miles to the S.W. of Zebayer islands, the mean of three Azimuths taken during a calm, August 23rd, 1857, gave 4° 30′ West; Bar. 29·89, Ther. 91° Fahr.

"The northerly winds blew strongly between Toor and the Khurrar Reefs; and the southerly winds are most violent between the Straits of Bab-el-Mandeb and the Zebayer islands. Off the north end of Jibbel Zoogur, in December and January, they are very severe. With the northerly winds, ships are rarely reduced on a wind below double-reefed topsails, courses, and jib. With southerly winds in the lower part of the sea, it is common to be under the lee of Jibbel Zoogur, with close-reefed topsails, for fourteen days at a time. At Jiddah there is an off-shore wind in the early part of the morning, which enables ships to get clear of the reefs before the northerly wind comes down: in September it commences as soon as the last star in the tail of the Great Bear rises above the horizon in the north-east. This is the Arab's sign for it, who have all ready for tripping by the time it makes its appearance.

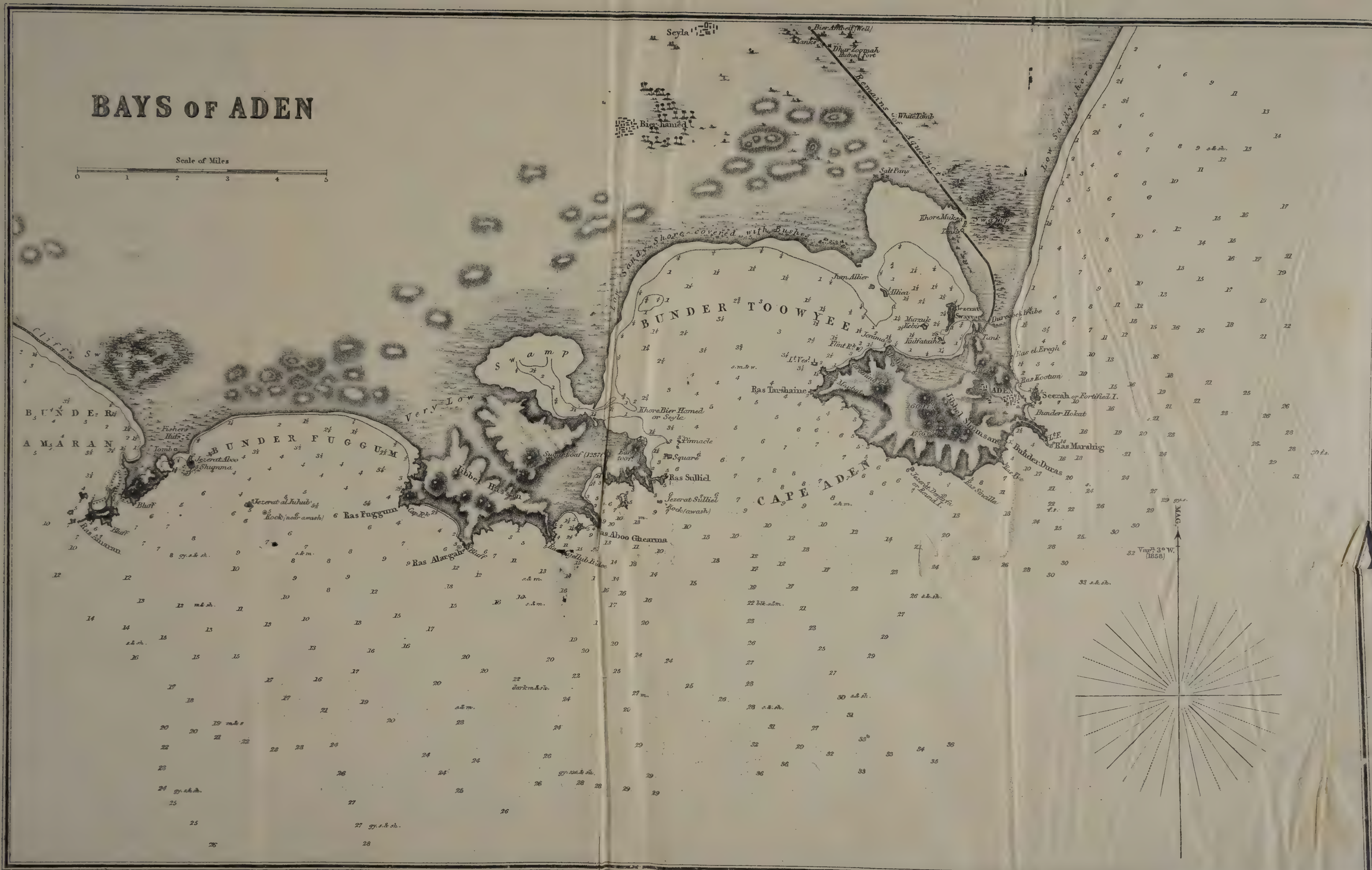
"The atmosphere, at times, is remarkably clear in the Red Sea. At sunset, with Riackah Island on the Arabian side, bearing N.E. ½ E. 4 miles, I have seen Moilah High Peak, bearing N. by W., distant about 92 miles. It appeared like a bark under canvas, on the port tack, heading to the westward with her main-yard to the mast.

"The quickest passages up the Red Sea, from 'Aden to Suez, against the N.W. winds, under canvas, have been made by the Hon. E. I. Company's schooners *Mahi* and *Constance*, which were running with the mail at that season, before steamers were established at Suez. The *Mahi*, I believe, has turned up from 'Aden to Suez in twenty-eight days; they, however, at times, could make no progress against the northerly winds in the lower part of the Gulf of Suez. I remember seeing the *Constance* at Toor on her first trip, where she landed her mails, which were forwarded by land to Suez from the above cause. Forty-five days up, and ten days down, is about the average passage for a coal-laden ship between 'Aden and Suez in June, July, and August.

"September is the best time to leave England to get a good run up, and also down the Red Sea; this period should always be selected for an ordinary sailing ship, which will then be enabled to procure, by the time she is discharged at Suez, a cargo of pilgrims from thence to Jiddah, and possibly a cargo of salt from Jiddah to Calcutta.

"A fast sailing ship may leave England in February, provided there is a good run out of the English Channel, and quick despatch at Suez. She may thus clear the Red Sea in September before the strong southerly winds set in, outside, in the Gulf. It has been done. At this period cargo down, or pilgrims, as passengers, are not to be obtained.

"With the exception of country ships from Calcutta to Jiddah with rice, and those from England to Suez with coals, from the Tyne and Liverpool, for the


BAYS OF ADEN
Scale of Miles
0 1 2 3 4 5
Seyla
Bier hamed
Remains of Aqueduct
White Tomb
Low Sandy Shore
Salt Pans
Swamp
Low Sandy Shore covered with Bushes
BUNDER TOOWYEE
Swamp
Very Low
BUNDER FUGGUM
BUNDER AMARAN
Cliffs
Fishers Huts
Tomb
Jezerat Aboo Shumma
Bluff
Ras Amaran
Jezerat al Juhub
Ras Fuggum
Ras Alargah
Jibbel Hasan
Sugar Loaf (1237)
Ras Aboo Ghearma
Khore Bier Hamed or Seyla
Pinnacle
Square
Ras Sulliel
Jezerat Sulliel Rock (awash)
CAPE ADEN
Ras Tarshaine
Jibbel Shumsan
ADEN
Tank
Ras el Eregh
Ras Kootum
Seezah or Fortified I.
Bunder Hokat
Ras Marshig
Bunder Duras
Ras Sincilla
MAG.
Var.n 3° W. (1858)

Peninsular and Oriental Company, the Red Sea is but seldom visited by merchant vessels. Occasionally American and French ships will proceed to Mocha or Hodeidah to purchase coffee; the latter will sometimes proceed to Massowah and purchase a cargo of mules for the Mauritius or Bourbon.

"At Suez, sand is supplied for ballast, and placed on deck at 3*s.* per ton. The port charges are trifling.

"Water and fresh provisions can be obtained on the passage up, at Mocha, Hodeidah, Jiddah, Wedge, and Toor—all easy of access without pilots, except Jiddah, which is not safe to attempt without one; but vessels hove-to outside, near the reefs in sight of the town, with a pilot-jack flying, will soon have one alongside. Beating down against southerly winds, vessels in want of dunnage, or fire-wood, can anchor and obtain it for the cutting. Off the north end of Jibbel Zooghur, and on the north-west side of Jezirat Fartmar, on the African side, south-west of Mocha. Pilots for the Red Sea can be obtained at 'Aden, but they are not so good as those at Jiddah, particularly for the northern part of the sea. JERBOUSE SERROUL is the only pilot at Jiddah who speaks English, but many of them understand Hindústanee.

"The agent at Suez being limited as to the amount of cash to be advanced for ship's use, commanders of ships who have not quick despatch may find themselves in an awkward situation for want of money to pay disbursements; and as there are no parties in a position to advance money in return for captain's bill on owner, a journey to Alexandria, and detention of the ship is the consequence.

"Owners who have ships chartered for Suez, can correspond and arrange with some firm at Alexandria, to forward to Suez any stores required. MESSRS. TANCREDI, AGIUS, and Co., from long connexion with the shipping interest at Malta and Alexandria, are in a position to do this satisfactorily.

"Scorbutic ulcers, to which seamen are so liable after a long salt-beef passage, are in the Red Sea difficult to eradicate; an efficacious mode of treatment, in the absence of fresh provisions, is to apply lint dipped in fresh water, and kept moist with the same. Generally the climate may be considered healthy, although excessively hot at times.

"A boom foresail, and an apparatus for distilling salt water, will be found advantageous; the former will greatly assist in turning to windward, and the latter will amply repair its cost, as fresh water is not only difficult to obtain, but the best is brackish, and the average price at any of the ports is £1 per ton.

"Commanders, however, are recommended to get their supplies of fresh provisions out, either at Johanna or Jiddah, for which purpose they had better provide themselves with cash for the same, in dollars, prior to leaving England; they will then only have to lay off 'Aden to receive and post letters."

'ADEN HARBOUR AND ITS VICINITY.

THE **BAY OF 'ADEN** is situated between two lofty, peninsular-form promontories—Cape 'Aden (or Jebel Shamshán) on the east, and Jebel Hasan on the west—which rise abruptly from the low sandy region of Southern Arabia.

Cape 'Aden, the most remarkable feature on the south coast of Arabia, is so

conspicuous that it cannot be mistaken, being more elevated and much more peaked than the rock of Gibraltar, to which, however, it bears some resemblance; it extends 5 miles east and west, and 3 miles north and south; and the highest part (1776 feet above the sea, and visible 60 miles), is called Jebel Shamshán—a name expressive of the *turreted peaks* on its summit.

Rás Marshigh is a narrow cape, projected from the promontory to the south-eastward of Cape 'Aden; it shelters (from N.E.-ly winds) the entrance of Bander Darás which lies between Rás Marshigh and Rás Taih, a point half-way toward Rás Sinaïlah.

Flagstaff.—The flagstaff, hitherto on Sírah island at the east side of 'Aden, is now removed to the highest part of Marshigh promontory at the S.E. corner of the peninsula.

Rás Sinaïlah, the [illegible]nmost point of the peninsula, is in Lat. 12° 45′ 10″ N., Long. 45° 0′ 40″ E. On old charts this point is called Cape 'Aden.

North-westward of Rás Sinaïlah, distant 3⅔ miles, is Rás Tarsheïn, the extreme west point of the peninsula near to which is a peak 988 feet high. A little more than a mile W. ⅓ N. from Rás Sinaïlah is Jezírat Denáfah, or Round island.

To the north (a little easterly) of Ras Tarsheïn, distant about ½ a mile, is Rás Marbút (or Steamer point), off which is the *light vessel*: continuing now to the north-eastward, at the distance of rather more than ½ a mile from Rás Marbút, is the small point of Rás ïbn Jarbeïn; 500 yards further eastward lies the Flint rock (or Sheikh Ahmed), and ¼ of a mile beyond is the rocky point of El 'Ainah; then, at ½ a mile more to the eastward, is Point Hejaf, forming the southern and western limit of the inner harbour of 'Aden, immediately off which lies a rock named Jerámah.

The peninsular promontory of 'Aden is almost divided from the main land by a creek on the eastern side of the inner harbour, called Khor Maksa, contiguous to which is a large swamp.

Jebel Hasan is the mountainous peninsular promontory, to the westward of and opposite to Cape 'Aden; it is six miles long from E. to W. by three miles in breadth; and its highest peak (in the form of a sugar-loaf) rises to an altitude of 1237 feet above the sea-level. To each of its numerous projecting points the Arabs give a name:—on the S.W. are Rás Feïkam and Rás Alargah; the most southern point—Rás Mujallab Heïdí—forms the western limit of a small bay called Bander Sheïkh: and Rás Abú Kiyámah divides this bay from Khór Kádir.

Rocks.—On the southern and eastern sides of the promontory of Jebel Hasan are nine rocky islets, nearly connected with the main at low water springs: one is in the small bay of Bander Sheïkh, to the eastward of Rás Mujallab Heïdí; two lie in the middle of the entrance to Khór Kádir, to the N. of which extends a reef of rocks for a quarter of a mile; another islet, Jezírat Sálil, S.E. of which is a rock awash, is situated off the S.E. point, called Rás Sálil; and five of them off the N.E. bluff, about one mile from the shore.

The bays and islands round the promontory are safe to approach, with proper attention to the lead, for the soundings decrease gradually to the shore.

About 1100 yards to the northward of the extreme point of Rás Abú Kiyámah is the white tomb of Sheikh Kádir. Near this spot the natives deposit coffee, cotton, and a few other articles of merchandise, in readiness for the small trading boats

lying in Bander Sheïkh and Khór Kádir, the only two ports belonging to the 'Akrabi tribe, who dwell on and in the vicinity of the promontory.

The outline of the whole of Jebel Hasan is very picturesque; a deep ravine winds through the hilly tract from Bander Feïkam to the little bay of Bander Sheïkh. The land to the northward is low, and immediately at the back of the mountains a deep inlet, named Khór Biyar Ahmed or Seïlán, extends three miles to the westward, almost insulating the promontory of Jebel Hasan.

Ass's Ears.—At the north-eastern end of this mountainous promontory is a remarkable double peak of granite, 700 feet in height, which, from its peculiar shape, is known by the name of the Ass's Ears, and is a remarkable object from seaward.

Biyar Ahmed, a small fort and village, about 3 miles from the beach, and 6½ miles north of the Ass's Ears, is the residence of the chief (or sultan) of the 'Akrabí tribe. These people are treacherous, and not to be trusted.

The chief produce of the country is jowárí (millet), of which great quantities are exported.

Jebel Hasan and 'Aden promontory are not very unlike, having at a distance the appearance of two islands, one on each side of the fine harbour they enclose.

'ADEN HARBOUR.—Bander Tuwayyi, or 'Aden West Bay, more generally known as 'Aden Back Bay, is formed by the two peninsulas just described. It is about 8 miles broad from east to west, by 4 miles deep; and is divided into two bays by a flat which runs off half a mile to the southward of the small island 'Alíyah. The entrance between Rás Salíl on the west and Rás Tarsheïn on the east is 3½ miles in width. The depths of water in the western bay are from 3 to 4 fathoms, decreasing gradually towards the shore; across the entrance the depths are 4½ to 5 fathoms, and at a distance of 2 miles outside 10 to 12 fathoms; bottom, sand and mud—both inside and outside the bay. The town of 'Aden is about 4 miles from the landing-place.

The *inner bay*, known as 'Aden harbour, is at high water between 3 and 4 miles long from north to south, and 2 miles broad, but the sand-banks at its northern and eastern shores, which dry at low water springs, contract the harbour to about two-thirds the above dimensions; the entrance, between the sandspit off the island of 'Alíyah on the north and Rás Hejáf on the south, is, at low water, about ⅓ of a mile across; off Rás Hejáf is a *dangerous sunken* rock. The depths across the entrance, and in the centre of the bay, are from 2 to 2½ fathoms, decreasing towards the shore. This harbour can be used only by small vessels. A fine pier has been built here, and a large village has sprung up near it.

Islands.—There are several islands in the inner bay; the eastern and principal one, Jezírat Sawáyíh, is 300 feet high, and almost joined to the main land at low water springs: the others are named Marzúk Kabír, Keïs el Hammán, Kalfeteïn, and Feringí; and on the sand-spit at the north side of the entrance are two small islets named Jám 'Alí, and 'Alíyah: outside, about 2 cables distant from the peninsula, is the island Sheikh Ahmed, or Flint rock, with a channel between it and the main of 2 fathoms.

Light.—Off Rás Marbút, in the inner harbour, a light-vessel (painted red), is moored in 24 feet; it exhibits a *fixed white* light, and carries, at the mast-head, a

red ball by day, and fires a gun and burns a blue light when a vessel enters during the night; position, Lat. 12° 47′ N. Long. 45° 1′ 15″ E.

Anchorage.—A vessel may anchor in any part of these bays; but the usual anchorage is between Flint rock and Rás ibn Jarbeïn,—off the coal sheds, situated near the latter. The *tides* in the bay are very irregular, being influenced by the currents outside.

Directions.—The coast round Cape 'Aden is bold to approach, and a vessel may always choose her own distance. A vessel coming from the westward may steer direct for the light-vessel, rounding it to the northward, and thence to the anchorage. In like manner a vessel from the eastward, after passing Rás Tarsheïn, may steer directly for the light-vessel, and on to the anchorage. A vessel working into the bay, towards the anchorage, may stand boldly across in any direction, being guided by the lead, until the light-vessel is reached, to the north of which the depth becomes less, and short tacks must be made. It is advisable always to moor, the anchorage being rather confined; and good scope of cable should be given, in consequence of the sand squalls, which come from the northward and eastward after sultry weather, and which give but little warning.

Supplies.—The water supplied to the shipping from the wells is very brackish; but good water, distilled from the sea by a condensing apparatus which has lately been erected in one of the small bays in the harbour, may be purchased at 13s. per ton, not including casks or boat hire. A considerable sum has been expended in clearing out the old Portuguese tanks discovered (in 1850) near the town, from which water may be procured at a less price, but the charge for carriage to the harbour would raise the cost to more than that of the distilled water. There are immense stores of coal at 'Aden, the principal part of which belongs to the Peninsular and Oriental Company. Private merchants have large quantities stacked in the bay inside Sheïkh Ahmed, or Flint rock. There are great facilities for coaling steamers. Provisions of every description may be procured; but fruit and vegetables are scarce and dear.

Trade.—'Aden was declared a free port in 1850, since which it has engrossed nearly the whole of the coffee trade formerly enjoyed by Mokhá. The principal articles of export are coffee and honey; imports chiefly coal, cotton goods, sheep, malt liquors, wines, spirits, and sundries.

'Aden is in the territory of the Abdálí tribe, which is not friendly towards Europeans; consequently, it is not safe to land on the western shore of the West or Back bay.

The religion of the Abdálí tribe is Mohammedan, and they are, apparently, very strict observers of their creed.

'ADEN TOWN.—To the N.W.-ward of Rás Marshigh, distant about 1¼ mile, is situated the town of 'Aden, on a plain rather more than half a mile square, encircled on the land side by singularly-pointed hills, having its eastern face open to the sea, while immediately in front is the rocky fortified island of Sírah. This island, which commands the eastern bay and town of 'Aden, is a triangular rock about 430 feet high towards the southern end, half a mile long by 600 yards wide: the passage which formerly existed between it and the main is now filled by sand, consequently at low water it is joined to the coast.

Between Sírah island and Rás Marshigh the curve of the land forms a small

sandy bay, named Bander Hokat; there is another to the northward, between the north point of the island and Rás Kútam.

The following remarks on the passage to, and on making, 'Aden are by Captain Brown, of the *Ayrshire*:—*

"Crossed the line on the 13th in Long. 48° 54′ E.; our average current from Bourbon to the Equator S. 31° W., 105 miles in nine days; from thence to Rás Hafún the currents were very strong and mutable. The first day after crossing the line we were swept to the westward thirty miles, and afterwards constantly to the eastward, more or less, with a great deal of weed, and strong scent of the same. Average current from Equator to Cape Guardafui was N. 85° 30′ E., 128 miles in five days, or 25·6 miles daily.

"From the strong northerly currents said to be experienced between Guardafui and Sokotra, sweeping vessels far to leeward at times, determined to steer for Rás Hafún, and run along the land from thence to Guardafui, and by shortening sail a little the night previous, managed to make it at daylight on the 18th. Some precaution is here necessary from the uncertainty and strength of the currents, and the hooked form of the cape; a ship might get embayed at night without seeing the headland, which has been the case in some instances. Had a fresh Monsoon while running along the land, which here forms a deep bight up to Ras Banneh. This cape we had on our beam at 2 P.M., distant four leagues; at 7 P.M. abreast of the Cape Guardafui, distant 6 miles, easily distinguishable. Steering along due north, by 10 P.M. had ran beyond the distance of Cape Asir by log, and as the high land of Guardafui was fast receding from view, nothing to be seen in the western direction, concluded we were in a position to steer N.W.; took in first reefs, expecting it to be squally on hauling under the land; in a short time began to shoal our water—by the lead kept constantly going—and on having 15 fathoms hauled out again to eastward of north, and could now see with the night-glass, but very indistinctly, a low deceiving point about N.N.W.

"I cannot account for this, having ran more than the distance between the capes, otherwise than that a counter-current probably exists in-shore, making very great precaution necessary in rounding those capes at night-time, for the deceptious appearance of the land here would deceive and lead any one astray. The *lead, and nothing but the lead,* can positively be trusted to, and must not be neglected be the night ever so clear. At midnight had fairly rounded, and, contrary to expectations, the fresh wind fell away to a calm about 2 A.M., and continued until near noon; the 19th, got a light breeze and hauled in-shore, for Ras Met; from hence had very light and variable airs, with a slight favourable current, by keeping at a moderate distance from land, but found it most tedious up to Burnt Island, and were a little surprised at not having the strong gusts spoken of by Horsburgh, who recommends, and very properly so, to have all best canvas bent in the months of June, July, and August. However, we had yet to learn this by bitter experience, when lulled asleep by the recent calms and light winds; as the wind got to the westward it came off the land at night.

"On the 24th of June stood off from Burnt Island; in standing over, the wind increased and became more favourable; carried a great press of canvas across, and on the morning of the 26th expected to have been abreast of Cape 'Aden, but nothing to be

* Naut. Mag., 1847.

seen at daylight; and on having sights, to our dismay, found we were fifty miles to the eastward: it now fell calm, found the current running not less than three knots to the eastward; at once concluded it to be useless to attempt beating up on this side. A fast barque which fetched into 'Aden Front bay about the same time was ten days beating round into Back bay, within the sound of the morning and evening gun the whole time; she lost kedge and warp, and on entering the harbour at night-time grounded on the mud flat which lines the northern and eastern part of the harbour, and had to be lightened before she hove off. Another ship making to leeward at the same time stood across again to the African side, and fetched 'Aden on the eighth day.

"We stood over again and fetched in with the coast of Africa, far to the eastward of Burnt Island; now found the winds constant and strong from the S.W. to W.S.W., and to come off about midnight in sudden and very violent hot gusts, to which we could show but very little canvas; working to the westward of Burnt Island. In standing over there came one of those tremendous gusts, blowing the clews out of the reefed sails (being all 'preventered' and 'stoppered'), and raised such a sea, we were glad to get under the land for shelter and bend other canvas; intending to have anchored under Burnt Island, but could not find sufficient shelter, the wind being at west, along the land; stood off and on under the lee till we shifted sails. There is a good passage between the island and the main land; but we observed some shoal water about $1\frac{1}{2}$ mile from the coast, and tacked pretty close to it.

"The seamen now began to complain of excessive thirst, and I was obliged to increase their allowance (although short), from the air being impregnated with sandy particles in the hot winds; indeed, all began to feel it very acutely. While under Burnt Island, searching, without success, for the watering-place, the gusts that came off were literally as though they came out of a furnace. Notwithstanding what is here narrated of our troubles in the passage up the coast, some vessels, a few days ahead, made the passage from Guardafui to 'Aden in eight or ten days without difficulty, and apparent ease, the winds being favourable and moderate, the moon, then in the last quarter, having apparently great influence on the winds and weather in this gulf.

"Working alongshore until off Ras Kurrum, or about 60 miles to windward of Burnt Island, we experienced those heavy gusts which come off about midnight, but took especial care to be under double reefs and reefed courses before that time. Stood over from thence, and fetched to windward with ease, although a heavy sea. The day previous to making Cape 'Aden, came suddenly into green water (from the deep sea blue), and the edges very clearly defined; had a cast of the lead, but found no soundings.

"On the 4th of July made Jebel Shamshan (the high land off Cape 'Aden), bearing N.N.E.; stood on under all sail, breeze decreasing to a calm as we approached the high land, a short sea heaving us in; anchored in 10 fathoms, sand, Round Island, or rock, bearing N.E. $1\frac{1}{2}$ mile; afterwards, in endeavouring to avail ourselves of a light air, got too close in, with the heave of the sea, and obliged to anchor in 6 fathoms for the night; veered to 60 fathoms, much closer to the rocks than agreeable, with the heavy sea tumbling in. (There was no light-vessel at this time.) In the morning ran in with the sea-breeze, and anchored in about 4 fathoms, sand, a quarter of a mile from the Coal Depôts; moored N.W. and S.E. 40 fathoms each way, which is not too much for a heavy ship in the westerly Monsoon, as the squalls at times are heavy, with a little swell,—and the sudden sand squalls also that come

occasionally from the northward and eastward, after very sultry weather, give but little warning, raising a dense black mass, and in half an hour, or less, burst upon you, covering and filling every crevice with sand. It is requisite to secure every hatch, skylight, and door, to keep it out, and to have all awnings furled, for while the squall lasts, or the pillar of sand is passing, you cannot discern a single object out of the ship. Had three or four during the time we lay there; in some cases, two or three vessels drove and fouled each other, not having sufficient scope on their outer anchors.

In reference to the approach to the harbour from the westward during the *South-west Monsoon*, the land is easily distinguished by the Jebel Hasan, with the Asses' Ears and Sugarloaf on the west, and Jebel Shamshan over Cape 'Aden on the east. I would recommend keeping the western land aboard, and having the harbour open, by steering in upon a N.E. by N. to N.N.E. course, so that should it fall calm, you can safely anchor; and with the lightest air, will drive in with the swell.

The whole of the foregoing remarks are applicable only to the western Monsoon. In the north-east Monsoon, of course, ships take the eastern passage, to fetch Guardafui; from thence there can be no difficulty, only taking care not to make the Arabian coast, as it is a lee shore, until up with Cape 'Aden. Back Bay anchorage is *then* perfectly smooth; but the egress from thence to the eastward is very tedious; and long passages may be anticipated (five and six weeks) at times, to Bombay,—and even more from October to March and April."

Capt. E. G. Dent, of the *Cambridge*, in 1859, made the following observations on the same subject, viz., the passage to 'Aden during the period of the S.W. Monsoon:*—

"After rounding the Cape of Good Hope, the passage through the Mozambique Channel is to be recommended during the N.W. Monsoon; besides having the wind free, and comparatively smooth water, it enables ships to call at Johanna—which is easy of access, and the charges are light—fill up water casks and obtain a supply of fresh meat, vegetables, and live stock, at a low rate; these being scarce and dear at 'Aden at times.

"After crossing the Equator, it is prudent to make the land before getting into the latitude of Ras Hafún, as the current sets strongly toward the island of Sokotra; in passing, found the current setting to the north-east, sixty-three miles in twenty-four hours. After rounding Cape Guardafui and Cape Felix (Ras Filuk), the coast should be worked along well in-shore (where the current will be found favourable), to at least ten miles to windward of Burnt Island, before standing over to 'Aden. Many shipmasters, in their anxiety to make a quick passage, often make a long one by standing over too soon,—for on approaching the north side the wind decreases, the current becomes adverse and strong, and if 'Aden cannot be reached it is useless to attempt beating up on the Arabian side. The African shore must be made again, and navigators who are compelled to do this will find themselves a long way to leeward of their original starting-point. Many have been a month on the passage from Cape Guardafui to 'Aden from the above cause, when by going further to windward, five or six days would have sufficed. In beating up from Cape Filuk to Burnt Island, it is well to be in-shore about sunset, as the wind hauls more to the southward, and remains so till about two o'clock in the middle watch, when it backs to the south-west. Attention to this enables a ship to make a long favourable reach.

* Mer. Mar. Mag., vol. vi. p. 2.

"The high land of 'Aden is so conspicuous that it cannot be mistaken. The town of 'Aden is on the eastern side, but ships discharge coals in 'Aden Back bay (Bander Tuwayyi'), on the west side, the entrance to which is between the high land of 'Aden and the Asses' Ears on the land to the westward. Ships may run in, keeping nearest the 'Aden side, until they sight the light-vessel, on arriving near which the pilot generally comes alongside and directs to a berth for discharging. If calling for letters or refreshments only, the light-vessel, bearing from E. to E.S.E., half a mile distant, is a good berth, in 5 fathoms. Rock stone is supplied for ballast, and placed alongside at two shillings per ton."

MAKALLEH.

Makalleh, the principal commercial depôt on the south coast of Arabia, is constructed on a narrow rocky point projecting about half a mile into the sea, with a bay on each side of it. The Nakib's (or governor's) house is in Lat. 14° 13′ 40″ N., Long. 49° 3′ 20″ E., is situated almost directly beneath a curious and remarkable oblong hill, the circular top of which rises above the summit of a steep cliff, commanding a complete view of the town, and on which six square towers have been erected for its protection.

A ship in want of supplies will find Makalleh the best port on the coast for the purpose of renewing her stock. Persons should be careful to send their own casks on shore for water, as otherwise the people are likely to bring it off in quite a brackish state; it is conveyed in skins, which women fill and donkeys transport from a well nearly 2 miles West of the town; yet notwithstanding the trouble of obtaining it, they do not render it expensive. Firewood, bullocks, sheep, fowls, eggs, and vegetables are to be procured in abundance.

The Bay of Makalleh may be said to extend from Rás Burúm to Rás Makalleh. Owing to the promontory on which the town is situated projecting from the centre of a large concavity on the coast, two small bays are formed. Of these, the lesser, or western one, is the general anchorage for boats. This is merely a small nook, with 1, 2, and 3 fathoms, having Makalleh to the eastward, and a reef to the westward (nearly dry at low-water springs), extending ½ a mile from the shore. The eastern small bay is seldom or never used, owing to a swell which rolls in with considerable violence during the N.E. Monsoon, causing a surf on the beach. The bank of anchoring soundings round the Bay of Makalleh extends for about half a mile from the shore, until off the low sandy beach running towards Fuwah, when it increases to nearly one mile.

The great Bay of Makalleh (in which are the two smaller ones, known as the eastern and western) is sometimes affected by a swell rolling in, when the wind blows strong outside; but, generally speaking, the breeze falls off towards night, and the swell goes down. A vessel can lie here with perfect security during the N.E. Monsoon.

The weather in this bay is exceedingly warm during the middle of the day, and on shore intolerable. Occasionally, however, land and sea breezes, with slight showers, seem to pour a refreshing influence over the scene in the months of October, November, March, and April, and often in June and July.

The natives say that in the S.W. Monsoon the wind blows home with very great force; but always as the sun declines the breeze and swell decrease, and that often during the morning it blows strong enough from the N.W. to carry a ship clear out to sea. They also say that a vessel with chain cables might ride out the Monsoon with safety; which is probably true, otherwise (judging by comparison), one half of Makalleh town would very soon be demolished, as the houses are, for the most part, erected in a careless and slatternly style, on a projection which necessarily receives the whole benefit of the S.W. winds, and their inevitable fate must be a general sweep into the waters beneath them, whereas they still quietly retain their separate stations.

Anchorage.—The anchorage off the town is good, in 8 to 10 fathoms water, sandy bottom, with the flagstaff off the governor's house bearing N.N.E., distant a quarter to half a mile from the shore. The only danger in the bay is the reef and sunken rock to the westward of the boat anchorage, and which must be carefully avoided. The flood sets S.W.

Ras Makalleh is a low neck of land projecting about 2 miles in a S.S.E. direction from the base of the hills, which here extend from the interior close down to the shore. Three-quarters of a mile W.N.W. of the cape is Rás Marbát, with a ruined fort; and $1\frac{1}{2}$ miles to the N.W. lies the town of Makalleh. To the southward of the cape, distant one-third of a mile, is a rocky shoal with only 4 fathoms water on it, there being 18 fathoms between it and the cape, and 40 fathoms close outside of it. The bank of soundings extends about 2 miles from the cape.

The sea along the whole of this coast is remarkable for its clearness, the bottom being plainly visible—when calm and the water smooth—in from 12 to 15 fathoms. When the *Palinurus* was lying at Makalleh, anchored in 12 fathoms, a new coil of deep-sea lead-line accidentally fell overboard and sank, but was plainly seen at the bottom. An Arab seaman belonging to the vessel went down with a sounding lead attached to his feet, and recovered it without any difficulty.

KURIYAN MURIYAN BAY AND ISLANDS.

Kuriyan Muriyan Bay is an extensive concavity of the Arabian coast formed between Rás Nús to the S.W., and Rás Sherbedát to the N.E.—being 68 miles wide by 26 in depth, having on the outer edge of the bank of soundings five islands, called the Kuriyán Muriyán. The soundings in the bay are regular, varying from 20 to 40 fathoms, decreasing towards the shore and islands; bottom of sand, coral, and shells, but occasionally rocky near the islands, and off Rás Karwáú, a bluff projecting headland 800 feet high, 2 miles W. of Rás Sherbedát. The coast line within the bay presents a succession of limestone cliffs generally fronted by a sandy beach.

Rás Nús, in Lat. 17° $12\frac{1}{2}'$ N., Long. 55° 14′ E., is a low rocky but prominent point, which may be easily known by a mountain, 1200 feet high, immediately over it, the highest and steepest part being towards the sea.

Rás Sherbedát, in Lat. 17° $53\frac{1}{4}'$ N. Long. 56° 20′ E., is a steep, projecting headland, flat on the summit, but the face of the bluff is considerably convex.

Within the great bay of Kuriyán Muriyán there are several small bays and anchorages, separated sometimes by low rocky or sandy points, sometimes by bluff

projecting headlands; but there are no villages, and only a few inhabitants, who are generally ready to assist in procuring wood and water.

The KURIYAN MURIYAN ISLANDS, to which ships have occasionally resorted for guano, are five in number—namely, Hásikí, Sódah, Hulláníyah, Kiblíyah, and Kirzáút (or Rodondo). The first four are on the edge of the bank of soundings, and lie nearly parallel with the north shore of Kuriyán Muriyán bay, from which they are distant about 22 miles. The shores are generally bold and rocky, and the hills rise in the interior into irregular conical peaks.

Hasiki, the westernmost island of the group, is nearly $1\frac{1}{2}$ mile long by $\frac{3}{4}$ of a mile wide; and 500 feet high near its southern point, in Lat. 17° $27\frac{1}{4}'$ N., Long. 55° 36′ E. The surface is quite white with the guano, and it is without a vestige of tree or shrub.

The island is rocky all round, but there are two small indentations of the coast on its eastern side. The only danger off the island is a rock $\frac{1}{2}$ a mile S.W. by W. $\frac{1}{2}$ W. from the N.W. point; it is 150 yards long, and dries at low water; the channel between this rock and the island has 16 fathoms water.

Round the island the average depths are from 25 to 30 fathoms at a mile distance from shore; but the edge of the bank of soundings passes near the south point, where no bottom is found at 145 fathoms half a mile from it.

Sodah, the second island of the group from the westward and the second largest in size, is 3 miles long by 2 miles wide, and lies 12 to 13 miles from Hásikí. Its shape is oblong, and the surface is an irregular slope from the central peak 1310 feet high, near the summit of which is some grass. The coast has many small projecting points, off which reefs extend from 100 to 300 yards, forming coves for small vessels or boats; and at the east end is entirely lined with rocks.

On the south side of the island there is a small bay, $\frac{1}{2}$ a mile wide at its entrance, and about $\frac{3}{4}$ of a mile deep, with good anchorage, having 10 fathoms water in the centre, decreasing as the shore is approached. A ledge of rocks extends 500 to 600 yards from the eastern point of the bay, in a S.W.-ly direction, and there is a sunken rock at a short distance from the western point. This bay affords shelter from all winds, except from W.S.W. to S.

Danger.—Half a mile west of the S.W. point of the island is a sunken rock, surrounded by a bank, with 2 and 3 fathoms water on it, between which and the shore is a narrow but safe channel, having 5 and 6 fathoms water in it.

The soundings round Sódah are generally deep, 20 to 30 fathoms being found close in, between the east and north points; from the north to the west point 20 to 30 fathoms a mile off; 40 fathoms a mile off the S.W. side; and the edge of the bank passes $\frac{3}{4}$ of a mile from the south side, there being 130 fathoms at that distance. The bottom is sand and rocks on the east and west sides of the island; sand, shells, and coral on its north side, and grey sand on its N.W. side. Off the S.E. side, between this island and Hulláníyah, the bank extends southwards, but deepens suddenly from 33 fathoms.

The highest peak of Sódah is in Lat. 17° $29\frac{1}{2}'$ N., Long. 55° $51\frac{3}{4}'$ E. At the S.E. point, near a well, the water of which is brackish, are the remains of a few huts.

The channel between Hásikí and Sódah is safe, with the exception of a sunken rock off the west side of Sódah. On a line drawn from the north side of Hásikí to

the north side of Sódah, the depths are from 35 to 40 fathoms; to the south of that line the soundings suddenly deepen off the bank.

Hullaniyah, the largest island of the group, is $7\frac{3}{4}$ miles long by $4\frac{1}{2}$ miles wide, and nearly 20 miles in circumference; it lies $4\frac{1}{2}$ miles to the eastward of Sódah.

The general aspect of the island is rugged, and the centre consists of numerous peaks (the highest 1503 feet above the sea) forming a cluster of irregular pillars: the eastern and western ends of the island terminate in comparatively low points; but the north end is a bold, projecting bluff, 1645 feet in height, being the loftiest part of the island, and presents a rugged and nearly perpendicular face to the sea for upwards of a mile on each side of the cape. The whole island is extremely barren, the largest and only tree being the tamarisk; there is a little grass on the eastern side.

The western point of the island is called by the Arabs Rás Shatt, by the islanders Erékhi Frahunt; the eastern point is Rás Sáïr; and the northern point, called Rás Hulláníyah (or Erékh-er-rahíb) is steep-to—there being 12 and 13 fathoms water close to the cliff.

The N.E. bluff of Hullaniyah is in Lat. 17° $32\frac{3}{4}'$ N., Long. 56° $2\frac{1}{2}'$ E.

The edge of the bank of soundings is about 2 miles south of the island, beyond which distance there is no bottom at 140 fathoms.

Ghubbet Er-rahíb is a bay on the N.E. side of the island, $3\frac{3}{4}$ miles wide from point to point, and $1\frac{1}{2}$ miles deep, formed by Rás Hulláníyah on the N.W. and Rás Sáïr on the S.E.; there is good anchorage here in from 7 to 14 fathoms water, and good shelter from all winds between S.E. to N.W. round by S. and W.

Dangers.—Several shoals and rocks extend to the distance of 2 miles off the west end of the island, and have between them narrow channels of from 5 to 10 fathoms. One of these rocks $\frac{3}{4}$ of a mile from the point, dries at low-water springs. Off Rás Sáïr, and for $2\frac{1}{2}$ miles to the S.W., the coast is fringed with rocks, extending in some places half and three-quarters of a mile from the shore. One-third of a mile S. by E. of the south point of the island is a small bank, having $3\frac{1}{2}$ fathoms water over it; and in the bay to the westward of the point is a reef of rocks close to the shore.

Although the distance between Hulláníyah and Sódah is $4\frac{1}{2}$ miles, yet the safe channel is on the Sódah side, since the rocks lying off the western end of Hulláníyah reduce the width of the channel to $2\frac{1}{2}$ miles. There are 12 to 20 fathoms water in the clear channel; and the east side of Sódah, though rocky, may be safely approached to within half a mile.

Tides.—The ebb sets through the channel northwards, but is much influenced by the sunken rocks.

Water.—There is a well of fresh water about 400 yards from the beach, in the centre of the valley turning westward, abreast of a small nook with a sandy beach, which may be known by a small peak that forms its eastern end; this nook is situated one mile to the westward of the east end of the long sandy beach, in the centre of the bay. Two other wells are situated towards the western end of the island—one northwards, and the other southwards.

The anchorage is 600 to 800 yards off shore, in 10 or 12 fathoms, sandy bottom, abreast of a small sandy nook, $1\frac{1}{4}$ miles west of two conspicuous sand-hills, which are about $2\frac{1}{2}$ miles east of the western point of the island, and visible at a distance of 10 or 12 miles. It is open to all winds from East through North, to West.

Vessels anchoring here must therefore be prepared to start at a moment's warning, the beláts, or northerly winds, setting in very suddenly, when the coast becomes a dead lee shore.

Hulláníyah is the only inhabited island of the group, and the few people who live on it dwell in huts on the N.W. side of the island, about one-third of a mile from the beach. They chiefly subsist on the fish they catch; but a few native boats occasionally touch here, on passing, and generally exchange small and useful articles for dried fish.

KIBLIYAH, the eastern island, and third largest of the group, is nearly 2 miles long and 1½ miles broad; but it is merely a barren rock, rising into several peaks, one of which is 550 feet high, and in Lat. 17° 29¼′ N., Long. 56° 19½′ E. The island is rocky all round, with the exception of a small sandy bay at the N.W. point. Like Hásikí it is white with the guano deposited by birds.

Danger.—A small and dangerous rock, even with the surface of the sea at low water, bears from Kiblíyah E. by S., 3¾ miles distant. Vessels should be careful in rounding the island at night, as the soundings are a bad guide, and the breakers on the rock are not always visible. Within a few yards of the rock are the following cross bearings: Four Peaked Rock in one with the north end of Kiblíyah, and Well Rock on with the south end of Hulláníyah.

Between the rock and the island the least water is 9 fathoms; the edge of the bank of soundings is 1½ miles south of the rock, 2 miles north, and 2⅔ miles east.

The channel between Hulláníyah and Kiblíyah is 12½ miles wide, with from 20 to 46 fathoms water, and perfectly free from all dangers, except close to the islands.

FOUR PEAKED ROCK, so named from its outline, lies two-thirds of a mile W.N.W. from the north point of Kiblíyah, with a rocky channel between them of 2 to 3 fathoms. It is about 100 feet high, and has a rocky ledge extending from it half a mile to the N.W., on which there are four small rocks dry at all tides; several parts of the reef are also dry at low-water springs.

WELL ROCK—so called from is salt-water well—lies 800 yards S.S.W. from the S.W. part of Kiblíyah; there is a channel between them of from 7 to 10 fathoms water.

KIRZAWET, Kirzáút, or Rodondo, 6¼ miles N.E. by E. from the north point of Hulláníyah, is the smallest island of the group; it is a mere rock, with a double peak, the highest of which rises to 230 feet above the sea, and is visible 25 miles; the point to the eastward is low.

The only dangers off this island are two sunken rocks, one about 300 yards to the West of it, and the other 150 yards to the N.W., with a channel between them of from 8 to 16 fathoms water. Close off the east point of the island are two rocks above water. On all other bearings the island is safe to approach, 20 fathoms water being found within 500 yards of its shore.

Tides.—On the north side of the islands the flood sets to the westward, and on the south side to the eastward.

CURRENT.—Between Rás Farták and Rás Nús the current often runs against the wind, during the N.E. Monsoon; amongst the Kuriyán Muriyán islands the direction is uncertain, but it frequently sets to the north-westward, rendering it unsafe if becalmed near them.

RAS-AL-HED:—The N.E. point of Arabia is in Lat. 22° 32¾′ N., Long. 59° 48′ E.; it is a very low sandy point, having near it a few date trees—and the little town of Al-Hed, lying 1 mile south-west of it; a spit runs from the point nearly 300 yards.

To the north of this cape no soundings are to be obtained when more than half a mile from the shore; to the east the bank of soundings extends about 3 miles, and the 20-fathoms line is 1 mile off shore. This bank is famous for large fish.

Challenger Bank.—On August 9th, 1830, at 1.30 P.M., discoloured water, with ripplings, was observed from H.M.S. *Challenger*, in 22° 29′ N., and about 40 miles east from Rás-al-Hed. On sounding, two casts of 13 fathoms water were obtained, and soon after no ground at 65 fathoms, the sea having resumed its natural colour. The bank appeared 3 miles long by half a mile broad. Having been observed so shortly after noon, the position given is probably correct. The *Palinurus*, while surveying the coast, made diligent search for it, but without success.

WEST COAST OF INDIA.

KARACHI.

KARACHI, on the sea coast of the Indus valley, is the nearest safe port to the Persian Gulf, and the only land-locked harbour between Bombay and the Red Sea.

Manora Point, at the west side of entrance to the harbour (and on which is the lighthouse), is in Lat. 24° 47′ 21″ N., Long. 66° 58′ E.; being a bluff 100 feet high and surrounded by low land, it is readily recognised from a distance, appearing as an island.

To the N.E.-ward of Manora point, at the distance of rather more than a mile, are the Oyster islands, situated on an extensive shoal flat having from 6 to 10 feet on it at low water. Inside Manora point and the Oyster islands is the low sandy island of Keamari, 2 miles long E. and W., having off its southern side an extensive sandy flat, dry at lowest spring tides. Two miles beyond is the town of Karachi.

Depth of Water on the Bar.—The great difficulty at this port has always been the state of the bar, which is very uncertain. In 1852 the *Duke of Argyle* (800 tons), drawing 16 ft. 9 in., crossed the bar the day preceding the lowest neap tides. In 1857 a notice was issued stating that no vessel drawing more than 18 feet should be sent to Karachi; and in 1860 the Port officer (Mr. E. Giles) published the following as the state of the bar:—

"*S.W. Monsoon season, May to September.*—Spring tides, 22 ft. to 23 ft. 6 in.; neap tides 19 ft. to 18 ft.

"*Fine season, October to April.*—Spring tides 20 ft. to 21 ft. 6 in.; neap tides, 19 ft. to 18 ft. Ships may load.

"*From September 15th to April 15th (the bar being generally smooth).*—Spring tides, 19 ft 6 in.; neap tides, 18 ft.

"*From April 15th to the end of May, from September 15th to the 30th, periods*

before and after the S.W. Monsoon.—Spring tides, 18 ft. 6 in.; neap tides, 17 ft. 6 in.

"*From June 1st to the middle of September, with the average weather in the S.W. Monsoon.*—Spring tides, 17 ft.; neap tides, 15 ft. There are days during this Monsoon when the sea on the bar is so heavy that ships at the above draught could not with safety cross."

Since that date great efforts have been made to improve the harbour and increase the depth of water, as the following letter (1862) from Lloyd's agent shows:—

"We have the pleasure of informing you that, during the last two years, the depth of water in the eastern and deepest channel into Karachi harbour has been gradually increasing. Vessels drawing 22 ft. to 22 ft. 6 in. can now safely load inside the harbour, leaving on the springs, during the N.E. Monsoon, say from 15th October to 1st April. During the remainder of the year, when there is more or less swell on the bar, the draught of ships entering and leaving harbour should not be more than 18½ feet.

"The Karachi harbour improvement works, especially the Keamari groyne, which has been run out exactly one mile in length, with a bottom breadth of 70 feet, and a top breadth of 15 feet, have already begun to have a favourable effect in deepening the channels; this groyne has still to be carried out 2120 feet further, and will probably be completed by next May or June. There is every reason to believe that the extensive harbour improvements at present being proceeded with, will, if carried out in their entirety, be real and permanent improvements, and that they will render this harbour available for ships of the largest draught at all times of the year. The amount of room in the harbour can be indefinitely increased by dredging, and the formation of floating docks."

The latest information by the Indian Overland Mail, June 1865, respecting the depth of water on the bar is as follows:—

"The ship *China*, from Glasgow, Mr. Smith, commander, crossed the bar on the 27th May, drawing 20 feet 6 inches. The least water she had while crossing the harbour was 26 feet. This is a fact well worthy of note, as it shows that if the harbour improvements now in progress have altered the channel into this harbour and made it more tortuous, they have at the same time increased the depth of water very considerably. The largest line of battle ships can now enter the port at spring tides in perfect safety.

The Coast of Cutch and Sindh, and the Approach to Karachi Harbour.—The following remarks are by COMMANDER GRIEVE, I.N., who surveyed this part of the coast in 1848-50:—

Wind and Weather during each month:—

January.—Steady land and sea breezes between N.N.W. and N.N.E. The North-easters on the coast of Sindh and Cutch frequently blow fresh for three or four days at a time. Southerly winds are rare, but the sea breeze occasionally veers to S.W. Squally weather, with rain, sometimes occurs near Karachi.

February.—Winds become more variable. The North-easters less frequent, and of short duration. Sea breezes between W.S.W. and W.N.W., and towards the end of the month you may get a hard blow from the westward for two and three days, particularly on the northern part of the coast. A heavy sea always accompanies these breezes, and renders the anchorage off Karachi, in the outer roads, very unsafe.

March.—Land winds become less regular. Sea breezes are generally moderate, between W. and N.W., but blow very hard at times, with thick, misty weather.

April.—Winds much the same as last month. Weather generally hazy, with a very damp atmosphere. Swell from the westward at times.

May.—Winds moderate, W. to W.S.W. Weather hazy, with very heavy dews. Clouds begin to gather, and much swell prevails from the westward.

June, July, and August.—The S.W. Monsoon prevails, blowing moderate, and fresh breezes from W. to S.W. by W., with passing clouds and hazy weather. It becomes very cloudy as the season advances. Rain is uncertain, but may be looked for in the latter half of July; and when it falls it is generally accompanied by variable winds and thunderstorms. A heavy swell prevails during these months.

September.—Winds light from W. to W.S.W. Squalls from the land may be expected. The weather is generally hazy, and the Monsoon swell not quite subsided.

October.—Winds W. to N.W., light, with occasional calms. Land winds begin to get steady about the latter end of the month. Weather generally very clear and pleasant, but occasionally dense fogs come off the land. Sea smooth.

November.—Land and sea breezes become steady, veering from W. to N.E., the land winds towards the end of the month often lasting two days at a time, but not very strong. Weather generally very clear, and objects visible at a great distance. Remarkable terrestrial refraction prevails this month and the next, making distant objects appear much closer.

December.—Winds and weather the same nearly as described for January. North-Easters prevail, and the weather is cool and pleasant, with a remarkably clear atmosphere.

Currents along the Kattiwar Coast.—The current during the months of November and December sets always to the N.W., from 1 to 1½ knots per hour, but liable to checks, particularly at night, when there is sometimes a drain in the opposite direction. After the middle of January there is little or no current; but again, from the end of March to the beginning of May, the current frequently sets to the S.E. at the rate of 12 to 20 miles per day; and there is no doubt that the S.E. current prevails along this coast throughout the whole of the S.W. Monsoon, many navigators having experienced it as strong as 30 and 36 miles per day all along the coast from Karachi to Bombay.

Directions for the Coasts of Sindh, and the Approach to Karachi Harbour:—

Vessels from Europe or from the westward, bound to Karachi, should not care to make the coast of Sindh and Cutch, or any of the contiguous land whatever, previous to sighting Karachi lighthouse; but should they do so, and find they have to beat up to Karachi, they will find the entire coast, with one or two exceptions, which are hereafter specified, a perfectly safe one to approach.

From Diu head to Karachi the coast is divided into three parts:—

1. Diu head to Dwarka is the west coast of Kattiwar.

2. From Dwarka to Juckoo is the entrance to the gulf of Cutch; and any vessel bound to Karachi, or even out of Karachi (unless bound into the gulf of Cutch), ought not, on any account whatever, to go inside of a line drawn from Dwarka to Juckoo.

3. To the southward of the Lukput river the coast is within the territory of Cutch, and all to the northward of that river is the coast of Sindh.

The different ports on this part of the coast are very seldom visited by any vessels except the native craft of the country.

The west coast of Kattiwar runs about N.W. and S.E., with bold soundings off its entire length, except a small patch of 2 to 3 fathoms extending from $1\frac{1}{2}$ to 10 miles west of Diu head.

No vessel should approach this shoal under 12 fathoms, which is about 1 mile from its southern edge.

The general character of the west coast of Kattiwar is low, with a sandy ridge fronting the sea. There are a few hills visible along the coast. The Barda range lies N.E. 12 miles from Porebunder, and may be seen 25 to 30 miles off. Junaghur hill is in 21° 31′ 48″ N., and 70° 32′ E., of a conical form, 3,837 feet high, with three small peaks on it, and may be seen all along the coast from Diu head to Porebunder.

As a general rule, no sailing vessel should come nearer this coast than 20 fathoms by night or in rough weather; or under 12 fathoms by day, in fine weather.*

Off the entrance of the gulf of Cutch is a small patch called the Lushington shoal, having 3 fathoms (or less) on it; and during the S.W. Monsoon the sea breaks on it. There is also another shoal spot of $5\frac{1}{2}$ fathoms 4 or 5 miles S.W.-ward of the Lushington shoal. Great care should be taken in approaching the vicinity of the danger.

From above Juckoo, the coast is pretty safe, and may be approached to within 7 fathoms, until you reach the Muneja bank.

The Muneja bank extends 6 to 7 miles off shore, from Lat. 23° 55′ N. Long. 67° 27′ E. to Lat. 24° 11′ N. Long. 67° 15′ E. It is formed by the alluvial deposits of the river Indus, which, in 1854, was navigated by the Hujamree channel, but the waters have since forced their way to the southward, through the Kokowarry mouth.

The western edge of the bank is very steep, having 5 fathoms at 1 mile, 8 fathoms at 2 miles, and 10 fathoms at 3 miles' distance. The flood tide rushes with great strength, causing a high ripple, which would very probably be mistaken at night for shoal water, particularly as the muddy particles give the water a whitish and sometimes a luminous appearance.

During the inundation the water is frequently fresh at the mouth of the river at half ebb. The flood tides are not strong.

The coast above the Muneja bank up to Karachi is very safe to approach during the fine season, and vessels may go safely into 5 fathoms by day, and 8 fathoms at night; and good anchorage is always available; but during the S.W. Monsoon months it would be prudent to avoid getting in too close, partly because there is a

* Commander C. G. Constable, I.N., under date Bombay, June 22nd, 1863, writes as follows respecting the loss of the *Lord Raglan*, by striking on a rock off Mongarol:—"I write to inform you that the ship was wrecked by running ashore on the Kattiwar coast, about 6 miles S.E. of Mangarol. The coast is low and level, of a brown colour, and it is seldom you can see it at night, but the bank of soundings extends a great distance off it, and the lead is the best guide when standing in towards the coast by night:—20 fathoms is 10 miles off; 10 fathoms is close to the shore, for it is a bold coast. It is perfectly free from shoals or rocks, except a narrow rocky shoal close to the westward of Diu head, distant from the shore 1 to $1\frac{1}{2}$ miles, which should not be approached under 13 fathoms.


KARACHI
Masan
Hindu place of Cremation
Burial Grd.
Burial Ground
LAYARI RIVER
Gaol
Ram Talao
KARACHI
Post Office
Burial Grd.
Slightly elevated stony land thinly covered with bushes
Mud & Sand covered by extraordinary spring tides
Kanana Creek
Sarai Grd.
Vikker
Camp
Mangroves
Mud Flat
dry at half tides
KADEERA
ab. 20 ft. high
CHOTADANT
ab. 20 ft. high
SOTI CREEK
VOYAR CREEK
PUHI CREEK
AND CHANNEL
Sand and Mud
Sand and mud dry at low water
BABA CHANNEL
dry at low water
Mud Banks dry at half tides
YARIRI CREEK
Low Sandy Ridge
BABA
TOOKAR CREEK
Tookar Creek
Dry at Low Water
Custom Ho.
Musjid
Flat muddy Plain partially overflowed by very high tides
Obelisk
Mud Flats dry at half tides
Mud Flat covered at low water
Dry at L.W. in most parts
CHINNA CREEK
Store houses
KEAMARI
Sand dry at lowest spring tides
Sand dry at L.W.
Two channels into the Creek at High Water
Clifton
Tomb
Sand dry at Low Water
SCANDAL Pt.
Chota Andai
OYSTER
Pyramid Rk.
Baur
ISLANDS
Bara Andai
Low Sandy Ridge from 10 to 20 ft. high
Breakwater
Flagstaff
MANORA POINT
(Light)
TRUE
THE SOUNDINGS are reduced to the average Low Water springs, but would be 1½ foot less during the extraordinary low tides in May and November. The highest tides occur in June, July and August. From September till March the P.M. tides are higher at high water and lower at low water than those occurring A.M. During the other months the lowest tides occur A.M. with little difference at High Water.
At the round Tr. Manora
High Water Full & Change 10h. 30m.
Average rise & fall of Sprs. 9ft. 6in.
Neaps 3. 0
Greatest 12. 0
Least 1. 0
Temporary anchorage
Scale of One Mile
10 Cables

set to the S.E., and partly because the wind is liable to lull occasionally, and thus a vessel might get into difficulty.

The deep-sea or outer soundings along the entire coast from Diu head to Karachi are very accurately laid down, and in cloudy foggy weather, when observations for latitude and longitude are not to be obtained, a little attention to the soundings will enable the navigator to fix the position of his ship with great precision. The most remarkable feature in the soundings is the Swatch, in Lat. 23° to 23° 45′ N., and Long. 67° to 67° 35′ E.; this is a deep and narrow valley (of 100 to 130 fathoms' depth) in the ocean bottom, between depths of 15 to 25 fathoms on the east side, and 40 to 50 fathoms on the west side.

Directions for Approaching Karachi Harbour.

At all seasons, if coming from the southward, the coast of Sindh, from the parallel of 23° 30′ N., should not be approached under 14 fathoms. This line of soundings will carry a ship from 7 to 8 miles off the dangerous banks which extend from the Hujamree, Kediwarry, and Kokowarry mouths of the Indus river to a distance of 7 miles, showing in several places 10 fathoms on their extreme edge. The set of the tides and currents being very uncertain, the coast low throughout, and barely visible from the outer edge of the banks in clear weather, too much attention cannot be paid to the lead in passing these banks.*

Ras Muari (or Cape Monze), distant 18 miles W. ½ N. from the western entrance to Karachi, is high and bold of approach. Ships during the S.W. Monsoon season should make this headland, keeping to windward of the port if the weather is thick, or if the tide does not suit for crossing the bar; allowance must also be made for a strong set to the S.E., always prevalent during the S.W. Monsoon. Do not bring Manora point to the South of East, and do not go under 15 fathoms near Ras Muari, nor along the coast between it and Manora point.

Manora point can be approached to within half a mile on any bearing from North to East, with 5 fathoms water. On this point stand the lighthouse and signal station. As at certain times of tide pilots cannot get off, attention should be given to all directions signalled from the shore.

Masters of ships should not, under any circumstances, attempt to enter the port without a pilot.

Anchorage in the Roads.—From June to the middle of September, ships should not on any account anchor, but stand off and on, keeping the lighthouse bearing from N.b.E. to N.E., one to two miles distant, until boarded by a pilot or directed by signal. September 15th till the end of March, anchorage, lighthouse N.b.E. to N.N.E., distant one mile, in 7 fathoms. April and May, lighthouse N.N.E. to N.E., distant 1½ miles in 8 fathoms.

To the southward of the port, vessels should not come under 8 fathoms, or bring Manora point to the Westward of North, and under no circumstances, except the most urgent necessity, should vessels anchor on the coast to the Southward during the S.W. Monsoon.

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* Since the beginning of 1857, the ship *Admiral Boxer* has been totally lost on the Indus banks. The ships *Thomas Campbell* and *Augusta*, with the steamer *Pioneer*, have grounded on them, but were eventually floated off. Two large troop steamers have also, in the same period, touched on them.

Vessels making the Lighthouse should always endeavour to come within signal distance before dark; but if not able to do so to keep standing off and on till daylight; they should endeavour to pick up the Pilot-boat without delay if she displays a Pilot Jack, for when she does so it is to intimate that there is no time to be lost to save the tide; but in picking up the Pilot, no vessel should run down to the Eastward further than to bring the lighthouse to bear North.

Light.—The lighthouse at Manora point exhibits a *fixed white* light at an elevation of 120 feet above high water, visible 16 miles, but frequently during the hazy weather of the S.W. Monsoon not more than from 7 to 10 miles.

For coming into the harbour, vessels should have all the fore and aft sails that belong to them bent, and their hawsers on deck, with everything ready for laying out a kedge anchor.

In consequence of the tides being irregular, persons are apt to be out in working them, therefore a red burgee at the yard-arm of the flagstaff will signify that it is flowing, and when at the mast-head that it is high water; a burgee at the yard-arm will signify that the tide is ebbing, and when at the mast-head that it is low water.

Leaving Karachi in the S.W. Monsoon.—Bound out in the S.W. Monsoon, it would be advisable to work to the W.S.W.-ward into about 15 fathoms or 10 miles to windward of Manora before stretching to the South, for, although a vessel might lay along shore direct from the entrance of the harbour, she might get into difficulties by the wind falling light, and the tide and S.E. current setting her in towards the mouths of the Indus; in passing the Hujamree and Muneja banks, which extend from Lat. 23° 55′ to 24° 10′, and Long. 67° 12′, she should not be in less than 20 fathoms, or more than 2 to 4 miles east of the meridian of Manora.

The S.W. Monsoon does not blow strong generally on the coast of Sindh, the wind at times is variable, and generally so when it rains, which is mostly in July.

The navigator is cautioned to be careful about anchoring anywhere on this coast if there is any sea on; it would be much more advisable to keep under way.

If bound to Bombay, it is as well to know that a line from Diu head to Bombay lighthouse is the 20-fathom line; so that a vessel, by her lead and soundings alone, could make Bombay from the northward, by simply keeping in the 20-fathom line.

In 1862, Captain L. Bilton, a correspondent of the *Mercantile Marine Magazine*, gave the following information respecting **Karachi**:—

"I reached Bombay on August the 25th, and lay there a fortnight, but finding freights low, and my owners having a valuable ship loading at a very low rate, I considered it advisable to look out for other than home employment, and chartered to proceed to Karachi to load a cargo of salt for Calcutta. I had, however, now lost the opportunity of making a quick passage thither, as the S.W. Monsoon was over. I experienced nothing but light baffling winds from N.W., with a lee-current, and did not reach that port till the 5th October, making 28 days' passage from Bombay; however, I should have been in no way advanced by arriving earlier, as, owing to the heavy and protracted rains, the salt was so wet as to be unfit for shipment.

"Karachi is a new and highly favoured port, with all sorts of public works and improvements in progress—the harbour being deepened, wharves and docks being built, piers and railways projected, with the determination, apparently, of making it

a first class place of trade. I was close to Manora point at daybreak, and soon had a pilot on board—their residence is just inside the point, at Manora village, and on a gun being fired, one is always ready to come out. Crossed the bar at high water—on which is 18 to 19 feet at neaps, and 22 feet at springs—and moored abreast of the village with 35 fathoms of cable each way. Mooring-buoys are to be laid down here, and they will be a great advantage to large ships not intending to proceed further up than Manora. Smaller vessels go to Keamari, a village two miles further up, where the Custom-house is at present situated, and whence various descriptions of carriages ply for hire to Karachi, about 2 miles further still, or to the camp three miles off.

"Karachi is built at random and without any apparent plan—every one planting his house on the spot that best suits his convenience; the native town, like all others of its class, has narrow dirty streets, and houses with windows like pigeon-holes. The roads are excellent, there being plenty of good stone in the vicinity. A long bund runs through a low, swampy salt-marsh, from Keamari to Karachi, having rails laid down on it for a projected railway. When the new Custom-house (of stone) is finished, the present temporary one (of bamboo) will be abolished; here, Mr. P. Dalzell is collector, police magistrate, municipal commissioner, and I know not what besides, in his own person.

"The offices of the European merchants are mostly at Karachi, and are magnificent stone edifices, with extensive warehouses (or *godowns*) surrounding them. A large and increasing trade in grain, seeds, cotton, gums, wax, dates, salt, &c., is carried on. A well-built wharf is in a very advanced stage, extending from a column marking the spot where General Sir Charles J. Napier embarked when leaving Sindh (which fact it records) to the town; it is nearly half a mile in length, and joins a railway which runs to Hyderabad, and is already in full operation. Here the native craft discharge and load, and representatives of most of the countries in the East may be seen jostling each other. There are also no less than three steam companies engaged in the navigation of the river Indus, who are fitting out an immense number of vessels both at Manora and Keamari to develope the trade. It is a busy place, and no doubt will one day be a port of great consequence, from its position—more particularly if the Euphrates Valley railway is carried out.

"Manora is the Brighton of Karachi—or rather will be—where the inhabitants resort for change of air; it is well adapted for bathing, and is cool and pleasant from its vicinity to the sea; there is, however, a scarcity of houses and general accommodation at present. Point Manora is a high bluff, on which is the lighthouse, with a good fixed light, visible 16 to 18 miles off; but the whole point is rapidly wasting away, and will in time be only a sandy spit. The Oyster rocks, forming the eastern side of the entrance, are also fast crumbling away, owing to the action of the heavy sea in the S.W. Monsoon, and the soft sandy nature of the rock of which they are composed; there are two perforations through them—one of which I have often pulled through in a boat. The northernmost of the rocks is the resort of innumerable flocks of birds, which build their nests and hatch their young in security in holes in the rock. It is intended to run a pier from Keamari to join these rocks, with a view to deepening the channel—which is quite practicable, the foundation being a stiff clay. It is supposed the current will then alter or completely remove the present bar—which is a very bad one, particularly during the S.W. Monsoon, at which period no ship drawing more than 17 feet should attempt to enter the port; but in

the fine season, during the N.E. Monsoon, a ship may safely cross at springs, drawing 21 to 22 feet. The Collector of Customs, Master Attendant, and other government officials reside at Manora, and transact business there; the houses of the pilots are also down near the shipping, which is very convenient. A medical gentleman resides at Manora, and attends the shipping, but there is not much sickness.

"I loaded inside to 19 feet, and filled up outside the bar. Manora point at N.E. ½ E., 1½ miles off, which anchorage is quite safe during the N.E. Monsoon.

"Supplies of every kind are cheap and good. Abundance of turtle may be procured on the beach to the north of Manora, and my Jacks, though hard at work all day, loading salt, never thought it the least hardship to range four or five hours every night to catch them—in this, I too was very successful; there are also plenty of fine oysters to be got. Game abounds in the neighbourhood, and can be bought very reasonably. There is, however, a great lack of trees, and the country looks barren in consequence.

"I left on the 21st November—having been 12 days on demurrage—deeply laden with salt; and on the 25th was off Bombay, having accomplished in four days the distance it took me twenty-five to get over, going to Karachi."

Captain Bilton, writing again in May, 1863, says:—

"I arrived off the bar of Karachi on the 4th of May, and though near the top of springs, found there was but 20 feet water now at the very highest tides. The old deep-water eastern channel is now completely filled; and the western (formerly the shoalest) is at present the only available passage—through which no vessel above 17 feet can proceed during the south-west Monsoon, and then at a great risk without steam.

"I found several ships lightening outside the bar, having been detained several days, and paying 2s. per hogshead for beer being landed. I lay there two days, and could not get a boat off; when I had a consultation with the port officer and senior pilot, and finding there was just the ship's draught on the following day, I determined to attempt it, as the obstruction is only about 20 feet broad, and loose sand; and on the 7th, at high water, made a dash at the bar, and went safely over without a bump, the sea being quite smooth, and moored off Manora, in about the same berth I occupied two years ago. However, even then my troubles were not over, as I had not room to swing, and had to heave a-head to my anchor on each tide, till lightened, to avoid tailing on the eastern bank, drawing 19 feet 8 inches. The generally received opinion is, that the bar will eventually be better when the aforesaid harbour works are completed, and the port yet be all they anticipate. It never can, however, contain any number of ships, *and large vessels should not be sent here at all during the south-west Monsoon.* By *large*, I mean ships exceeding 800 tons. The trade of the port is, however, rapidly increasing; and the enterprising firm of Fleming and Co. have established cotton screws. Mooring buoys are being laid down for the larger class of shipping at Kemari and Manora. There is a great want of a good tug here.

"Large crops of cotton are being grown, and as the climate is one of the finest and healthiest in the world, I have little doubt that the country will soon assume a degree of prosperity almost unprecedented. All that is wanted is a small influx of European energy and capital. The railways and Indus steamers have trebled their receipts in as many years, and a line is projected from Kotree to Moultan.

"I thought it well to give you the earliest information as to the decrease of depth

of water on the bar, as many people will, no doubt, be misled by the statement issued about the time I left London—viz., that they had gained 2 feet water additional; now, when last here, we had 24 feet in the east channel; two additional would make 26; and large ships sent hither on the strength of such a statement would have to endure an amount of danger, disappointment, and loss, very serious to contemplate."

At the entrance to the Gulf of Cutch, on the S.W. bastion of the fort of **Mandavee,** there is a *fixed white* light, visible 10 miles. Position, Lat. 22° 50′ 20″ N., Long. 69° 20′ 49″ E.

Between Diu head and Tarrapur harbour is the entrance to the Gulf of Cambay. Here are the dangerous **Malacca Banks,** which extend from Lat. 20° 20′ to 21° 12′ N.; they run in irregular ridges from north to south, and are connected by shoal water affording no safe channel. Sutherland or the easternmost channel into the Gulf of Cambay lies between Malacca bank and the Snally bank—which extends about 2 miles from the shore of the main; it is 3 miles wide, with depths of 12 to 17 fathoms; at its northern end is **Surat,** where there is anchorage in 7 or 8 fathoms.

Tapti Light, at the entrance to the Tapti river, leading to Surat, is *fixed white,* elevated 61 feet, and visible 10 miles. Position, Lat. 21° 5½′ N., Long. 72° 37½′ E.

The Grant, or western channel, is formed by the west edge of the Malacca banks on the one hand, and Goapnauth shoal and the shore of the main on the other; it is 5 miles wide, and has in it depths of 10 to 20 fathoms.

The northern limits of the Malacca banks should never be approached with an ebbing tide, as the shoals are very steep.

There are also *fixed white* lights at Dandi, Perim island, Gogah, Deojugan or Tankaria, and Koon Bunder, higher up the Gulf of Cambay.

Between Terrapur and Bombay there is no danger, provided a ship does not approach the coast under 10 fathoms in the fine season; but during the S.W. Monsoon the parallel of Khundari island (say 18° 42′), at the southern entrance to Bombay harbour, ought to be made at the distance of 30 to 40 leagues from the land, and then steer East.

BOMBAY.

BOMBAY is the seat of government for the western presidency of British India, and the centre of an extensive commerce carried on with all parts of the world, while its trade with China exceeds that of either Madras or Calcutta.

Bombay Island, about 7 miles long by 2 wide, is generally low—the sea in many parts being kept out by embankment; but there are also two parallel ridges of sandstone hills running north and south—the most conspicuous being the western ridge, which terminates on the S.W. side of the island in Malabar hill. From seaward this hill has an oblong appearance; it is covered with trees, among which are interspersed many houses (or bungalows), and near the extreme (south) point are the signal post and flag-staff. The town and fort of Bombay are at the S.E. part of the island.

Close to Bombay island, and extending to the S.W.-ward nearly 2 miles, are **Old Woman's** and **Kolaba** islands, now united by a causeway, as the former is to Bombay island; formerly the three islands were separated by narrow creeks fordable

only at low water. The point of Kolaba, on which the lighthouse stands, is guarded on all sides by an extensive reef of rocks, divided into prongs,—the most dangerous being the S.W. prong.

Salsette, to the north of Bombay, and formerly an island, is now, like Kolaba and Old Woman's islands, united to Bombay island by several causeways; between the two, however, there are several creeks navigable by small craft.

In the northern part of the harbour is the island of **Trombay,** $4\frac{1}{2}$ miles long by $3\frac{3}{4}$ wide, near the centre of which is Salsette hill, 1008 feet high, being the highest point of a ridge which terminates at the south extreme of the island, and from its appearance is generally known as the Neat's Tongue. At the east end of the island there is another conspicuous hill and leading mark 324 feet high, having on it the ruins of a church. Here is the entrance to the Tannah river.

Cross Island, which from a distance resembles a haycock, lies about $1\frac{1}{4}$ miles to the northward of the anchorage off the town, and $\frac{3}{4}$ of a mile from the nearest shore. A shoal projects $\frac{1}{2}$ a mile from it to the S.W., but there is a very narrow passage between this shoal and the bank off the main shore.

Butcher (or **Derdewee**) **Island**, nearly due S. of the Neat's Tongue, distant $2\frac{1}{8}$ miles, is much larger than Cross island, from which it lies to the E.N.E.-ward nearly 3 miles; on it are several buildings, and a tower in the centre. Near the S.E. end of the island is a large tree, which, in one with Trombay old church, leads inside Thull shoal.

Elephanta (or **Garaporee**) **Island,** $1\frac{1}{8}$ miles due E. from Butcher island, and $2\frac{1}{8}$ miles S.E. from the point of the Neat's Tongue, has a conspicuous peak on its western side, which is the *first isolated high land seen to the right of the* NEAT'S TONGUE, when approaching the harbour from the S.W.-ward. This is the island in which is the celebrated temple, with immense excavations and figures cut out of the solid rock.

Khundari and **Oonari** are two islands outside Bombay harbour, near the shore of the main land on the south side of entrance.

KHUNDARI ISLAND, the highest summit of which is 120 feet above the sea, lies $2\frac{2}{3}$ miles from the main land opposite the village of Nagaow, and W. by N. $\frac{1}{2}$ N. from the village of Thull, close to Thull knoll; though small, it is covered with houses and trees, and is surrounded by a fortified wall. Large ships should not borrow too near Khundari island in the S.W. Monsoon, as it is situated on an extensive flat which projects from it several miles to seaward, and over which a heavy ground swell rises, causing ships to labour very much.

OONARI ISLAND, inside Khundari, is very low, and rather more than a mile off the shore of the main land.

Thull.—The high land of Thull forms the S.E. boundary of Bombay harbour. Near the N.W. corner of this land is Thull Knob (180 feet high), to the S.E.-ward of which, at the distance of $3\frac{1}{2}$ miles, are two peaks called the Paps. The Knob and northern Pap in one clear the Thull shoal to the northward.

Carija Island, 4 miles long in a N.N.W. and S.S.E. direction, and 2 miles wide, forms the east side of the entrance to Bombay harbour; it is generally low and woody, but near its north and south extremity are two conspicuous and remarkable hills. Great Carija hill (990 feet high), near the south end of the island, is of a tabular form, slightly convex, and has a steep declivity at each end—the northern brow having on it the ruins of a church; it forms the third isolated high land to the

right of the Neat's Tongue. Little Carija hill (690 feet high), near the north end of the island, is irregular in its outline, and, from seaward, resembles the elevated island (Elephanta) beyond; this is the *second* isolated high land to the right of the Neat's Tongue.

Casoah (or **Gull**) **Island** is a large rock midway between Thull Knob and Carija island; it lies on the south side of the entrance to an estuary into which the rivers Amba, Penn (or Bhogeshwuree), and Aptah (or Mehgownee), discharge their waters.

Thull Shoal, 2 miles long N.N.E. and S.S.W., and $\frac{3}{4}$ of a mile wide, consists of rocky patches with soft ground between; and having on it from 20 to 27 feet of water, with three spots of only 17 feet, and one of only 13 feet, may be considered very dangerous during the S.W. Monsoon, owing to the high sea that rolls in towards Thull. Its centre is about $3\frac{2}{3}$ miles E. by N. from Thull Knob, and $2\frac{3}{4}$ miles from the shore of Thull Land; and the following marks and bearings clear it on every side:—

To the southward, Keyim bungalow in line with One Tree hill S.E.; to the S.W. and west, the foot of Kamballa hill open westward of the lighthouse; to the northward, Gull island open twice its breadth to the right of Carija point.

In the channel between the Thull shoal and the foul ground fringing the shore of Thull there is a depth of from 27 to 30 feet, and the large tree at the E. end of Butcher's island, in line with Toorbah church ruin, N.N.E., gives a safe course through it.

The foul ground of Thull shoal is very dangerous with Thull Knob bearing between E. $\frac{1}{4}$ N. and E. by S., and it should not then be approached nearer than the lighthouse well open to the eastward of the range of hills at the back of Bombay—say N. $\frac{1}{2}$ E., or Khundari island S. $\frac{1}{2}$ E.

The S. W. Prong is the name given to some rocky ground (partly uncovered at low water) on the north side of the entrance to Bombay Harbour, and stretching $2\frac{1}{3}$ miles from the lighthouse in a S.W. by S. direction, but it really forms part of an extensive mass of foul ground—here rock and there mud—surrounding the west, south-west, and south sides of Bombay island, and thence entering the harbour itself. The following marks and bearings clear this danger:—

The outlying shoals $2\frac{1}{4}$ miles west of the lighthouse must be approached no nearer than Mahalakshmi Pagoda, open west of the bungalows on Malabar hill, N.N.E. $\frac{1}{3}$ E.; the outer light-vessel in one with Khundari island S. by E. $\frac{1}{3}$ E., clears the S.W. Prong on the S.W. side; Thull Knob in one with the North Pap S.E. by E. $\frac{1}{4}$ E.; or Funnel hill just open of or touching the north brow of Great Carija hill E. $\frac{1}{2}$ N., clears the prong to the south; and the left end of Butcher's island, seen to the right of the inner light-vessel, clears the east side of the Prong.

Carija Shoal, on the east side of Bombay harbour, extends 3 miles west of the S.W. point of Carija island, and 2 miles N.W. by W. $\frac{1}{2}$ W. from the N.W. point of the same island: off the middle of the west side of the island at the distance of $2\frac{1}{2}$ miles is a 10-foot patch; and at the N.W. projection of the shoal is a 6-foot rocky patch. The large tree at the east end of Butcher island in one with Toorbah church ruin, N.N.E., clears Carija shoal to the westward in 27 to 30 fathoms *until* the lighthouse on Kolaba point bears west. The northern part of the shoal is very irregular—steep and rocky in places, but the southern end is more even and composed of hard sand.

Sunk Rock Shoal extends $1\frac{1}{3}$ mile to the E.S.E.-ward of the lighthouse, and its outer edge is marked by a *red* buoy, which bears from the lighthouse S. 68° E., 2 cables to the southward of which is the inner light vessel.

The Middle Ground Shoal, opposite the Apollo Bunder, is steep, and has but a few feet of water on it at low water springs when blowing hard; its S. end is marked by a *black* and *white* buoy, and its N.E. end by a *black* buoy: the W. side of Cross island, in line with Sewree fort, leads clear inside or westward of this shoal; and Cross island, open twice its breadth to the left of Sewree fort, clears it to the eastward.

The Flagstaff Shoal, opposite Bombay castle, is marked by a *red* buoy.

Lights.—Four lights mark the entrance to Bombay Harbour:—

(1.) At Kolaba point, the N.W. side of entrance, there is a lighthouse exhibiting a light *revolving every two minutes:* the lighthouse is coloured white, and the light being at an elevation of 132 feet above high water, is visible 17 miles. Its position is Lat. 18° 53′ 42″ N., Long. 72° 47′ 42″ E.

It is said that the tower is not easily discerned in daylight, being lost in the surrounding trees and buildings. The S.W. point of Kolaba, on which the lighthouse stands, dries out at low water to the distance of $1\frac{1}{2}$ mile.

(2.) The Outer light-vessel, moored in 6 fathoms, lies S.S.W. $4\frac{1}{2}$ miles from Kolaba point, W.N.W. 2 miles from the centre of Thull shoal, N. by W. $\frac{1}{3}$ W., 7 miles from Khundari island, and S.W. by S. $\frac{3}{4}$ of a mile from the Fairway buoy: it exhibits a *fixed* light at 36 feet above the sea, visible 9 miles. The vessel is painted red, carries a red ball at the mast head, and hoists a red flag when a sail is seen in the offing. During the night a blue light is burnt every hour, and a torch every half hour.

(3.) The Inner or Sunk Rock light-vessel lies $\frac{1}{4}$ of a mile southward of the Sunk rock, and a short distance eastward of the south part of the shoal on which the rock is situated; it exhibits a *fixed white* light; the vessel is painted red, carries a red ball at the masthead, and hoists a red flag when a ship is seen in the offing.

(4.) The Dolphin rock light is *green* to south and east, *white* to northward, and screened to westward; it is 20 feet high, and is visible 2 miles.

A Fairway Spiral Buoy marks the entrance to Bombay Harbour, being southward of the S.W. Prongs, and N.W.-ward of the centre of Thull Shoal—equidistant from both; it is also about N.E. by N. $\frac{2}{3}$ of a mile from the *Outer* light-vessel.

The Outer and Inner light-vessels have been known to break adrift during the height of heavy S.W. Monsoon weather. Until replaced, the *Fairway buoy* is the only guide to the entrance.

Tides.—The flood sets into the harbour from the S.W., and ebbs out from the N.E. At the entrance, the stream does not set in fair through the channel, but slants over the foul ground off Thull towards the opening leading to Penn river, and during the rains in the S.W. Monsoon, the ebb sets strong out of that river to the westward.

Directions to enter Bombay Harbour.—As soon as the *Outer light vessel* is visible on any bearing (from seaward) between N. by E. and S.E. by S. round by East, steer directly for it; when up with it, steer to the N.E.-ward so as to pass the Inner or Sunk Rock light-vessel, 1 to 2 cables to the eastward; thence steer to pass the same distance to the eastward of the Dolphin Rock light; from which make for the anchorage off the town.

Or, *if it be night*, after rounding the Inner or Sunk Rock light, steer to the N.E.-ward, and anchor about 1 mile N.E. by N. of it, where the water will be smooth, and there wait for a pilot.

Approaching Bombay.—The following directions for approaching Bombay in thick weather, are from LIEUT. W. B. SELBY, surveyor, I. N.:—

"In coming from the westward, and being at Lat. 18° 30′ N., a vessel will first strike soundings of 55 fathoms coarse sand, decayed coral, and broken shells, in Long. 70° 30′ E. Should, however, the latitude be doubtful, with tolerably correct longitude that point will be at once ascertained, as, on *this* meridian, the depths will decrease to 51 fathoms fine sand, and even 48 fathoms fine sand, as far north as Lat. 19° 16′, while 10 miles to the southward no bottom at 300 fathoms will be found.

"Again, should the latitude be correct, and longitude doubtful, 4 miles west of this meridian no bottom would be had at 300 fathoms, while 20 miles to the eastward 47 or 48 fathoms fine red sand would be obtained.

"In the parallel of 19° N., the bank extends to Long. 70° E., when the first cast would be 75 fathoms greenish sand; and continuing to steer east 60 miles, you would cross over 50 to 51 fathoms grey sand,—at last 48 fathoms fine red sand; and this nature of bottom would continue for 40 miles more, when you would obtain from 40 to 50 fathoms, on a very remarkable bed of gritty mud (*i. e.*, soft mud mixed with small dead pieces of coral), and, probably, in some places, decayed coral rock or sandstone rock.

"The nature of the bottom is now such as cannot be mistaken, and by steering S.E. about 50 miles, you will carry a line of 38 fathoms, same bottom, till you strike your first cast of from 37 to 27 fathoms coarse sand and shells; you are then on the Northern edge of 'Direction Bank' (which I shall subsequently describe), and distant from lighthouse S.W. 30 miles, or by steering E.S.E. 50 miles, you would have 30 or even 24 fathoms coarse shells and sand, in which case you would be distant from the lighthouse about 25 miles, bearing E.N.E.

"In the parallel of 18° N., the bank of soundings extends to Long. 70° 47′ E., and the first cast would be 56 fathoms sand and shells.

"Continuing to steer east, you would pass over a coral belt of 49 fathoms, then a flat of from 49 to 52 fathoms fine red sand (deepening to the eastward), until, having run 60 miles, the bottom would change to mud and sand, though the depth, 52 fathoms, is the same. Forty miles more easting will place you, with a gradual decrease of soundings, in 23 fathoms mud, from whence the water shoals gradually towards the coast.

"About 100 miles W. by S. from the lighthouse, in Lat. 18° 35′ N., Long. 71° 5′ E., is a knoll of 38 fathoms fine sand, having all round it soundings of about 50 fathoms, same nature of bottom.

"Running E. by N. from this, you will have 50, 46, and 42 fathoms, fine red sand; and after 60 miles, 38 fathoms, on the edge of the gritty mud and decayed coral belt.

"Almost due S.W. from the outer light vessel, distant 38 miles, and therefore on the best bearing for making the harbour in the S.W. Monsoon, is a bank of soundings, which, from its being in nearly the same position as that assigned by Horsburgh to the '**Direction Bank,**' I have called by that name. It extends in a N.N.W. and S.S.E. direction from Lat. 18° 7′ to 18° 27′ N., centre in Long. 72° 20′ E., having an average breadth of 7 miles, with a depth of from 22 to 27

fathoms small, white, dead, bivalve shells, in places mixed with a little sand, and but rarely a few pieces of coral. From Lat. 18° N., and Long. 72° E., where a depth of 50 fathoms, mixed mud and sand, will be found, the soundings in running for it will gradually decrease to 30 and 26 fathoms mud, close to its outer edge: immediately inside, the depths are from 30 to 27 fathoms mud, gradually decreasing towards the land. On obtaining soundings on it, the arming of the lead will be found almost entirely covered with these shells, and as this is the only spot over the whole of the great bank off Bombay where they are found in such profusion, the navigator cannot doubt his position. A course may then be confidently shaped according to circumstances, allowing for a southerly set after the middle of July; and as the soundings decrease quite gradually in towards the land, the navigator will be warned in time, should the weather be so very thick as to prevent the land from being seen when within a reasonable distance.

"From the northern part of Direction Bank, and extending as far north as Lat. 19° 20′ N., Long. 71° 40′ E., is the remarkable belt which I have noted, averaging 15 miles broad, of a peculiar soft slimy mud, mixed with decayed coral, having on it from 34 to 47 fathoms, with gradually decreasing soundings of blue mud inside it towards the land.

"And here I would observe that, from the very soft, unadhesive nature of the bottom of this belt, recourse must be had to other means than that of arming the lead to bring it up; coir rope yarns frapped round the lower part of it I found answer very well.

"Although this belt extends about 50 miles in a N.W. and S.E. direction, yet a glance at the chart will show that there can be no doubt as to whether a vessel is on the northern or southern part; if the latter, a run to the eastward of 26 miles will cause a decrease of 17 fathoms, while, if on the northern, the same distance would not cause a greater decrease than from 6 to 10 fathoms.

"In conclusion, I would observe, that although from a careful study of the chart the seaman would fix upon many other points whereby his position in dark weather might be known, I have in these remarks only endeavoured to draw attention to those which appeared to me of the greatest importance, convinced that in themselves they offer all that is necessary for an object which has so long been desired."

Coast.—South of Bombay the coast is foul as far as Rajapúr; opposite Choul harbour (Lat. 18° 32½′), the 10-fathom line of soundings is 12 miles off shore, and, in the fair season, fishing stakes lie out in 6, 7, and 8 fathoms; on the parallel of 18° N. the 10-fathom line is 7 miles off shore.

Angria Bank.—Viziadrug or Geriah Harbour flagstaff is in Lat. 16° 34′ N., Long. 73° 19′ E.; west of it, at the distance of 64 miles, is Angria bank, extending between Lat. 16° 18′ and 16° 39′; it is of a curved form, the convex side being towards the land, whence the extremes stretch N.W. and S.W. It is about 23 miles long; and, near the centre, 10 miles wide E. and W. The depths on it vary from 15 to 12 fathoms, but they are irregular, and though nothing less has been found there may be shoaler water: the bottom is rocky. Angria bank is steep all round; on the landward side no bottom has been found at from 50 to 100 fathoms, and at a

short distance off 140 to 170 fathoms has been obtained; 7 miles off is a cast of 115 fathoms, then 49 fathoms at 12 miles distance, thence decreasing gradually to the coast. There is a very perceptible tide on the bank at springs, flood to N.E., ebb to S.W., with a rise and fall of 9 feet.

Off **Melundy Island**, in Lat. 16° 2′ N., a large ship in passing should not come under 13 fathoms, for 11 fathoms is close to the edge of foul ground; about 3 or 4 miles to the *northward* is **Kura** islet, standing $1\frac{1}{4}$ miles from the shore, and connected with it by a reef; to the southward of Melundy island, as far as **Newti Point**, in Lat. 15° $56\frac{1}{4}$′ N., several rocks extend 3 miles off shore, making it unsafe to approach the coast.

Vingorla Rocks, or **Burnt Islands.**—These are a group of rocky islets, the highest of which is 180 feet above the sea, but the rest are considerably lower; many are only even with the water's edge; the rocky patches connected with the islets make the vicinity of them dangerous for vessels passing in the night, on which account they should not be approached under 18 fathoms, since, on the S. and W. sides, there are 15 fathoms very close to them. They extend from the parallel of Newti point to Lat. 15° $52\frac{1}{2}$′ N., a distance N. and S. of nearly 4 miles, and have a white appearance when the sun shines on them. The channels inside the Vingorla rocks, and between them and the reefs to the northward, should never be attempted by a large vessel, for, though in several places they are sufficiently deep, they are everywhere very narrow.

Coast.—Between Geriah and Goa, the bank of soundings is generally from 14 to 18 leagues off shore; 6 or 7 leagues off there are 30 to 32 fathoms; and 2 leagues off 15 to 16 fathoms.

Aguada Point is the northern extremity of Goa bay; at Aguada fort, on a hill above the landing-place, and about a mile from the outer port, there is a lighthouse 280 feet above the sea, which exhibits a **Light**, *revolving* every *seven* minutes, visible 12 miles; its position is Lat. 15° 29′ 26″ N., Long. 73° 45′ 32″ E. A convenient place for watering is to bring the flagstaff and lighthouse in line (N.N.W. $\frac{1}{4}$ W.), and anchor in $4\frac{3}{4}$ fathoms, at the distance of 2 cables or more from the flagstaff.

St. George Islands, in Lat. 15° 21′ N., are about S. $\frac{1}{4}$ W., distant 8 miles from Aguada point: although there is deep water (4 to 6 fathoms) between these islands and the shore the passage should never be attempted by large vessels, for the bottom is uneven and rocky. Between Aguada Point and the St. George islands, the coast has, in many places, rocks and reefs fringing it at the distance of $\frac{1}{2}$ a mile to 1 mile off shore, so that if not intending to call at Aguada (or Goa), a vessel should not come under 16 fathoms at night; there are 14 fathoms close to the southernmost rocky islets of St. George.

The high, bluff headland of Cape **Ramas** is in Lat. 15° 5′ N.; the soundings between the St. George islands and Cape Ramas are regular,—as also between cape Ramas and Carwar—6 or 7 fathoms, from $1\frac{1}{2}$ to 2 miles off shore.

Carwar Head and Sedashigur Bay.—Carwar head, a conspicuous headland, 640 feet high, is in Lat. 14° $48\frac{1}{4}$′ N., Long. 74° 5′ E. The port of Carwar is to the northward of the head in **Sedashigur Bay.** Great improvements have been

projected and are in progress here, making a large area available for anchorage in *both* Monsoons,—building piers, wharves, &c.

The **Oyster Rocks** are high (160 feet), rocky, and have deep water close to them; from Carwar head they bear W.N.W. distant $2\frac{1}{2}$ miles, and from Cape Ramas S.S.E. $\frac{1}{2}$ E. 16 miles.

Light.—A temporary *fixed white* light has been established on the Oyster rocks at an elevation of 160 feet above the sea, visible 10 miles. The light tower is round, of white granite, 40 feet high, and stands on the summit of the outer Oyster rock, in Lat. 14° 49′ 15″ N., Long. 74° 2′ 45″ E.

The apparatus is to be replaced by a dioptric one of the first order, when the light will be visible 20 miles.

A *sunken rock* with 14 feet on it at low water, lies between the Oyster rocks and Elephant islet, with the lighthouse bearing N.W. $\frac{1}{2}$ N., distant $1\frac{6}{10}$ miles; Elephant islet E.S.E., $6\frac{1}{4}$ cables; and the western ends of Deogur and Coormaghur islets nearly in line about N.N.E. A *red* buoy marks its north-west side.

Also, a *shoal* about 50 yards in length north and south, and 20 yards east and west, with $2\frac{1}{2}$ fathoms on it at low water, over rocky bottom and shells, lies with the lighthouse bearing S.E. $\frac{1}{2}$ E., distant $2\frac{1}{2}$ miles; Coormaghur islet E. $\frac{1}{2}$ N.; and Black rock N.N.E. $\frac{1}{2}$ E. There are 10 fathoms all round the shoal. A *red* buoy marks the west side of it; vessels should not approach nearer than a cable.

Directions.—Steam vessels from the northward should make Cape Ramas, and then steer for the Oyster Rocks lighthouse, avoiding the rocky shoal north-west of the lighthouse. When within 3 to 4 miles of the lighthouse, the Collector's bungalow on Konay hill will be seen, and when it bears E.S.E. steer for it and anchor in 4 or 5 fathoms water, mud bottom, near a white buoy which is placed to mark the anchorage, at about half a mile from the shore. As the Oyster light is approached at night, a *red* light should be seen on the shore of the bay, and when it bears E.S.E. steer for it, and anchor in about 5 fathoms water as before.

Vessels from the southward should make the Oyster Rocks lighthouse, and during day can with safety pass between them and Carwar head. The highest part of Deogur islet on with the highest part of Goormaghur islet, leads eastward of the Oyster rocks reef, which will shortly be marked by a beacon. When the Collector's bungalow on Konay hill is in sight, bring it to bear E.S.E., steer for it and anchor as before. Vessels from the southward at night should not pass between the Oyster rocks and Carwar head, unless well acquainted with the harbour; but should keep westward of the Oyster light until the *red* light on the shore of the bay bears E.S.E., then steer for it.

Sailing vessels making the port at night should anchor in about 8 fathoms water, near the Oyster rocks light, and wait till daylight. It is high water at full and change at 9h. 30m. A.M., and the rise is 7 to 8 feet.

Coast.—Fronting the bays to the S.E.-ward of Carwar head are several small islets. Anjediva, in Lat. 14° $45\frac{1}{2}$′ N., about a mile long, is 1 mile from the southern shore of Carwar head; close to it on the seaward side the depths are 9 and 10 fathoms, and 14 fathoms at the distance of 4 miles; a vessel may find shelter under the island, between it and the main, during the S.W. Monsoon, there being 4 to 5 fathoms in the channel; $2\frac{1}{2}$ miles to the S.E.-ward of Anjediva, and $1\frac{1}{4}$ miles from the shore, is the Button rock.

At Coumta, in Lat. 14° 25′ N., Long. 74° 22½′ E., a *fixed white* light is exhibited on a columnar tower 180 feet above the sea, and visible 12 miles.

Pigeon, or Netrun Island, in Lat. 14° 1′ N., Long. about 74° 18¾′ E., is about 10 miles from the coast, and being 300 feet high is visible 24 miles in clear weather; a small rock lies near its south side, but passing the island to the eastward, there are 20 fathoms a mile off it; but at night do not approach it nearer than 2 or 3 miles in 23 to 24 fathoms.

S.E.-ward of Pigeon island the coast for a distance of 17 or 18 miles is foul and rocky. Hog island, close to the main, is nearly on the parallel of Pigeon island, and between them the channel has 15 to 16 fathoms near the latter, with 9 or 10 fathoms near the former island. The worst ground is nearly opposite False Barsalore Peak (4400 feet high), in Lat. 13° 51¼′ N., where several rocks are found 4 miles from the coast; consequently ships would do well not to come under 20 to 22 fathoms. The edge of the bank of soundings abreast of Pigeon island and Barsalore peak is from 60 to 70 miles from the coast.

The St. Mary Isles extend from Lat. 13° 27′ to 13° 19¾′ N., and though generally low, some of them may be seen 18 miles. They are 2⅓ miles from the shore, having a boat passage between them and the main. To the southward of St. Mary islets, distant 2¾ miles, and about 1½ or 2 miles from the coast, is an islet with detached rocks awash.

Primeira or Molky Rocks, in Lat. 13° 11¾′ N., are 4 miles from the shore, and have 8 fathoms close to them: they are 50 feet high, and visible 20 miles. At night these rocks and St. Mary Islets should not be approached under 16 to 20 fathoms, for in some places the depths decrease suddenly.

The Asses' Ears, a double-peaked hill, to the N.E.-ward of Mangalore, and 15 miles from the coast, is in Lat. 13° 5¼′ N.

MANGALORE.—The anchorage in the roads is with the flagstaff bearing from E.N.E. to E. by N. ½ N., in 5 or 6 fathoms, muddy bottom.

Light.—A *bright fixed* light is exhibited at an elevation of 250 feet above the sea, visible 14 miles; it shows on all parts of the horizon to the westward: position, Lat. 12° 51′ 30″ N., Long. 74° 49′ 25″ E.

Directions.—Coming from the *northward*, having passed St. Mary islands and Primeira rocks in 16 fathoms, haul in for Mangalore roadstead to 7, 6, and 5 fathoms. Coming from the *southward*, and having made Mount Dilly (or Yelly Paud), the coast may be approached, provided that proper attention be given to the lead, and a good look-out kept.

The river is navigable only by small vessels, the bar having but 10 or 11 feet of water on it.

Mount Dilly is a bold, bluff headland, very conspicuous, owing to the coast north and south of it being low and wooded; its position is, Lat. 12° 0¼′ N., Long. 75° 11½′ E. The shore is bold, and may be safely approached; at 2 miles' distance there are 7 to 8 fathoms, and at 10 miles' distance 20 fathoms: the edge of the bank of sounding between Mount Dilly and Mangalore is about 40 to 45 miles from the shore.

CANNANORE.—The anchorage is abreast the fort in 5½ to 6 fathoms; 4½ fathoms is close to the point, and near a dangerous reef of rocks under water.

Light.—A *fixed white* light is exhibited on a flagstaff on the fort at an elevation of 110 feet, visible 12 miles. The Admiralty light notice says it is extinguished during the S.W. Monsoon from May 20th to August 10th; but this is not certain; probably it is lowered to 85 feet during the S.W. Monsoon, in bad weather. Position, Lat. 11° 51′ 20″ N., Long. 75° 21′ 40″ E.

TELLICHERRY.—The anchorage is in $5\frac{1}{2}$ to 6 fathoms, soft mud, with the flagstaff bearing N.E. by N., and Green island N.N.W.—2 miles off the town; in unsettled weather not less than 7 or 8 fathoms. Under 4 fathoms the ground is foul and rocky between Tellicherry and Green island for a distance of 4 miles; therefore the coast should not be approached under 7 or 8 fathoms.

Light.—Two *bright fixed* lights—in the same tower of the fort wall—are exhibited at an elevation of 140 and 104 feet respectively, visible 12 miles. The high light is lowered to 112 feet during the S.W. Monsoon, from May 16th to Sept. 14th. Position, Lat. 11° 44′ 50″ N., Long. 75° 28′ 30″ E.

Coast.—Between Mount Dilly and Tellicherry the bank of soundings is from 40 to 50 miles off the coast; 30 to 35 fathoms at 22 miles; and 20 fathoms at 12 to 15 miles.

Sacrifice Rock, $4\frac{3}{4}$ miles from the coast, in Lat. 11° $29\frac{3}{4}$′ N., is 40 feet high, and having a whitish appearance is visible 18 to 20 miles off: it is steep all round, with 12 fathoms close to, and 16 fathoms 2 to 3 miles off it: the channel between it and the main is good—10 fathoms close to the rock, and 7 fathoms in mid-channel. Passing the rock during the night, do not come under 16 or 17 fathoms.

Off **Kuddelur** or **Cotta Point,** in Lat. 11° 28′ N., a reef projects $2\frac{1}{2}$ miles from the shore; a ship passing should not come under 10 or 12 fathoms.

CALICUT.—The best anchorage is with the lighthouse bearing from East to E. by N. $\frac{1}{2}$ N. in 5 to 6 fathoms,—or with the tombs to the northward of the town bearing E.N.E. to E.N.E. $\frac{1}{2}$ N., about $2\frac{1}{2}$ to 3 miles off shore. Great caution is requisite, as the shore is fronted by shoals which have several rocky heads and are very dangerous.

Light.—A *fixed white* light is exhibited from a column near the beach at a height of 105 feet above the sea, visible 12 miles; it is extinguished during the S.W. Monsoon, from May 20th to August 10th. Position, Lat. 11° 15′ 10″ N., Long. 75° 45′ 35″ E.

Bound from the northward, do not come under 8 fathoms until the lighthouse bears E. by S. or E. The 30-fathoms line of soundings is about 25 miles off shore,—the 20-fathoms line about 14 miles.

The trade of Calicut is in pepper, spices, and timber.

Beypur.—The entrance to the river is in Lat. 11° 10′ N.; there are some shoals here, near the coast, on each side of the river's entrance.

Between Calicut and Cochin the coast may be approached to 7 or 10 fathoms.

COCHIN.—The town is on the south side of entrance of a considerable river, which, though barred, is deep inside.

Light.—A *fixed white* light is exhibited on a staff above the tower on the S. side of entrance, at an elevation of 114 feet, and visible 12 miles: it is lowered to 62 feet during the S.W. Monsoon. Position, Lat. 9° 58′ 5″ N., Long. 76° 13′ 55″ E.

The bar, $1\frac{1}{4}$ miles west of the flagstaff and light, is navigable by ships drawing 14 feet; it is buoyed—a north buoy and a south buoy, between which is the entrance. The rise and fall of tide is greatest when the moon's perigee coincides with a syzygy, being then sometimes 3 feet, but it is commonly not more than $1\frac{1}{2}$ feet. The night tides are highest from November till March, and the day tides from May to August, in the other months the two are equal: both ebb and flood are very strong; and the stream sometimes runs in for many hours without raising the level of the water. There is, at times, a heavy surf on the bar, occasioned by the strong ebbs running over the shoal parts against the sea breeze.

In 1860 the fairway between the buoys was the Pilot's Cocoa-nut Tree in line with Builder's (or Nypeen) point—both on the north bank of entrance. Having crossed the bar, and approaching the mouth of the river, there is a *black* buoy in 18 feet, to the southward of which Lieut. Taylor's I. N. chart (1860) gives 30 to 33 feet, low-water springs. It is said the buoys are removed during the S.W. Monsoon.

The common anchorage is with the flagstaff or light bearing E. $\frac{1}{2}$ N. to E.N.E., in $4\frac{1}{2}$ to $5\frac{1}{2}$ fathoms, soft bottom, and about $2\frac{1}{4}$ to 3 miles off shore. During the S.W. Monsoon, vessels should not anchor in less than 6 fathoms, as there is then a heavy swell rolling in on the coast.

The following is from a letter, dated Cochin, May 9th, 1865:—

There is a good Master Attendant; but, considering the magnificent harbour, the lighthouse arrangements are singularly defective. There are about 1600*l.* to the credit of the harbour from Port Dues, and it is estimated 2200*l.* would give a proper lighthouse. Proper wharfage is also required, and elevators for loading and unloading.

The great danger is in the S.W. Monsoon. There are $13\frac{1}{2}$ feet of water on the bar, which could easily be deepened, when there would be a harbour of refuge fit for a thousand vessels. There is now a steam-tug at this port. Narrakel, 6 miles off, is a safe anchorage in the Monsoon.

Cochin is connected by telegraph with Bombay, Madras, and Calcutta,—and, consequently, by the Indo-European line, with England. The water communication is excellent. There are three lines of steamers calling here.

The coffee, oil, and other trades are all on the increase. Ginger and coprah are also important items of commerce; and the sea teems with fish. If English capital and skill were applied, much larger quantities would be taken than at present by the rude native process. The Bank of Madras has an agency here, but money is scarce.

Cochin is built on the north extremity of an island, and along the southern entrance from the sea to the "Backwater"—an inland harbour or lagoon, which extends nearly 120 miles, being separated from the sea by a narrow peninsular tract. Large supplies of teak are floated by the rivers, from the forests, into the Backwater—some of which is exported and some used in shipbuilding: the other exports are sandal wood, pepper, cardamoms, cocoa-nuts, coir, cordage, sussin, and fish maws.

Supplies of all kinds can be obtained at Cochin.

NARRAKEL, OR NARAKET.—The first notice of this port appeared in the *Mercantile Marine Magazine*, June, 1863, given by Captain D. Cowen, of the *Euphrates*, as follows:—

"The roadstead of Narrakel, 6 miles north of the entrance to Cochin harbour, was first made known by Messrs. Pearce, Leslie, and Co., merchants, of Cochin,

about twenty years since. It is a good and safe anchorage in the S.W. Monsoon. A ship may run in and bring up in 3 and 4 fathoms, and find smooth water at all times—the sea breaking very heavily outside this depth. The bottom is mud, and the anchor sinks down many feet into it. I discharged a cargo of salt, with the S.W. Monsoon blowing very strong, and with a heavy sea in the offing, but quite smooth where we were discharging. I could at all times go on shore in my gig. The Master Attendant of Cochin has placed a mast or flag-staff, about E. by S., off the best anchorage; but that is no guide to ships going into the roadstead, as the cocoa-nut trees at the back of it hide it until you get close in shore. It can be seen from Cochin along shore, but not when in the offing. If a *white* landmark were put up, it would be a guide to shipmasters."

And again, in the *Mer. Mar. Magazine* for January, 1864, Captain Lewis Bilton, R.N.R., writes:—

"Having picked up some information about Narrakel, I hasten to tell it you, giving also the experience of others, who have had better means of information, from living on the spot. In August, 1863, being abreast of Alipey, and finding my fore-topsail yard badly sprung, I anchored to procure another, but failed in doing so. Alipey is situated in the dominions of the Rajah of Travancore, and, until Sedashigur and Narrakel had been opened up, the only port on the Malabar coast where vessels could load during all the S.W. Monsoon, in safety—a fact I believe not generally known in England. It seems, however, very doubtful if Narrakel is known at all; it is situated about six miles north of Cochin, and is formed by a mud bank, deposited there within the last few years, and where ships lie in perfectly smooth water, during the S.W. Monsoon—as certified by a correspondent of the *Times of India*:—

"'The port of Narrakel, in the state of Cochin, promises to succeed; three vessels have been lying there since the commencement of the Monsoon, and business has been transacted with perfect ease and safety—a circumstance that places the accessibility of the new port at all times of the year beyond the possibility of a doubt.' The weather is very wet and stormy, and in fact just what the Monsoon is expected to be. A resident merchant of Cochin, writing to the *Times of India*, under date of July 7th, 1863, says:—'There is no doubt considerable diversity of opinion as to the S.W. Monsoon, and its effects on this coast—viz., whether it is possible, or not, to carry on communication by sea with the different ports. It is not our purpose here to argue the point, and we content ourselves by remarking, that with the exception of Sedashigur, Narrakel, and Alipey, we believe the S.W. Monsoon may be said to close the ports on the western coast of India, excepting, as a matter of course, the great port of Bombay. We have taken upon ourselves, however, to address you with respect to one of the places above mentioned—viz., Narrakel, and its capabilities as a port, more particularly during the S.W. Monsoon. It is hardly possible that all which has been written, printed, and published with respect to it should have been altogether delusive; and the experience of the last few weeks has considerably brought us to the conviction that the port is a good one. But for facts—

"'1st. When the Monsoon broke, communication was all but impossible with the outer roads (Cochin), and boats could not be got to take cargo outside; the *Charlotte Jane*, 619 tons, Captain Burgoyne, on the berth for London, was moved up to Narrakel, and there finished her loading.

"'2nd. The barque *Salvia*, 347 tons, CAPTAIN REES, came in here (to the outer roadstead) about the 6th ult., and the captain finding Narrakel a more comfortable berth, moved his ship up there, where she lay safely and quietly for a week, he having the means of communication with the shore every day.

"'3rd. The barque *Armenian*, 347 tons, arrived here about the 24th ult., when communication from the shore off Cochin was quite impossible; and the captain, by the advice of the Dubash (who in the previous case, as well as in this, had boarded the vessel from Narrakel,) proceeded there, went on shore, got his orders from Cochin, and proceeded.

"'4th. The *Anatoon Apear* (980 tons) steamer, arrived here on the 6th instant, the weather being exceedingly boisterous and wet, and signalled for boats to come off to her. The chief officer made an attempt to land in the life-boat, but did not succeed. On the following morning the steamer was boarded from Narrakel, and the captain was induced, from the representations made to him, to shift his berth to that port, where he has lain in 5 fathoms, smooth water, and shipped 80 tons of coals. CAPTAIN DE SMIDT, of the above steamer, expressed his great surprise at finding his vessel in smooth water, and at being able to land in his own boat, and step ashore from it without the least difficulty. His expression was "that there was not a ripple on the beach." We doubt not CAPTAIN DE SMIDT will corroborate this fully, if applied to. These facts, in our opinion, entirely prove what has before been asserted respecting the advantages Narrakel offers to vessels requiring to touch on the coast during the S.W. Monsoon, but it does not appear that these facilities are generally known, or if so, that they are not believed, for in the cases adduced, none of the Masters were aware that there was such a place as Narrakel; and in the case of the *Lowick* (which arrived about the 17th ult.) whose Captain, we have reason to believe, did know of the place, and also of that of the B. I. S. N. Co.'s S. S. *Kurrachee*, no attempt even was made to test the capabilities of Narrakel. We therefore hope, that should you think with us, that it would be to the advantage of the trading community of this coast, that the port of Narrakel should be more generally known, you will take such steps as you think most likely to attain that result, and give a wide circulation to the government directions for making the port.'

"I have therefore deemed it of importance to bring the matter to your notice, for the benefit of my brother shipmasters, or of owners who may be induced by a knowledge of these facts to trust their property on such a voyage, as there seems no reason to doubt that vessels can load at Narrakel during the whole S.W. Monsoon without any risk or difficulty."

ALIPEY.—This is a safe roadstead all the year round, and the town carries on a considerable trade; the shore is fronted by hard patches, alternating with soft mud.

Light.—A *revolving white* light, attaining its greatest brilliancy *every minute*, is placed in a tower at an elevation of 130 feet above the sea, visible 15 miles; position, Lat. 9° 30′ N., Long. 76° 20′ E.

Two miles south of the lighthouse a shoal bank of 6 to 9 feet extends $1\frac{1}{2}$ miles off shore.

Coming from the north, Alipey may be known by a *large white house*, off which, when it bears N.E. by E., a large vessel may anchor in $5\frac{1}{2}$ fathoms; also with the light or lighthouse bearing E. by N. you may anchor in $4\frac{1}{2}$ to 6 fathoms, according to the size of the vessel.

Captain Lewis Bilton, R.N.R., writes :—

"All that has been written of Narrakel may with equal truth be said of Alipey, as it enjoys exactly similar advantages, viz. :—a mud bank sheltering the anchorage and landing-place, in the same manner as at Narrakel. I touched there as before-mentioned for the first time, on the present voyage, and remained till next day, and found it all that had been represented; I could have easily landed in the smallest boat in the ship; I was, however, disappointed in procuring a spar, not finding them plentiful, the longest to be obtained was only 45 feet, whereas I required one 66 feet, and I was not disposed to stay and have one made in two pieces, but fixed the broken one in the most substantial way our means admitted of, and proceeded. Found a very strong S.E. current setting along the coast, with an in-shore tendency that requires to be guarded against in thick rainy weather, and at night.

"The port of Alipey is under the charge of Captain Hugh Crawford, who is Commercial Agent, Master Attendant, Custom Master and Superintendent of Police to the Rajah; he resides on the spot. The only other European inhabitants are the clergyman, and an old skipper who keeps an hotel. There is also one American merchant. There is a large Mussulman population, and some of the merchants very wealthy, carrying on a steady trade with the Red Sea and Persian Gulf; they reside here in preference to Cochin for the facility of trading from the port in the S.W. Monsoon. The town is well built, and does not display the ruined appearance of most native towns; and the streets well kept; it is, however, completely hidden from seaward by the dense vegetation, and nothing is visible but the lighthouse and flag-staff, except a long barn-like building on the beach, from whence goods are shipped and landed, and which is connected with the town by a tramway; a canal also runs through the town, by which trade is chiefly carried on along the coast in the bad season, as it extends north nearly to Beypur, and south to Cape Comorin, as I was informed. The principal exports are cocoa-nut oil, cassia, coir, molasses, timber, paddy, turmeric, hides, arica nuts, mats, cinnamon, flour, coffee, pepper, arrow-root, croten seed, sapan wood, &c. The English system of postage stamps has been adopted and seems to succeed; in fact, everything seems here to be carried out in the English method. The present Rajah, Rumah Vurmah, is now thirty-one years old, and he is a very intelligent man; he resides at Trivandrum, the capital, where he has a number of Europeans occupying various situations under his Government. His army is commanded by English officers. The Hospitals (public and private), an Observatory, a Museum, Printing Presses, Schools (government and free), and various other institutions, are all under European superintendence, and are flourishing. The Law Offices and Courts also boast of an intermixture of the European element. Few of the Rajah's predecessors, I suspect, were as liberal as he is. Large quantities of pepper were formerly exported from Alipey, but this branch of trade has fallen off in consequence of the Rajah having given up the Government monopoly in the article, and also from competition. Formerly, all the pepper grown in the country was delivered to the Government at a fixed rate; and the large godowns where it was stored, dried, and shipped from, yet remain, but they are now fast going to decay, and do not seem to be used for any purpose. A duty of fifteen rupees per candy of 500 lbs. is now levied instead on all pepper, and the producers allowed to ship or sell it as they please. Salt is imported in large quantities from various sources—also tobacco, piece goods, cotton, thread, bullocks and buffaloes, iron, copper, coriander, gingelly and cummin seeds, liquors, wheat dholl, ghee, gram, camphor,

sugar, &c. The boats at present employed are a species of canoe, hollowed out of a single tree, and of great length, but Masoolah boats similar to those in use on the Coromandel coast are being introduced by the enterprising agent at Alipey, and I saw several building. Good roads have been made to intersect the country in all directions, with commodious bungalows at intervals, for the accommodation of European travellers.

"The anchorage in the roads during the S.W. Monsoon is with the lighthouse bearing from E. by N. to N.E. by E. in $3\frac{1}{2}$, 4, or $4\frac{1}{2}$ fathoms, soft mud, where ships will be in perfectly smooth water, with a ridge of breakers in $6\frac{1}{2}$ fathoms water (in bad weather) to seaward of them. It is very seldom that there is any surf on the beach at Alipey, even in the worst weather, so that ships' boats can at all times communicate with the shore. In very heavy weather, for a number of years back, the sea has broken in six fathoms, inside of which it is quite smooth, and Arab ships of 600 to 1000 tons anchor inside of these breakers in $3\frac{1}{2}$ to 4 fathoms, landing their cargoes during the whole of the bad season. Ships may procure water from a well on the beach, and good vegetables and fruit can be obtained (generally) in abundance. Fish is plentiful, and of the best description and variety; and live stock abundant, and only half the price they cost at Bombay. The whole of the adjacent country is one continuous tope of cocoa-nut trees, and the green nuts are a great luxury on board ship, and cost but little. There were formerly no very distinctive marks by which Alipey could be known, unless a ship was very close in, except a long white building, with an archway in the centre; this is now completely hidden by the dense and luxuriant vegetation around it; nor is the church tower now visible. The new lighthouse, however, is a very conspicuous object, and *painted white*, it cannot be mistaken in either Monsoon; it was red, being constructed of the red laterite which forms the superincumbent strata all along the Malabar coast; it is a credit to the architectural talent of the worthy Master Attendant, who superintended the construction himself—without any engineering assistance whatever.

"Bound from the *southward*, from the Bay of Bengal and the Coromandel coast to Alipey, in the S.W. Monsoon:—Ships bound to Alipey from any of the above-mentioned places in the S.W. Monsoon, should steer north until in Lat. 9° 30′, then run down east for Alipey, making an allowance for a 3-knot southerly current after passing the vicinity of Kalpeni island.

"A large ship from the *northward* ought not to come under 7 fathoms, if drawing much water, until the lighthouse bears to the eastward of S.E., as there are some shoal patches (with only 4 fathoms) in-shore of those soundings.

"Alipey and Narrakel are the only ports on this part of the Malabar coast which a ship can run for, if disabled during the S.W. Monsoon,—the water being so perfectly smooth that repairs of any kind could be conducted with ease and facility. Captain Cope, an old navigator, calls this place Mud bay, and says, '*It is one of ye most curious places in ye world;*' and I certainly never, during the 22 years I have been trading to Bombay, had the remotest idea that I could land anywhere on this coast in the bad season, and I believe most of shipmasters are in equal ignorance.

"Ships from Colombo, or Tuticorin, bound to Alipey in the S.W. Monsoon, should, on leaving those ports, be in good sailing trim, and have good sails bent, as the weather will in all likelihood be bad. From Colombo roads, or the Gulf of Manaar, a W.N.W. course should be steered, close-hauled, for the coast of Tinnevelly; should

the wind hang to the southward, advantage may be taken of the same, and endeavour to get in with the land about Cape Comorin, after rounding which it often happens that a ship will carry the southerly wind all the way up the coast; at all events, a ship which sails moderately well by the wind after having rounded Cape Comorin, will always be able to make the passage to Alipey in 8 or 10 days, there being often a favourable current along the coast, to the northward, after a slant of wind from the south; and a well-found ship, taking every advantage of the shifts of wind, will be able to make a much better passage, and with less wear and tear than by the southern route. The general direction of the wind in the S.W. Monsoon at Alipey and along the coast to the south is from the west,—perhaps to the northward of west. These directions (amended to the present time by me), were drawn up at the request of a few merchants and captains of ships in 1851, to whom the advantages of Alipey were known. Since then, English, French, Swedish, and Russian ships have loaded throughout the bad season; and the vessels at Cochin (before the discovery of Narrakel) that have been unable, from bad weather, to complete their loading there, have come to Alipey, their cargoes having been sent down in boats by back water."

QUILON is in Lat. 8° 53½′ N., Long. 76° 34′ E.; it is a projecting part of the coast, and the foul ground fronting it should not be approached under 13 to 15 fathoms.

Anjengo is in Lat. 8° 39¾′ N., Long. 76° 45′ E. Between Cochin and Anjengo the depths are 20 to 24 fathoms about 7 miles off the coast, and 30 to 35 fathoms at 15 to 16 miles off. The edge of soundings to the S.W. of Anjengo is 24 miles distant from the coast.

The Enciam Islands, or Inni yebiparare, in about Lat. 8° 13′ N., are near the shore, and there are several rocks above and under water.

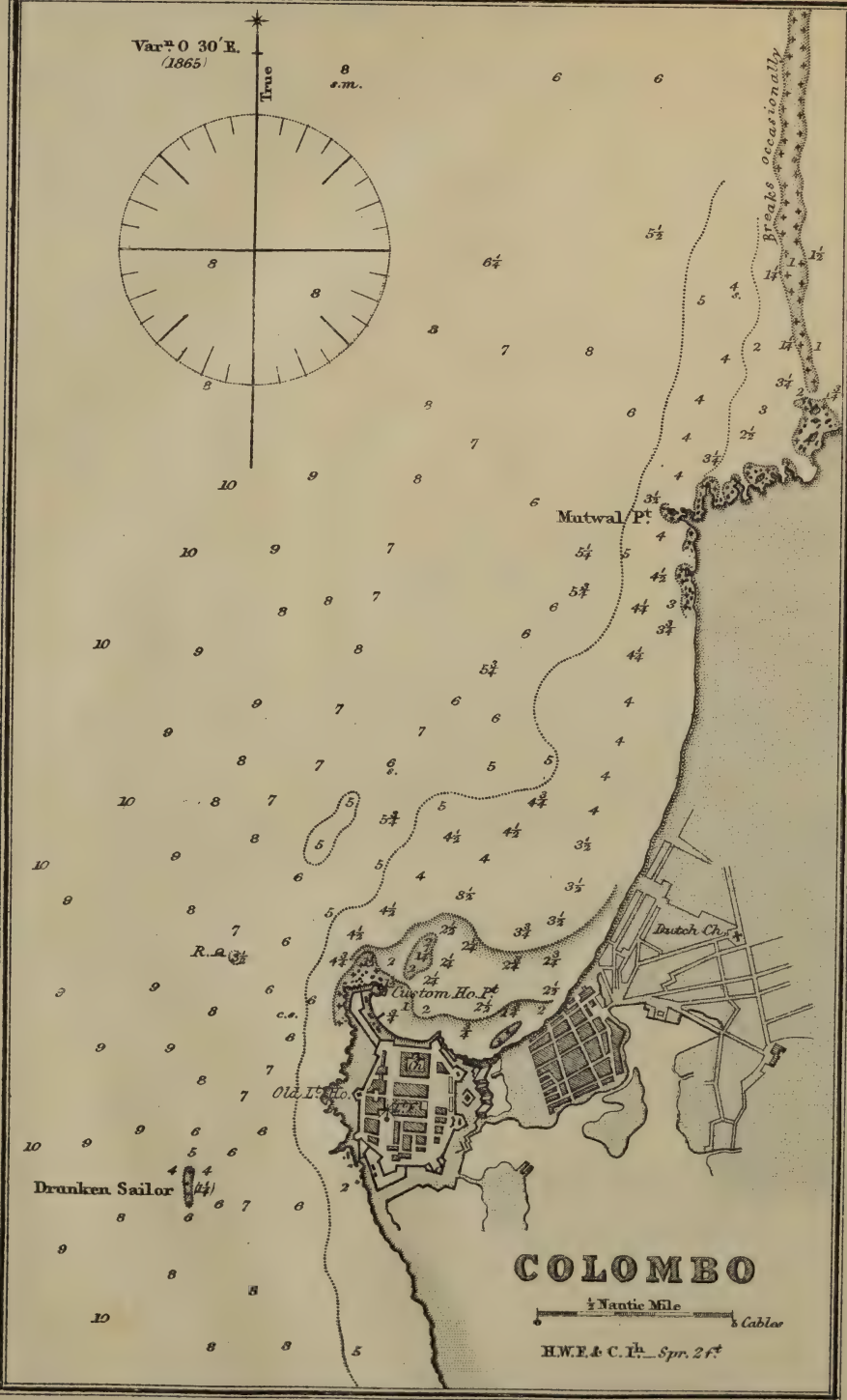
The coast thence curves rapidly to the S.E.-ward.

Off **Cadiapatam Point** are the Kotah and Adumdah islets, distant respectively 1 and 2½ miles off the point; they are surrounded by foul ground and rocks under water. **Crocodile Rock** is also 2¾ miles off the point, and close to it, at 1½ miles, are 13 to 14 fathoms. The sea does not always break on it. From this rock Cape Comorin bears East distant 5¼ leagues, Cadiapatam point N.N.E. ½ E., and Adumdah islet N. ¾ W.

Wadge Bank is in Lat. 7° 24′ to 7° 44′ N., Long. 76° 30′ to 76° 42′ E.: the least water reported is 7 fathoms. On its northern end there are 17 to 18 fathoms, and 42 fathoms towards the centre and southern part.

Cape Comorin is a low, sandy point in Lat. 8° 5¼′ N., Long. 77° 32½′ E. About 2 or 3 cables from the S.E. part of the point is a rocky islet, with several rocks about it, on which the sea breaks. Opposite the cape the edge of soundings is 46 miles distant, and there are 20 fathoms 5 miles off it.

Having passed Cadiapatam point, the coast may be approached to 20 fathoms; but in hazy weather, or during the night, stand further off. (*See also* pp. 442-443 for a description of Cape Comorin and the navigation of the Tinevelly coast.)



LONDON, James Imray & Son.

THE ISLAND OF CEYLON.

PORT OF COLOMBO.

The following directions are by Mr. James Donnan, Master Attendant at Colombo, 6th July, 1864:—

Port of Colombo.—The roadstead of Colombo, although exposed to the S.W. Monsoon, is a safe one for vessels well found in ground tackle. Vessels generally ride out the Monsoon at single anchor, with a long scope of chain. A gale of wind may occur about the changes of the Monsoon, in the months of May, June, November, and even as late as December; though a gale in the latter month is very rare, and several years sometimes pass away without any beyond a stiff Monsoon breeze. These gales are seldom violent, and it is only during them that casualties occur to the shipping. Only five vessels have been wrecked within the last thirty-two years. Communication between the shore and shipping is seldom interrupted, although there are occasional spells of squally weather and a high sea during the S.W. Monsoon, which make the passage over the bar difficult and dangerous, especially for small boats.

A vessel may anchor anywhere in the outer roads with the flagstaff bearing from S. $\frac{1}{2}$ E. to S.E. by E. in $6\frac{1}{2}$ to $9\frac{1}{2}$ fathoms water, and distant from the north bastion of the fort from half to one mile. The best anchorage is with the flag-staff bearing about S.S.E. $\frac{3}{4}$ E., in 8 fathoms water. Vessels arriving during the S.W. Monsoon, or about the changes of the Monsoon, should not anchor nearer the north bastion than half a mile, or bring the rocky point at Mutwal (which is about $1\frac{1}{2}$ miles northward of the fort) to bear northward of N.E. $\frac{1}{2}$ E.; and they are recommended to ride with not less than 80 fathoms cable to the hawse, and to have all the shackles looked to, and the small pins well secured, before coming to an anchor. The constant pitching motions which vessels are subject to cause the cables at some distance from the hawse to beat and chafe on the ground, and the shackle pins frequently work out, if not well secured. The small pins should be of iron with large heads, and the other ends well clinched over a ring; if not clinched they invariably loosen, and work out.

The Inner road or harbour is mostly occupied by the native coasting vessels. It is considerably sheltered from the S.W. Monsoon by the north bastion of the fort and bar, and affords good and safe anchorage for vessels drawing not over 11 feet. The bar is a shifting sand-bank, extending for about $1\frac{1}{2}$ cables' length from the north bastion in a direction towards Mutwal point; there are 7 to 12 feet water on it, and $3\frac{1}{2}$ fathoms inside and beyond it. Strangers should not enter the Inner road without a pilot; and as the sea sometimes breaks on the bar during the S.W. Monsoon, and several lives have been lost by boats being swamped, they should not use their own boats in landing, but employ one of the outrigger canoes, which are always available, until they become acquainted with the passage over it.

The Ballast Ground during the S.W. Monsoon is in 15 fathoms water with the flagstaff bearing about East; and during the N.E. Monsoon in the same depth of water with the flagstaff about E.S.E., where vessels may discharge their ballast overboard.

Tides and Current.—The current off Colombo, and in the Gulf of Manaar, is subject to considerable variation, particularly about the changes of the Monsoon, when it is the strongest but, generally speaking, it sets with the Monsoon, and is never so strong as to inconvenience vessels making Colombo. The greatest difference between high and low water recorded at Colombo is not more than 2 feet 10 inches. In the S.W. Monsoon, when the mean level of the ocean is the lowest, the difference between high and low water is from 5 to 15 inches. On those days when the difference between high and low water is not more than 6 inches, the rise and fall has been observed to take place four times within twenty-four hours.

Directions.—Vessels bound to Colombo during the S.W. Monsoon from south of the Equator, should not cross it to the eastward of 78°, as between 3° N. and the coast of Ceylon a strong current sets to the eastward, and the wind frequently hangs from West until the Gulf of Manaar is entered, thus making it difficult to fetch the port, if not well to windward. The coast for 30 miles south of Colombo may be approached with safety to a distance of 2 miles.

The coast about Colombo is low, and not visible from seaward more than 10 miles. About one mile northward of the fort near Mutwal there are some lofty fir-trees, which are generally seen (when approaching from seaward) before the lighthouse or flagstaff. They afford a good landmark for Colombo, as, when viewed from seaward, they appear considerably elevated above the surrounding cocoa-nut trees, and seem as one *tope* rather thinly planted. No other part of the coast either north or south of Colombo affords a similar mark to this.

There are some isolated hills at a distance in the country, and the high mountain on it a sharp cone called Adam's Peak, about 7420 feet above the level of the sea, has been seen in clear weather at a distance of 30 leagues. In the N.E. Monsoon it is generally visible in the morning, and sometimes throughout the day, but is rarely seen in the S.W. Monsoon through the humid atmosphere which prevails in that season.

Light.—A *fixed white* light is exhibited every night from the clock tower, a square, grey-looking building standing in the centre of the fort. The light is elevated 133 feet above the level of the sea, and visible in clear weather from a ship's poop 18 to 20 miles.

Approaching the roadstead from the southward, the Drunken Sailor must be avoided; it is a ledge of rocks with only 6 feet water over the shallowest part, which bears W. by S. $\frac{3}{4}$ S., from the light tower, and is distant off shore about half-a-mile. This danger is clearly defined during the S.W. Monsoon by a constant break of the sea; but during the N.E. Monsoon, with smooth water, there is no break, and it will then be prudent not to come under 9 fathoms water, when in the vicinity of these rocks, as there are 8 fathoms close outside them; a more prudent course, however, would be not to approach the shore within $1\frac{1}{2}$ miles until the light tower bears eastward of E. by N., then to stand in for the shipping, as no advantage can be gained by steering close to these rocks at any time.

The approach from the westward is quite clear, and also from the northward, with the exception of a ledge of rocks that stretches along shore to the northward from Mutwal; but as this ledge is only about a quarter of a mile off shore, and so much out of the usual track of shipping, it is scarce worthy of note as a danger.

A rock, with 24 feet of water on it, has been discovered in the southern part of

Colombo roadstead, which is now marked by a *red buoy*. Vessels arriving in the roadstead must give the buoy a clear berth of half a cable's length, as there is foul ground for some distance around it.

NEGOMBA, 16 miles to the northward of Colombo, is in Lat. 7° 12½′ N., Long. 79° 48′ E.; it is a place of some trade, but ought not to be visited during the S.W. Monsoon, or at least from May to August inclusive. It may be recognised from seaward by a point well covered with cocoa-nut trees, whence there projects in a N. by W. ¾ W. direction for the distance of 3½ miles, a reef, or rocky ledge; near the shore this ledge, for the distance of a quarter of a mile, consists principally of rocks awash, thence there is a depth of 3, 4, and 5 fathoms in places, but the extremity is a coral patch, with not more than 9 to 12 feet over it. Bound to Negomba from the southward, the fort should be brought to bear S.E. by S., then steer direct for it, and anchor abreast the fort in 5 or 6 fathoms.

The bottom between Negomba and Colombo is mostly mud, with regular soundings, but the coast should not be approached nearer than 4 miles, nor under 10 or 12 fathoms, until Negomba flagstaff bears S.E. by S. To the northward of Colombo, and opposite the river Mutwal (or Kalany Grange), some rocks, with a line of breakers upwards of 4 miles long, stretch about a mile from the coast.

The following additional remarks are from Mr. J. J. Franklin's "Instructions for Navigating the Gulf of Manaar," 1846, &c.:—

Chilaw Bungalow, in Lat. 7° 34′, may be known by its high, red-tiled roof, seen 8 or 9 miles off in clear weather. Some rocks, once supposed to be at some distance from the shore, are now known to be not more than ¾ mile off, and consequently cannot be considered as forming any obstacle to general navigation; they are situated 5 miles due North of the bungalow, and are in a line between it and the next point. North of the bungalow, at the distance of 21 miles, and off Narakadoo, uneven soundings on rock to as little as 3¼ fathoms are found from 3 to 4 miles off shore, with 6 and 8 fathoms immediately outside; large vessels, therefore, ought to be careful not to come within this distance of the land hereabouts, although small craft can at all times go over the shoal. The coast between Narakadoo (Lat. 7° 59½′) and Dutch bay, must not be approached under 20 to 25 fathoms, for at 10 to 6 fathoms, much foul ground extends thence to the shore.

Dutch Bay, in Lat. 8° 19′ N., is well sheltered from all winds, but more particularly from the S.W., which are the strongest on the coast. Vessels can anchor here in 2½ to 3 fathoms stiff mud, close inside the neck of sand that forms the western side of the bay, with a cocoa-nut tope and house called Paringethoray bearing S.S.W. The only dangers in the approach to it are a rocky patch with 2¾ fathoms over it at low water, 2 miles W.S.W. of the North end of the neck of sand before mentioned; and some shoal water 3 miles N.N.W. of the same point, and 2½ miles West of some palmyra trees, a few of which are leafless, on the island of Karateevo. This last extends North and South about 2 miles, with an average breadth of 1, having over it from 3 feet to 3 fathoms, with a small patch of sand, generally dry, due West of the above trees. There are 4 to 5 fathoms to the Eastward of this reef, but no person, without being well acquainted with the coast, ought to attempt the passage inside. From seaward the North end of the neck of sand ought to be brought to

bear S.E. ½ E., when it can be steered for and passed within 50 yards, carrying 3 to 4 fathoms sand.

Very good anchorage in the S.W. Monsoon may also be found under the lee of Kodramallai point in Lat. 8° 32′ N., which may be known by the three long hills seen over the low land of Karateevo. In steering for this anchorage, the North end of the hills ought to be kept about E. by S. till well past the island, when the anchor may be let go in 2½ to 3½ fathoms sand, with the rocky promontory bearing S.S.W. to S.W., ½ to 1½ miles off.

No vessels ought to proceed on the Ceylon side further towards the head of the Gulf than this, as there are many shoal places at some distance from the shore, and no good holding-ground. In the S.W. Monsoon a strong current is found setting to the Northward over Adam's Bridge, which abates as the Indian coast is approached; and a confused sea is generally found to prevail near Manaar.

The coast between Colombo and Point de Galle has many outlying dangers near it, especially that part nearer to Galle; they consist of coral reefs, shoals, and rocky islets, but all are well cleared by not approaching the shore nearer than 3 to 4 miles, at which distance off Caltura (Lat. 6° 35′ N., Long. 79° 57′ E.) as well as north and south of it, there are soundings of 14 to 16 fathoms; southward of 6° 21′ N., and thence to Galle, the soundings vary from 20 to 35 fathoms at that distance from the coast, although the dangers stretch further to seaward along this part.

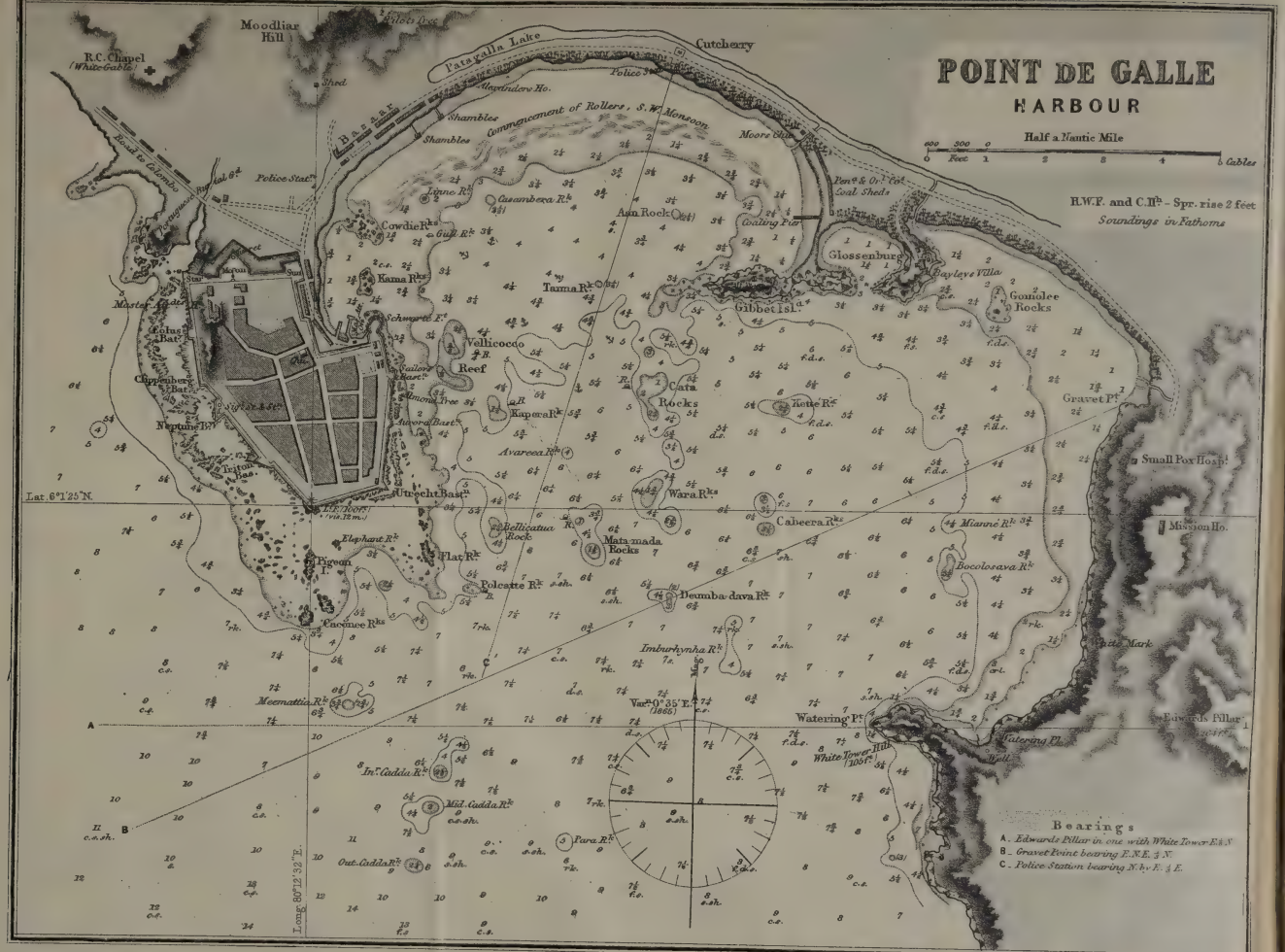
In the immediate vicinity of Point de Galle there are several rocks and shoals very dangerous to navigation.

Whale Reef, nearly 1½ miles wide, stretches westward from Point de Galle light-house to the distance of 3 miles, and has on it a general depth of from 4 to 10 fathoms, but there are several very shoal spots. The **Whale Rock,** 1½ miles from the shore, and W. 4° N., 2¾ miles from the flagstaff, always breaks, but in fine weather only once in four or five minutes. **Little Whale Rock** is small, and above water; it lies half way between the Whale rock and Galle flagstaff, and has several dangerous rocks between it and the shore. Between the Whale and Little Whale rocks there is a clear channel with 8 to 10 fathoms, but this should never be attempted except through sheer necessity.

North-westward of Whale reef lies **Gindurah Rock,** with only 9 feet on its shoalest part, and 4 to 5 fathoms within a cable's length of it. This dangerous rock is opposite the entrance to Gindurah river, distant 2¼ miles, and bears W. by N. ¼ N., 4½ miles from Point de Galle flagstaff. A coral spot, with only 3 fathoms on it, lies E. by N. ½ N. ⅜ of a mile from the Gindurah rock; and there is a depth of 16 fathoms between the two shoals. The soundings between Whale and Gindurah rocks deepen gradually from 8 fathoms near each to 20 fathoms in mid-channel.

S.W. ½ W., 3 miles from Point de Galle lighthouse, is Gallehogalle bank, with 17 fathoms water on it; from north to south it is ⅖ of a mile long, and ½ a mile wide from east to west.

Should the wind fail, and the current be unfavourable, ships may anchor on the bank of soundings extending 3 or 4 leagues to the southward of Point de Galle; the bottom is generally sand and gravel, but occasionally rocky. *During the night,* vessels coasting between Galle and Caltura should not come under 40 fathoms, and between Caltura and Colombo not under 20 fathoms.



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POINT DE GALLE BAY.

The Bay of Point de Galle was re-surveyed in 1860 by GEORGE F. McDOUGALL, Master, R.N.; and the following Sailing Directions and description of the dangers in the vicinity of the Bay have been issued:—

Point de Galle Bay is formed between Point de Galle and the sloping land to the eastward, on the highest part of which, at an elevation of 264 feet, stands Edward's Pillar, painted *white;* thence the land trends to the S.E., and terminates in Oonawatty point, which projects farther seaward than the true point.

The inner part of the bay is between Point de Galle (which is low) and a rocky bluff to the eastward, named Watering point, which has a natural *red* patch on the slope of its western face. The distance between the two points is a little more than a mile in an E. by S. $\frac{1}{2}$ S. direction; the actual entrance, however, is narrowed, and the anchorage within is much confined by numerous dangerous reefs, having only from 3 to 15 feet water over them. At the head of the bay is a low sandy beach bordered with cocoa-nut trees. Near the centre are two rocky promontories, known as Gibbet island and Glosenburg.

The anchorage frequented by shipping is in from 6 to 4 fathoms, sandy bottom, on the western side of the bay, abreast the fort, where supplies of every kind may be procured; but the space is too limited to accommodate the yearly increasing number of vessels visiting this port.

The land in the vicinity of Point de Galle is comparatively low and ill-defined, but the position of the bay may be readily known by the *lighthouse* which stands at the southern extremity of the western point of entrance. On this point the fort and town are built, the sea front being rendered inaccessible by a line of coral reefs, on which the sea breaks heavily.

Several rocky islets extend a quarter of a mile to the southward from the lighthouse point; on one of these (Pigeon island) stands a solitary cocoa-nut tree (1860). The dangers are all above water, and may therefore be easily avoided.

Light.—A *Fixed White* Light is exhibited from an iron tower, 80 feet high and painted *white*, on the south bastion of the fort of Point de Galle; the Light, elevated 100 feet above the sea level, is visible at a distance of 12 miles.

Anchorage.—During the N.E. Monsoon, the best anchorage in the roadstead off Point de Galle Bay is in 16 fathoms, with the Pilots' Tree and the Church in the Fort *in line*, and the rocks off Oonawatty point on with a point to the eastward of Oonawatty. In the S.W. Monsoon, vessels seldom anchor in the road, but should they do so, the best temporary anchorage will be in 16 fathoms, with the lighthouse bearing N.E., and distant about $1\frac{1}{2}$ miles off shore.

Tides.—The tidal stream does not exercise any perceptible influence in this bay. The streams are regular, east and west, rather more than 1 knot.

SUPPLIES.—Point de Galle is now much frequented as a port of call for orders, in consequence of the Electric Telegraph, which is in communication with every part of India. Supplies of every kind, including coal, can be obtained. Water may be procured from a small bay within Watering point, where there is an excellent spring and a wooden pier. Native boats and crews can be hired to supply ships with water.

The Off-lying Dangers are as follows:—

The Cadda Rocks consist of a series of disconnected patches, nearly 2 cables in extent, N. by E. and S. by W., and having 2 fathoms on the shoalest part. There is deep water between the rocks. During the S.W. Monsoon, heavy breakers extend the whole length of the reef, but in the N.E. Monsoon there is seldom a break.

The Outer Cadda, on which the least water is 13 feet, lies S. $\frac{1}{2}$ E., about two-thirds of a mile from the lighthouse, with the Pilots' Tree* and Sailors' bastion in line, and the *white* mark on the western side of the bay almost shut in with Watering point.

The Middle Cadda, with 2 fathoms on it, lies with the Pilot's Tree open of the Almond Tree, and the *white* mark a sail's breadth open of Watering point.

The Inner Cadda has 15 feet on its shoalest part, from which the Pilots' Tree is in line with Flat rock, and the signal-staff on Neptune's bastion is open east of the cocoa-nut tree on Pigeon island.

Para Rock, having 5 fathoms over it, never breaks. From it the lighthouse and east end of Elephant rock are in line, and the *white* mark is shut in with Watering point.

Meemattia Rock is half a cable in extent, has 17 feet on it, and breaks in bad weather during the S.W. Monsoon. It lies nearly in mid-channel, between the Inner Cadda and the islets extending south of the lighthouse; from it the east turret of the Church in Fort is seen touching the west side of Elephant rock, and Flat rock is in line with Cutcherry police station.

The Dangers in Galle Bay are as follows:—

Polcatte Rock has only 3 feet on it, and always breaks. The marks for it are, the lighthouse open south of Flat rock, and the Button rock on with left high shoulder of Moodliar hill. A *black* buoy is moored in $6\frac{3}{4}$ fathoms, about 30 yards E.S.E. of the rock.

Mata-Mada Rocks form two distinct patches about three-quarters of a cable apart, and always break. A *red* buoy is moored in 6 fathoms west, about 30 yards of the inner and shoalest patch of 6 feet, from which the white gabled Chapel, on an eminence outside the fortifications, is just open of Schwarte fort, and the cocoa-nut tree on Pigeon island is on with the north end of Flat rock.

Bellicatua Rock, with $2\frac{1}{2}$ fathoms on it, forms with the inner Mata-Mada Patch, distant $1\frac{1}{2}$ cables in an E. by N. direction, the narrowest part of entrance to the western portion of the bay. The marks for it are, the Pilots' Tree just open eastward of the Gull rock, and the cocoa-nut tree on Pigeon island on with north end of Flat rock. This rock breaks in bad weather during the S.W. Monsoon.

Wara Rocks always break, having only 3 feet on their shoalest part, from which the Pilots' tree is in line with the Arrack store; and the Church in Fort is on with the Almond Tree.

Kapera Rock, on the west side of the bay, has on it a shoal patch of only 9 feet water, from which the cocoa-nut tree on Pigeon island is on with the centre of

* The Pilots' Tree stands on Moodliar hill, and forms one of the most important leading marks into the bay. It is large and mushroom-shaped, but being almost hidden by the growth of trees in its neighbourhood, it has been recommended that these latter be removed, that this valuable mark may be more easily recognised.

Elephant rock, and the Sun bastion is touching the end of Schwarte fort. A *red* buoy is moored in 5 fathoms at a third of a cable E. by N. from the 9 feet patch.

Cata Rocks consist of a long ledge, extending in a southerly direction from near the west end of Gibbet island, towards the Wara rocks. There are several detached patches on the ledge, with from 1 to 3 fathoms on them, and deep water around. From the westernmost patch in 2 fathoms, the garrison flagstaff is on with north end of Schwarte fort, and the lighthouse is seen over the angle of Utrecht bastion; a *red* buoy is moored in $5\frac{1}{4}$ fathoms, about 80 yards west of this patch.

Avareea Rock, with 4 fathoms on it, lies directly in the channel, midway between the Kapera and Wara rocks, with the lighthouse open of Utrecht bastion, and the Sun bastion on with rocks off Schwarte fort.

Vellicocco Reef consists of two rocky patches, carrying from 3 to 9 feet water. The shoalest part of the northern patch, with only 3 feet on it, is the spot on which the Peninsular and Oriental Company's steamship *Malabar* struck, causing her total loss, in May, 1860. From it the Pilots' Tree is seen just open east of the Gull rock, and Edward's Pillar, its own breadth, south of the white mark; a *red* buoy is moored in 4 fathoms East, 40 yards from this patch.

Tanna Rock, with $3\frac{1}{2}$ fathoms on it, lies with the cocoa-nut tree on Pigeon island open of Utrecht bastion, and the Pilots' Tree nearly midway between the Arrack store and Alexander's house (a little nearer the former).

The Gull is a small round rock, about 5 feet in diameter, and 3 feet above the sea level. There is a large iron ring on its summit, to which native vessels secure their stern hawsers.

Imburynha Rock, with 4 fathoms on it, never breaks. It is the southernmost part of a rocky ridge of 5 fathoms, one cable in length north and south, and distant a quarter of a mile in a W.N.W. direction from Watering point, with a general depth of 7 fathoms between. The marks for it are, the Pilots' Tree on with the middle of the Arrack store, and the lighthouse in line with Flat rock.

Deumba-Dava Rock has 12 feet on it, and breaks during the S.W. Monsoon. From it the white gabled Chapel on an eminence outside the fortifications is just open of Schwarte fort, and Elephant rock is on with south end of Flat rock.

Cabeera Rocks are two patches, half a cable apart, north and south, with 5 and 6 fathoms between. From the northern and shoaler patch in 3 fathoms, the Chapel just mentioned is in line with Cowdie High rock, and the Church in Fort is open north of the Almond Tree.

Kette Rock, on which the least water is 15 feet, lies with the belfry just open of Schwarte fort, and the Pilots' Tree opens its own breadth west of Alexander's house.

Bocolosava Rock is well on the eastern shore of the bay, and is distant a $\frac{1}{4}$ of a mile in a N. by E. direction from the nearest part of Watering point. The least water on it is $3\frac{1}{2}$ fathoms, from which the Church in Fort appears open north of the Almond tree, and the Cutcherry police station is seen over the neck of Gibbet island.

Directions for making the Bay.—As the approaches to Point de Galle bay are rendered dangerous by numerous sunken reefs, it is essentially necessary that vessels should obtain the services of a pilot. In most cases, the pilot canoe, with flag displayed (white, red, white, horizontal) awaits a ship beyond the limits of the

off-lying dangers; but as circumstances may possibly compel a vessel to seek a place of refuge when the heavy sea precludes the possibility of a boat leaving the bay, the following directions, if closely attended to, will lead into safety:—

During the N.E. Monsoon, from December to March (inclusive), the bay is at all times accessible, and an anchorage can be obtained with facility; for a sea breeze varying from S.S.E. to W. generally prevails during some part of each day. Early in the morning, the wind is generally off the land from the northward, and enables vessels to leave the bay.

During the S.W. Monsoon, from April to November (inclusive), though the wind frequently veers round even to the northward of west, there is generally a heavy swell setting directly into the mouth of the bay from the southward; this sometimes occasions much difficulty in bringing a vessel up in an anchorage already so over-crowded as to compel vessels to be moored by means of stern hawsers, which, if required, are supplied by the local authorities.

Approaching the bay from the westward, by bringing Point de Galle lighthouse E. by N. $\frac{1}{2}$ N., a vessel will pass clear to the southward of the Whale and Little Whale Rocks, both of which are nearly in the same line of bearing, about W. $\frac{1}{3}$ N. from the lighthouse, the former being distant $2\frac{1}{2}$ miles, and the latter about $1\frac{1}{4}$ miles.

The rocky islets off the lighthouse may be approached in safety so long as the Church in the Fort is kept westward of the lighthouse; here the pilot's boat will generally be found.

To pass north of the Cadda rocks, keep the *white* mark on the east side of the harbour well open of Watering point, or Edward's Pillar on with a natural *red* patch on Watering point; both will lead between the Meemattia rock and the Inner Cadda rock. Proceed with these marks on, until the west turret of the Church in the Fort* is on with Elephant rock (which is a high, smooth, round-topped rock, unlike any other), then steer for Gravet point (the termination of the high land in the N.E. corner of the bay), until the signal-staff on Neptune bastion is in line with the lighthouse. Then haul up for the Cutcherry police station, N. by E. $\frac{1}{2}$ E., which will lead through in mid-channel between the *black* buoy of Polcatté and the *red* buoy of Mata-Mada. When the lighthouse is shut in with Utrecht bastion, anchor in about 6 fathoms.

To pass south of the Cadda rocks, keep the Church in the Fort west of the lighthouse until the *white* mark is *well* shut in with Watering point; the rocks off Oonawatty point will then be open of the point, and in line with a distant point to the eastward. Then steer to the eastward until the Pilots' Tree (the large mushroom-shaped tree on the summit of Moodliar hill) bears N. by W.; the left shoulder of the hill will then be clear of the Almond Tree, near Sailors' bastion. Haul up for the Pilots' Tree until the Signal-staff and Lighthouse are in line, then proceed as above directed, between the Polcatté and Mata-Mada buoys.

Caution.—Sailing vessels approaching Galle should be careful to keep a weatherly position to enable them to sail in, and it should be borne in mind that the current sets along the line of coast with great velocity—to the eastward during the S.W. Monsoon, and to the westward during the N.E. Monsoon.

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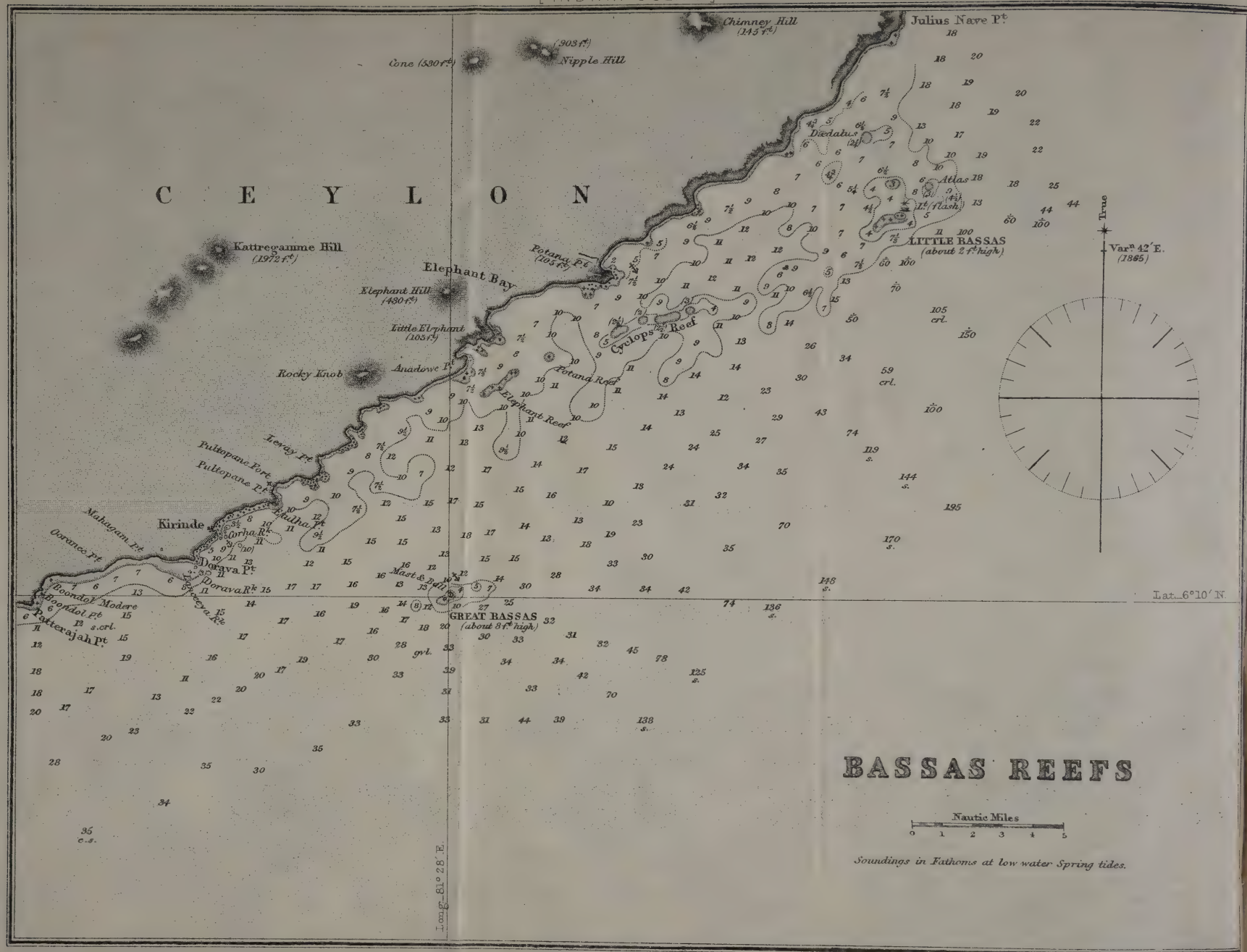
* Care must be taken not to confound the white gabled Chapel on an eminence outside the fortifications with the Church in the Fort.



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Vessels during the S.W. Monsoon, by getting to leeward of the port, have taken weeks to regain their position, and in some instances have been compelled to bear up for Trincomalee.

Coast between Point de Galle and the Great Bassas. — From Point de Galle to Dondra head the coast is low and sandy, with intervening rocky projections: from Dondra head to Tangalle it is more rugged, and thence to the eastward is again sandy and barren.

Dondra Head, the southernmost point of Ceylon, in Lat. 5°55′ N., Long. 80° 35½′ E., is low, with a grove of tall cocoa-nut trees on its extremity; from it a reef of rocks projects to the westward, having only 9 to 10 feet on it.

The ground is more or less foul within a mile of the coast-line, the whole distance between Galle and Kirinde (N.W. of the Great Bassas), and should not be approached within 3 miles (nor under 25 or 30 fathoms), which will clear all dangers: during the night, it would be prudent to draw more off shore.

THE BASSAS REEFS.

The GREAT BASSAS* is a dangerous reef of rocks 6 miles distant from the nearest part of the south-east coast of Ceylon. It is about half a mile broad and a mile long in a N.E. ½ E. and S.W. ½ W. direction, and being only about 8 feet above the surface of the ocean, is the terror of the mariner at all times when he has to round the southern point of that island in his passage to or from the Bay of Bengal.

A series of good observations with the sea horizon at the anchorage of H.M.S. *Cyclops* on their northern side, during the survey of these dangers and the adjacent coast, in the course of May, June, and July, places the north-east and highest part of the reef (distinguished by a pole) in Lat. 6° 9′ 53″ N., and 1° 15′ 30″ E., from Point de Galle lighthouse, and therefore in Long. 81° 28′ 2″ E. from Greenwich, assuming that lighthouse to be in 80° 12′ 32″ E.† This result being obtained with nine excellent chronometers from many good observations of meridian distance run both ways, not only between the Bassas and Galle, but also between Galle and the station on shore at Potana point, with which the Bassas is connected by triangulation, may be considered well worthy of confidence.

The reef is one continuous rocky field, portions only showing here and there in the wash of the sea: the north-eastern part is the highest and broadest, forming a rocky wedge-shaped ledge, 70 yards long, N.E. and S.W., by about 30 yards broad, and from 6 to 8 feet above high water. A mast with ball, 68 feet above the sea level, was erected on it in 1858.

The reef has deep water to within half a mile of it on all sides; there being 16 to 19 fathoms on the southern side, 11 and 12 fathoms on the western, 9 and 10 fathoms on the northern, and 7 and 8 on the eastern sides; but beyond these depths, on the western side, about 1 mile from the reef, there is a patch of 8 fathoms; and on the eastern side at 1½ miles, there is another of 5 fathoms, with deeper water between it and the reef.

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* These directions are from the Survey of CAPT. W. J. S. PULLEN, R.N., H.M.S. *Cyclops*.

† This is the longitude of the Admiralty Chart. SIR ED. BELCHER gives it as 80° 16′ 53″ E.; RAPER, in his "Maritime Positions," 80° 13′ E., which latter will probably prove to be nearer the truth.

From the pole on the reef, Kattregamme peak bears N.W. by N.; Elephant hill, North a little westerly; Chimney hill, N.N.E.; and Nipple peak, N. $\frac{3}{4}$ E. This latter line of direction also passes a little eastward of Little Elephant hill, a round-topped hill of 105 feet elevation close to the beach, on the west point of the bay next west of Potana.

Anchorage.—The proper station for a light-vessel for the Great Bassas would be in 10 or 12 fathoms water, sand and stones, with the pole on the highest part of the reef, bearing S.S.W. $\frac{1}{2}$ W. to S.W. by W. distant half a mile. This was the usual anchorage of the *Cyclops*, where she rode out many strong breezes.

LITTLE BASSAS.—The centre of this reef bears N.E. $\frac{1}{2}$ E. (N. 49° 45′ E. true), distant 20 miles from the pole on the Great Bassas, and from being only about 2 feet above water, is even more dangerous. It appears to consist of large boulders, which even by daylight are scarcely perceptible from a ship till close up to them.

The extent of that portion usually shown by breakers is not more than a quarter of a mile across, about E. by S. $\frac{1}{2}$ S. and W. by N. $\frac{1}{2}$ N.; but W.S.W. from its western part are many sunken patches, breaking so much in heavy weather that occasionally the sea covered with surf is $1\frac{1}{2}$ miles in extent. The anchorage of the *Cyclops* was on the north-east side of the reef, and from observations similarly obtained as those at the Great Bassas anchorage, the centre of the reef is in Lat. 6° 22′ 48″ N., Long. 81° 43′ 23″ E., being 1° 30′ 51″ East of Galle lighthouse.

The Little Bassas is not more than $4\frac{1}{2}$ miles from the nearest part of Ceylon; and on its northern side are several patches of shoal water, one of which, named the 3-fathoms tail carrying the least water, 3 fathoms, bears N. by W. distant $1\frac{1}{2}$ miles from it. This patch is of very limited extent, having $3\frac{1}{2}$ and 4 fathoms water close to on its southern and western sides, and 6 and 7 to the northward and eastward. From a description by HORSBURGH, it is concluded to be the shoal on which the *Atlas* (one of the fleet of Indiamen under convoy of H.M.S. *Dædalus*), first grazed over on the morning of the 2nd of July, 1813.

The Atlas reef, bearing N.E. $\frac{3}{4}$ N. $1\frac{1}{2}$ miles (nearly) from the centre of the Little Bassas, is another patch of 3 fathoms, with 4 and 5 fathoms water close around it, and being most probable where the *Atlas* grazed the second time in getting out clear of the shoal water on that eventful morning, is so named in consequence.

There is much difficulty sometimes in discovering the Little Bassas (the light-vessel will now point out their position), especially when approaching them from the westward, while the sun is in the eastern horizon. The *Cyclops*, when sounding off the coast, in hauling in from deep water for her friendly mark, the Chimney hill, had no bottom with 110 fathoms of line, and almost the next cast had soundings in 9 or 10 fathoms, with the breakers just perceptible, close aboard of her,—a practical proof of the steep nature of the bank in the vicinity of the reef on its outer side, and the danger of approaching it from the eastward and southward in that direction on any course from N.N.W. to N. by E. inclusive.

The following are the bearings from the reef:—Chimney peak, N.W.; Nipple peak, N.W. by W. $\frac{1}{2}$ W.; Elephant hill, W. $\frac{3}{4}$ S.; and Kattregamme peak, W. $\frac{1}{4}$ S. By seeing either of these objects on the bearings stated against it, the mariner will know that the Little Bassas reef is in the same direction. The reef should always be approached with caution, and a vessel should never attempt to pass between it and the Ceylon shore.

Anchorage.—Between the Atlas and Little Bassas, and clear of the 5-fathoms line of soundings around the reefs, is a space at least half a mile wide, with depths varying from 5½ to 8 fathoms water, where the *Cyclops*, while examining these shoals, in 1860, usually anchored on a bottom of sand and small stones. This being good holding ground, is the position best adapted for a light-vessel for the Little Bassas; and if moored in 6 fathoms of water nearly, with the Little Bassas S.S.W., distant two-thirds of a mile, about half way and a little westward of an imaginary line from this reef to the Atlas shoal, it would be sufficiently clear from tailing into shoal water in either the S.W. or N.E. Monsoon. Some experience of this anchorage in the S.W. Monsoon has led to the conclusion that there need be no kind of apprehension whatever for the safety of the light-vessel.

Light-vessel.—A light-vessel is now moored (1st of June, 1863) inside the Little Bassas reef, the centre rocks of the reef bearing S. by W. ½ W., distant about one-third of a mile. She exhibits between the hours of sunset and sunrise a *flashing* white light at intervals of *one minute and a half*. The light is 33 feet above the sea, and to a ship within 7 miles of it, in fine weather, it will not entirely disappear; and it is visible from a ship's deck 18 feet above water at the distance of 11 miles.

Coast.—The foregoing being a description of the off-lying dangers, the following is a brief account of the coast, as well as of the high conspicuous land in its vicinity, the heights of which may be used in the daytime, on certain bearings, to point out the position of these dangerous reefs.

The south-east coast of Ceylon between Dorava and Julius Nave points, a space of 30 miles, trends nearly N.E. and S.W., with ranges of high mountains inland, often obscured, however, by the hazy state of the atmosphere, said to be peculiar to this part of the island, particularly during the S.W. Monsoon.

Near the coast inside the line of the Bassas, are several hills of a remarkable form (about to be described), which from their position form admirable landmarks, during daylight and fine weather, for navigating in the vicinity of the Bassas.

The shore is comparatively low and barren, fringed with a belt of sand, but without any marked salient features; the points are generally rounded and sandy, rising to elevations of about 100 feet. Off the pitch of all the points are rocky patches, extending in some cases to the distance of a quarter of a mile. Along the whole line of coast the surf breaks heavily on the beach, the first roller rising at the average distance of a cable's length from the shore.

Kattregamme Hill.—The most prominent land seen when approaching the Bassas from the westward is the Kattregamme range of hills, the nearest and highest of which is between 7 and 8 miles distant from the sea. These hills are sometimes conspicuous both from the eastward and westward, when others nearer to the sea are hardly discernible. Their summit presents an irregular ridge, the north-east peak of which is the highest, being 1972 feet above the sea.

Elephant Hill, the next height to the eastward, is conspicuous from standing alone on the low land near the shore, and bearing a remarkable resemblance to the animal from which it is named. It is 2 miles from the beach, bare and destitute of trees on its summit, which is 480 feet above the sea.

Little Elephant Hill, in shape resembling a haycock, stands on the extreme point forming the western horn of Elephant bay; its elevation is 105 feet, and from it Elephant hill bears N.W. ½ N. 2 miles.

Off this point, at the distance of one-third of a mile in an E.S.E. direction, is a rock just above the water.

Anadowe Point, next west of Little Elephant, may be known by its off-lying rocks. The outer one, which is about 4 feet above the sea level, is distant three-eighths of a mile from the shore, and is steep-to on the outside, having 7 fathoms within a cable's length.

Nipple Hill, farther inland, bears from Elephant hill N. by E. $\frac{3}{4}$ E. distant about 9 miles. Rendered conspicuous by its superior elevation, 903 feet above the sea, which places it as if alone, this peak is also distinguished by a flattened summit, with two lumps (one at each end) in a direction about W.S.W. and E.N.E., from which it derives its name; the western of these nipples is the higher, the position of which was determined. This hill may also be known by a remarkable cone W.S.W. of it, generally distinguishable, but more so from the eastward, although only 520 feet above the sea.

Chimney Hill, next in succession eastward, is of much service to a vessel for ascertaining her position in reference to the Bassas. It is $4\frac{1}{2}$ miles from the nearest beach, 445 feet above the sea, and very conspicuous, being the highest part of a low range which takes an east and west direction; it appears to be separated from the western part of the range, and derives its name from its resemblance to a chimney. From the Great Bassas it is not easily seen, being in fact sometimes entirely concealed by the haze which generally hangs over the land, especially in the S.W. Monsoon.

Potana Point is rather more than one-third the distance along the coast, between Elephant and Chimney hills. The station on this point, a sand-hill 105 feet above the sea, is in Lat. 6° 21′ N., Long. 81° 33′ 23·45″ E., depending on the position assumed for Galle lighthouse, and is the mean of the runs to and from Galle, being 1° 20′ 51·45″ E. of that lighthouse. The station bears from the pole on the Great Bassas, N. 24° 35′ E. (true) distant $12\frac{3}{4}$ miles; and from the centre of Little Bassas S. 79° 10′ W. (true), distant 10 miles.

Potana point forms perhaps the deepest bay on this coast, and would afford shelter, in the S.W. Monsoon, for small craft not drawing more than 10 feet, but a heavy sea always setting into it, throws the surf up to its innermost south-west angle, permitting no one to land or embark without a good wetting. Off the point, and also to the westward of it, the shore is beset with detached rocks for about a mile out, with some showing and others covered, on which the sea is always breaking; thus presenting the characteristic feature of the coast—viz., a rocky sandy shore, wherever there is any tendency to a point.

Off Potana point is the only anchorage in-shore that was used or was even found available for the *Cyclops* in the course of the survey. She anchored in from 5 to 6 fathoms water, with the point bearing about W.S.W.

Dangers within the Bassas.—**Elephant Reef** is $1\frac{1}{3}$ miles in length, N.E. $\frac{1}{2}$ E. and S.W. $\frac{1}{2}$ W., and a quarter of a mile broad. The north-east breaker on it is $1\frac{1}{3}$ miles from Little Elephant hill, which is in line with Elephant hill.

The south-west extremity is S.E. $\frac{1}{2}$ E., seven-eighths of a mile from the detached rocks of Anadowe point. Between is a clear channel carrying 8 to 9 fathoms.

Potana Reef, the centre of which lies E. by N. $\frac{3}{4}$ N. $1\frac{1}{3}$ miles from the north-east end of Elephant reef, and N.N.E. from the pole on the Great Bassas, is a rocky patch about half a mile broad and nearly square, on which the sea always breaks. No

broken water was seen between it and the Elephant reef, and there may be deep water between them, but the space could not be examined owing to the heavy sea, and should not therefore be attempted.

Cyclops Reef is a hard, narrow, sandy ridge, with patches of rock and boulders, having only 2 fathoms on it in some places. It is $3\frac{3}{4}$ miles long, E. by N. $\frac{1}{2}$ N., and W. by S. $\frac{1}{2}$ S., and from a quarter to half a mile in breadth.

From its west end, in 3 fathoms, Potana point bears N. two miles; and from its eastern end, in 4 fathoms, Chimney hill bears N. $\frac{1}{4}$ W., the shore in that direction being $3\frac{1}{2}$ miles distant. This reef is more dangerous than either of the former, in consequence of the sea breaking only occasionally on it, and from its having deep water close-to on each side. In the course of the survey the *Cyclops* struck on it three times, in different places.

There is a channel between the western extreme of the Cyclops reef and the Potana reef 2 miles wide, with from 8 to 10 fathoms, frequently used by the *Cyclops* in passing between her anchorage at Potana and the great Bassas. Chimney hill, on with Potana point, leads through in mid-channel.

Two lines of soundings were taken across the Cyclops reef with 5 fathoms being the least water, so that it is possible a clear channel may yet be found there; but the least depth on the reef was 2 fathoms, besides many patches of $2\frac{1}{2}$ and 3 fathoms.

Dædalus Reef is a small narrow patch of 15 feet water, lying N.N.W. $3\frac{1}{2}$ miles from the Little Bassas, and $1\frac{1}{2}$ miles off shore, with Chimney-hill bearing N.W. by W. In the course of the survey the *Cyclops* struck on this shoal heavily, and lifted her rudder several times, but from its being so narrow, was soon off it, and could not again find the exact place with the lead. The depth, therefore, was determined by the ship's draught of water, for on sounding around her there were no less than $4\frac{1}{2}$ fathoms at the bows, $4\frac{3}{4}$ in starboard chains, $3\frac{3}{4}$ in port chains, and $3\frac{3}{4}$ fathoms astern. From HORSBURGH'S description, this is evidently the shoal on which the *Dædalus* was wrecked, for it states, "she fell over and went down," the only spot where this could happen, from the deep water close around it. The *Cyclops* had 7 fathoms as soon as she was off.

Directions.—There is a deep channel within all the before-mentioned dangers that may be taken in case of necessity, by keeping about midway between the Elephant, Potana, and Cyclops shoals on one hand and the main land on the other, or a mile off shore. The Dædalus may be passed on either side. If passing inside from the westward, keep about a mile from the shore till up to Julius Nave point, then edge farther from it; if passing outside, keep about half way between the Little Bassas and the shore; but no stranger should attempt the inner passage unless in case of sheer necessity, as the coast does not permit of any leading or back mark being given.

There is deep water between the Great Bassas and the land, the shore of which is clear at the distance of 2 to 3 miles from it all the way to Galle.

Should a vessel, from unforeseen circumstances, find herself at night inside the line of the Bassas, it would be better to anchor and wait for daylight to obtain her exact position by cross bearings.

A vessel bound westward, after clearing the Little Bassas, and certain of daylight, if keeping a good look-out, may haul in and pass inside the Great Bassas; she may also do the same going eastward, but when clear of the Great Bassas she must haul

to the southward to pass outside the Little Bassas, the light-vessel marking which will now be a good guide.

The coast is clear as far as Galle, and may be approached safely to 2 miles distance, but, as a rule, only in daylight, as it is impossible to judge of distances accurately by night.

Caution.—In Lat. 7° 1′ N., at 1 mile south of Saugheman-kande, the eastern point of Ceylon, the *Cyclops* sounded on the south end of a bank, which was found to extend 4 miles in a N.N.E. direction, with every appearance of a deep channel in shore. Four fathoms was the least water obtained, but the bottom was distinctly seen from the ship whilst skirting its outer edge in 8 and 10 fathoms, and it is probable that much less water exists. An offing of 4 miles is, therefore, recommended to strangers between the parallels of 7° and 7° 5′ N.

Currents and Tides. — The currents in the vicinity of the Great and Little Bassas reefs are alike remarkable for their rapidity and eccentricity. In the line of and between the two reefs, that is, about 6 miles off shore, the current, during the S.W. Monsoon, sets along the coast to the N.E., at the rate of 1 to 2 miles per hour, only diverging from this, its apparently natural course, when within the influence of the broken ground of the reefs.

The rate appears to be influenced by the strength of the wind, and is, consequently, most irregular; the only way, therefore, of avoiding danger is to give the rocks a wide berth, although it may incur a great loss of time. Instances are known, where vessels, most providentially, only have escaped wreck, particularly the *Dalhousie*, on her way from Madras to Galle: to have seen the pole on the Great Bassas in a dark night must have placed her close to it.

The *Cyclops*, towards the close of July, running a meridian distance to the Great Bassas from Galle, passed Dondra head at 6 P.M.; her position was well ascertained just before dark, showing the distance of 57 miles to the western reef, bearing E. by N. ½ N. The wind was aft, moderate, and a S.W. swell; sail was shortened, the fires had been banked, and wheels disconnected some time, so that the distance might not be overrun, and a large allowance made for current.

At 3h. 45m. the next morning the wind was somewhat fresher, and the vessel was rounded to, with head southerly, supposed to be 10 miles from the Bassas, after allowing fully 10 miles easterly current. At 4h. a cast of 45 fathoms was obtained, plainly showing from previous sounding the ship had drifted outside the line of the Bassas reefs; and at daylight, instead of having them in sight, she was at least 10 miles to the S.E. of them, and no bottom with 100 fathoms of line; set by a current of 26½ miles in 14 hours, or 1·85 the hour, on about a S. by E. course.

Had this current been more northerly, as might reasonably have been expected from former observations, serious consequences might have resulted. Nor was this the strongest current experienced, nor in the only place. About half-way between the two reefs a current of 2½ knots, on an E. by N. course, was found.

Midway between the line of the reefs and the shore the direction of the current assumes a more northerly trend, and the rate is reduced, until it at length becomes absorbed in an in-shore eddy, which was almost invariably found setting along the coast to the S.W. at the rate of half a mile per hour.

Between Point de Galle and the Bassas the current sets along the line of coast, the


TRINCOMALIE
Bearings
A Detached Rock at Flagstaff Pt. S.¼E.
B Detached Rock open of Flagstaff Pt.
C High Land of Marble Pt. just open north of Round I.
D Flagstaff Point bearing N.W. by W.¼W.
E Northeast Bastion of Ft. Ostenberg open
Nautic Miles
High Water F. & C. VIIIh. 18m.
Springs rise 2ft. _ Neaps r. 1½ft.
Lat. 8° 35′ 40″ N.
Lon. 81° 14′ 30″ E.
True
Varn. 1° E.
Elizabeth Pt.
Lively Rk.
Bungalow Hill (200 ft.)
Heroine Rk.
Pullacaulla Lake
Rock Hill
Back Bay
Custom Ho.
Detached Rk.
Flagstaff Pt.
Flagstaff
FORT FREDERICK
Yard Cove
Bungalow
Cod Bay
Dutch Bay
Dutch Pt.
Rocky Pt.
Powder I.
Plantn. Pt.
Victa. Wh.
China Bay
Round Pt.
York I.
York Sh.
Sisters Sh.
Naval Yard
Ostenbg. Ridge
Nicholson Cove
Chapel Hill (420 ft.)
Chapel Rk.
Chapel I.
Malay Cove
Snug Co.
Ostenbg. Pt. and Fort
Elepht. Pt.
Elephant I.
Elephant Rk. (4 ft.)
Clappenbg. Bay
Clappenbg. Hill 400′
Dead Man Cove
Clappenbg. Pt.
Minden Rk.
White Top Rk.
Marble Pt.
Round I.
Lt. F.
Diamond Hill 300 ft.
Niger Rk. (5 ft.)
Pigeon I.
Tamblegam Spit
Tamblegam Sh.
Oopar or Stately R.
Marvela Ghenga R.
Cottiar Sands
Sambore Bay
Sambore Sh.
Fisherman Rks.
Norway Sand
Beacon Rk.
Norway I.
Norway Pt.
Rocks (awash)
Northesk Rk.
Shell B.
Foul Pt.
Lt. P. (flash) vis. 17 miles
Guriere (good water)
Oote Oddy (good water)
C
E
Y
L

rates varying at different times, without any apparent cause, from 1 to 2 miles per hour (it is said to attain sometimes the rate of even 4 knots); but to the northward of the Little Bassas, close in on the eastern shore, a decided southerly set was experienced, at the rate of nearly a mile an hour, which increased to a velocity of 2 knots near Trincomalie.

While lying under the Little Bassas, or within them, this set directly to windward was occasionally felt, the wind blowing strong enough at the time to keep the ship quite broadside on; but this seldom or never lasted more than a couple of hours. At the Great Bassas it was never felt, and only occasionally as far west as the anchorage off Potana point, and the greatest strength found at the Little Bassas was three-quarters of a knot.

Coast between the Little Bassas and Trincomalie.—From the vicinity of the Dædalus and Atlas rocks, northward, the coast is supposed to be clear of danger as far as Lat. 7° N., and ships may safely approach it in fine weather to the distance of 3 or 4 miles, in 14 to 20 fathoms water. Between 7° 1′ N. and 7° 5′ N. there is a bank of shoaler soundings (4 fathoms or less) running N. by E., which must be avoided, —the coastline opposite to it trending for a short distance to the N.W.-ward; ships should not go nearer to it than 5 or 6 miles, where the depth is 16 fathoms and upwards. Thence to Lat. 7° 20′ the coast is again free from shoals; but beyond, and especially for the next 10 miles, ships are cautioned not to make bold with the shore, for there are several rocks and reefs in the vicinity—one of which, the Alphee (reported in July, 1864), lies 2 miles from shore, in Lat. 7° 24′ N., Long. 81° 50′ 30″ E.; it is from 100 to 150 yards in length (N. and S)., with about 19½ feet water upon it, and 12 to 14 fathoms close-to; bottom, white, with black patches, distinctly visible.* Nearly all the projecting points of land thence to Trincomalie are dangerous to approach on account of outlying foul ground, with rocks and shoals extending some distance seaward. Therefore, to be safe, do not stand in under 22 to 30 fathoms, or 5 to 6 miles from the shore, unless provided with a chart on a large scale.

Although the coastline above described is generally low, there are several remarkable objects inland:—the Friar's Hood, 1563 feet high, is in Lat. 7° 26½′ N., and 6¼ leagues from the sea; when bearing S.W.-ly it has the appearance of a friar's hood, but seen to the N.W.-ward it has the form of a pyramid. Gunner's Quoin, 1320 feet high, in Lat. 7° 52⅓′ N., is frequently seen 40 miles off.

TRINCOMALIE.

TRINCOMALIE, with its harbour and bay, is distinguished by the flagstaff near Fort Frederick (to the northward), and a lighthouse on Foul point (to the southward); both are conspicuous objects from seaward.

Flagstaff point, in Lat. 8° 35¾′ N., Long. 81° 14¼′ E., is high, steep to seaward, and covered with trees; it is the extremity of a narrow strip of land which, projecting about ¾ of a mile to the north-eastward, forms with Elizabeth point a large open bay 3 miles wide and 1 mile deep, known as the *Back bay* of Trincomalie. There is

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* H.M.S. *Vigilant* searched for this shoal in December, 1864, and found 6, 8, and 10 fathoms, but did not come on the 19 feet, as reported by Lieut. J. Gehenne, of the French Imperial steamship *Alphee*, from which it was inferred the shoal is closer in-shore.

a conspicuous detached rock off Flagstaff point. The peninsula which stretches to the southward and eastward from the town is steep and bluff on the seaward front, and is, therefore, easily recognised, as the coast north and south of it is low near the sea. The S.E. point of the peninsula has an islet off it, named Chapel island, off which, to the N.E. ½ E., distant ¾ of a mile, lies a reef of rocks; they are nearly on the edge of soundings, and have 20 to 30 fathoms very close to them on the east and south sides. Chapel rock, on the inner part of the reef, is above water. At two spots on the east side of the peninsula projecting rocky points stretch from a ¼ to a ⅛ of a mile seaward, and ought not to be approached under 15 fathoms. The detached rock open of Flagstaff point clears all these dangers. The S.W. point of the peninsula (Elephant point) has Elephant island near it—to the S.E.—from which a reef named Elephant rock projects to the westward, and has only 4 feet water on its shoalest part; this is marked by a *white* buoy.

Foul point, the outer S.E. point of Trincomalie inlet, is now marked by a lighthouse, and has a reef projecting from it to the northward for ¾ of a mile.

Lights.—A *white* light, showing a *flash* every *half minute*, and visible 17 miles, is exhibited from a lighthouse 104 feet high, recently erected on Foul point, the south-eastern point of approach to the great bay of Trincomalie. Beyond the distance of 7 miles the eclipses are total between the flashes, but within that distance there is a faint continuous light; the tower stands in Lat. 8° 32′ 10″ N., Long. 81° 18′ 50″ E.

A *fixed white* light, visible 10 miles, is also exhibited from a lighthouse recently erected on Round island, at the entrance to Trincomalie harbour.

The light on Flagstaff point is now discontinued.

Directions.—There is some difficulty in making a landfall about Trincomalie during October and November, from the strong current which sets to the southward at the rate of 2½ or 3 knots, and from the light variable winds, with occasional squalls and thick weather, prevalent just before the N.E. Monsoon sets in. Endeavour, therefore, to make the land in about Lat. 9° N., as, indeed, is advisable from the end of September to the end of March, if bound to Trincomalie during that period. The coast is clear on that parallel, and may be safely approached to the depth of 20 fathoms, even by night. If the land be made towards the close of the day, stand off to the N.N.E. or N.E. at the rate of 3 or 4 knots per hour during the night. Should the wind be N.E., keep working to windward, and when standing in shore keep the lead going *very frequently*, not failing to tack as soon as the water shoals to 22 or 20 fathoms.

At daylight, run in for the land on a N.W. or W.N.W. course, keeping outside Pigeon island (in Lat. 8° 43¼′ N.) a rock 99 feet high, and about 1⅔ miles from the shore. The coastline for 15 miles N.W.-rd of this island is, here and there, foul, but no rocks extend beyond a mile from the shore; but to the southward of the island, for the distance of 5½ miles, the foul ground extends nearly 2 miles off shore in some places.

Pigeon Island, about N. by W. ¾ W., 8 miles from Flagstaff point, and N.W. by N. 13 miles from the light-tower on Foul point, is a rocky island with some shrubs on it; being encompassed by islets, and rocks (above and under water)—especially between it and the shore—there is no safe passage inside except for boats. When passing, it is advisable to keep outside it at the distance of 2 miles *at least*, in soundings of 21 to 24 fathoms, although it may be approached to 18 fathoms.

Rocks.—*Diomede Rock*, on which H.M.S. *Diomede* struck, lies $1\frac{5}{8}$ miles S.E. $\frac{1}{2}$ S. from Pigeon island, and $1\frac{1}{2}$ miles off shore; the depths close to it are 9, 10, and 11 fathoms. Fairlie rock, on which the *Fairlie* struck, is $3\frac{1}{2}$ miles S.S.E. $\frac{1}{2}$ E. from Pigeon island, and nearly a mile off shore; it is about 40 yards in diameter, with 16 feet water on it, and has 9 to 11 fathoms close-to all round. Lively rocks $\frac{1}{2}$ a mile nearly due east of Elizabeth point, and Heroine rock $\frac{3}{4}$ of a mile S.S.E. $\frac{1}{2}$ E. of the same point, are about the size of a boat, and have 6 to 7 fathoms close to them.

In consequence of the foul ground in the locality just indicated, it is dangerous for ships to make too free with the shore, therefore do not haul in until 3 or 4 miles south of Pigeon island, then steer direct for Flagstaff point.

From March to September, during the S.W. Monsoon, there is no difficulty in making Trincomalie, for although the current in the offing sets to the northward, it seldom runs more than one knot near the shore. Between the parallels of 7° 30′ and 9° 30′ N., the coast may be safely approached to 22 fathoms at night, and to 15 fathoms by day.

Back Bay.—*Coming from the northward*, Pigeon island (in Lat. 8° $43\frac{1}{4}$′ N.) being rounded at the distance of about 2 miles, steer S. $\frac{1}{2}$ E., and having made out the flagstaff, approach it on that bearing, hauling more into the bay as soon as the Lively rocks are passed; the anchorage is in the southern part of the bay to the north-eastward of the town of Trincomalie, with Flagstaff point bearing S. by E. to S.E. by S., distant $\frac{1}{2}$ a mile, in 7 to 10 fathoms (according to the size of the ship), sandy bottom. The soundings decrease gradually to the sandy beach, except about a mile to the N.W. of the point where rocks stretch from the shore to 4 fathoms. *Coming from the southward*, as soon as the flagstaff is distinguished steer for it, rounding Flagstaff point close, and bringing up as above. This anchorage is safe between the middle of March and the middle of October, the period of the S.W. Monsoon.

To Enter the Harbour.—If the wind be fair keep in mid-channel, and when Round island and Marble point (beyond it) are made out, steer about W. by S. $\frac{1}{2}$ S., keeping the high land of the point open to the northward of the island until the entrance to the harbour is open; then steer midway between Round and Elephant islands, and between Minden and Elephant rocks, both of which are marked by buoys. When to the northward of these rocks, steer direct for the entrance of the harbour, which is about $\frac{1}{4}$ of a mile wide between Ostenberg point and Small Sober island,—either of which, however, may be approached within a vessel's length. On the hill of Ostenberg point there is a battery. Inside the entrance above indicated a spacious harbour, completely land-locked, is opened out, with several coves convenient for heaving down ships. After rounding the shoal (*buoyed*) to the northward of Ostenberg point, the *anchorage off the dockyard* is south of York shoal (also *buoyed*); but intending to anchor *off the town* in the usual position for merchant ships, when through the entrance between Ostenberg point and Small Sober island, steer N.N.W. until past the buoy on York shoal, then haul up to the N.E.-rd, and anchor abreast the Victualling store, and $\frac{1}{2}$ a mile from the wharf, in 6 fathoms water.

The shoal just inside Ostenberg point has only 3 feet on its shoalest part, and York shoal only 5 feet. When making for the merchant anchorage, pass midway between Powder rocks and York island.

At night, when approaching Trincomalie harbour *from the southward*, bring Foul

point light to bear W. distant 2 miles, and then steer N.W. until Round island light bears W.S.W.; then steer for this latter light until Chapel hill, the high bluff eastern extreme of land on the northern side of entrance, and easily seen in the darkest night, bears N. distant about $1\frac{1}{2}$ miles; then steer W. by N. until Round island light bears S. by E. $\frac{1}{4}$ E.; lastly, steer N. by W. $\frac{1}{4}$ W., passing midway between Ostenberg point and Sober island, and anchor with the light bearing S. by E. $\frac{1}{4}$ E., in 12 fathoms water.

After passing Ostenberg point the water shoals rapidly from 25 to 12 fathoms.

Approaching *from the northward at night*, when Foul point light is seen, bring it to bear S. by E. $\frac{1}{2}$ E., and steer for it until Round island light bears S.W. $\frac{1}{2}$ W.; then steer for Round island light until the extreme point of Chapel hill bears N. by E. $\frac{1}{2}$ E.; afterwards proceed as above.

Working In.—When the wind blows strong from the westward, a strong outset renders it difficult to work in (at times) during the S.W. Monsoon; ships then bound to Trincomalie generally fall in with the land to the southward of the port. Passing Foul point, it is safe to stand into 14 fathoms, or go about when Marble point just opens northward of Round island. To avoid the outset from the inlet, it is recommended to work in abreast of Back bay and Flagstaff point, taking care when near Rocky and Chapel points to keep the *detached* rock off Flagstaff point well open of that point to clear Chapel rock, and the dangers northward of it. When round the rock, Chapel and Elephant islands may be borrowed on, for they are steep-to; but in standing to the southward, do not borrow under 20 fathoms towards the dangers off Norway point and island. Being to the westward of Norway island, do not stand too soon to the southward, towards the bottom of Great bay, on account of the sand-bank, with 3 fathoms on it, extending about a mile to the S.S.W. of that island, having 15 and 16 fathoms water within half a ship's length of it, and at a small distance no soundings. In approaching the bottom of Great Bay, the lead must be kept going; for although there are no soundings within a mile of the shore in some places, the first cast may be 35 or 40 fathoms, then 18 or 20, and the next cast probably 10 or 12 fathoms. It would be imprudent to go under 12 or 14 fathoms, as the distance from these depths is not more than 1 or 2 cables' length in some places to 4 fathoms, at the distance of $\frac{1}{4}$ or $\frac{1}{2}$ a mile off shore: but to the southward of the bank stretching from Norway point, in the S.E. corner of Great bay, the soundings are more regular, and extend farther out, and here ships may anchor. In standing to the northward for the entrance of the harbour, pass close to the eastern side of Round island, which is steep-to, and you will probably reach the harbour's mouth without tacking, keeping the weather shore on board in entering.

The N.E. Coast of Ceylon.—Mœletivœ house, in Lat. 9° $16\frac{1}{4}'$ N., Long. 80° $49\frac{1}{4}'$ E., stands close to the sea, and bears about N.W. by N. from Pigeon island, distant $13\frac{1}{2}$ leagues; the coast between them is low, and safe to approach to 18 or 20 fathoms in the night, if the lead is kept going, or to 12 fathoms, occasionally, when working in daylight.

Mœletivœ Shoal.—From Mœletivœ house, a dangerous coral shoal, having only 6 to 12 feet water on it, called Mœletivœ shoal, extends eastward and N.E. nearly 4 miles from the shore, which ought not to be approached nearer than 13

fathoms. As there are 20 and 21 fathoms about 6 miles from the shore, and 4 or 5 miles to the S.E. of the shoal, a ship should edge out a little when near it; but when abreast of its eastern extremity, she may with the land-wind borrow towards it to 13 or 14 fathoms. The North side of this shoal is not so steep, but is composed of detached knolls, the depths decreasing regularly to 9 or 10 fathoms close to its northern verge, and to 6 and 7 fathoms along the N.W. part, close to the shore. From this shoal the coast is low to the N.E. point of Ceylon, with 7 fathoms water near the sandy beach; but care is requisite to avoid the following danger.

Point Pedro Shoal encompasses the N.E. extremity of the island, and from thence stretches nearly parallel to the coast about 8 leagues to the S.E., having only $2\frac{1}{4}$ to 4 fathoms on it in many places, and $2\frac{1}{4}$ fathoms on two patches in Lat. 9° $50\frac{1}{2}'$ N. and 9° $55\frac{1}{2}'$ N.: one of these bears nearly E. $\frac{3}{4}$ S. from point Palmyra, the N.E. extreme of Ceylon, distant about 5 miles; the other N. $\frac{1}{4}$ E. from the same point, distant 4 miles. Between this extensive narrow shoal and the coast there is a safe channel about $2\frac{1}{2}$ to 3 miles wide, with regular soundings, soft mud, 7 fathoms close to the shore, 7, 8, or 9 fathoms in mid-channel, and 5 or 6 fathoms close to the inner edge of the shoal. To the eastward of it the bank of soundings is also flat, with regular depths, decreasing to 5 and 6 fathoms close to the S.E. and eastern parts of the shoal, and to 4 fathoms, coarse brown sand, close to its N.E. verge. Mark house (in Lat. 9° $32\frac{3}{4}'$ N.), bearing S.W. by W. $\frac{1}{2}$ W., clears the south end of Pedro shoal.

THE GULF OF MANAAR AND TUTICORIN.

The Navigation of the Gulf.—It was formerly considered a hazardous undertaking for a vessel of any size to proceed far up into the Gulf of Manaar—more particularly during the S.W. Monsoon, when it was supposed to be impossible to beat out again. Later experience, however, has shown that no dangers exist that may not be avoided by ordinary care and attention; and that as regards working to windward against the Monsoons, no difficulty will be experienced if the following instructions be attended to.

During the N.E. Monsoon—that is, from November to March inclusive—fine weather, with land and sea breezes, will be found to prevail on the Ceylon side of the gulf, where good anchorage may always be selected between Colombo and Chilaw, at $1\frac{1}{2}$ to 3 miles off shore, in 6 to 9 fathoms sand. Vessels wishing to beat up during the first three months, ought therefore to keep over on that side till they have advanced sufficiently far to make certain of their port, if bound to the Indian coast, as the breezes there may be expected to blow steadily and strong from N.N.E. with a strong lee current. In rounding cape Comorin at this time, the Indian shore may be kept on board till abreast of Manapaud point, a high promontory with a small white church erected on its summit. A vessel may then stretch across with advantage, and probably in the next tack fetch Tuticorin, the only port on the Indian coast frequented by large vessels.

Small vessels of light draught will also find this the easiest method of working up; and if bound to Paumben, had better keep the Ceylon shore till abreast of Calpentyn, which they may know by the three long hills of Kodramallai, the only ones near the coast. They can then stand across, and make Paumben either by the

Eastern Channel between the island of Rameseram and the reef and islands south of that port, or by the Western Channel between Freshwater and Anapaar islands at Valinookum point.

During the S.W. Monsoon a ship ought to keep over on the Indian side till near Manapaud point, when she will generally be able to fetch to windward of Colombo, and be clear of all dangers. The only safe place for vessels of size to anchor in on the Ceylon coast during this Monsoon is at Colombo, where the current from the Kalany Gange or Mutwal River running to windward, takes much of the strain off the cables of vessels riding there. If obliged to slip, it is safe to stand across the gulf to Tuticorin, which being situated on the weather side affords good shelter and anchorage.

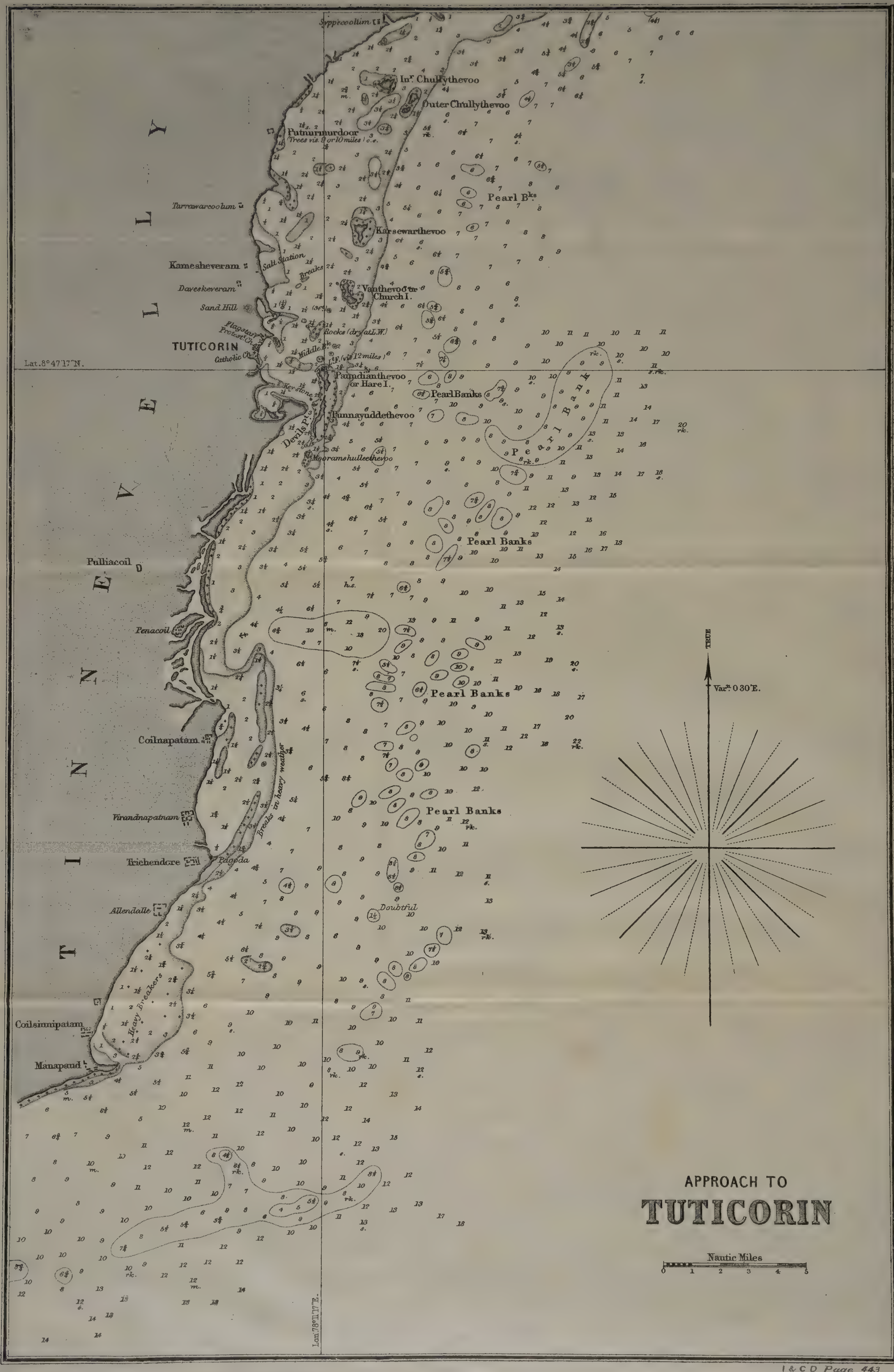
Small craft working down from Paumben will do well to keep inside the islands till they reach the Western entrance of the inland navigation at Valinookum point. They can now work down near the coast as far as Manapaud point, when their fetching Colombo on the starboard tack may be considered certain.

The breezes in the gulf of Manaar are generally stronger than on the adjacent coasts, the only moderate months being April and October; yet if the instructions already given be attended to, no difficulty will be found in working up or down against them. The N.E. Monsoon sets in with force about the middle of November, and lasts till the end of January, bringing with it a current of from 20 to 30 miles a day to the S.W. It blows steadily from N.N.E. along the Indian shore, but on the opposite side is modified into land and sea breezes with very fine weather. In February, land and sea breezes commence on the Indian side; and by April the general set of the wind in the gulf will be found to have drawn round to the Southward, the sea breezes being from S.E. to S.W., according to the coast on which they prevail. These now increase in force till about the middle of May, when the regular S.W. Monsoon sets in, blowing with great violence from W.S.W. on the Indian coast, and S.W. on the coast of Ceylon, where it commences rather earlier, and is attended with heavy fall of rain, thunder, and lightning. In August, the strength of the Monsoon abates, but strong Southerly winds are still experienced in this and the next month, becoming lighter as the season advances. Variable and gentle breezes, with smooth water, may usually be expected in October, lasting till the setting in of the N.E. Monsoon, which is ushered in on the Indian side by 15 or 20 days of heavy rain.

Current.—The current will generally be found to set with the wind in the strength of the Monsoons; but this is not invariably the case. Care and attention must therefore be paid to the soundings, and unless a good pilot be on board, a vessel ought not to shoal her water during the night to less than 12 fathoms above, or 18 or 20 fathoms below Manapaud, on the coast of India, or to less than 10 fathoms above and 20 below Colombo, increasing the depth to 40 till abreast of Point de Galle, on the coast of Ceylon; excepting, of course, her position be ascertained by the bearing of the light at Tuticorin or Colombo.

Tides.—The flood sets in about E.N.E. and the ebb about S.W., but their direction is greatly influenced by the wind.

Cape Comorin, as already noticed (p. 422), is low, rising in a gradual slope, and covered on the east side with palmyra trees, may be easily distinguished by the reddish appearance of the soil and a large white Choultry, situated near the beach. Two large rocks, with a small one outside, on which the sea at all times breaks with much


APPROACH TO
TUTICORIN
Nautic Miles
TRUE
Varn. 0 30′E.
TINNEVELLY
Syppicoolum
Inr. Chullythevoo
Outer Chullythevoo
Putnurnurdoor
Trees vis. 9 or 10 miles
Pearl Bks
Tarrawarcoolum
Karsewarthevoo
Kamesheveram
Salt Station
Breaks
Daveskeveram
Vanthevoo or Church I.
Sand Hill
Rocks (dry at L.W.)
Flagstaff
Protest. Ch.
TUTICORIN
Catholic Ch.
Middle Pt.
Lat. 8°47′17″N.
Paundianthevoo or Hare I.
Pearl Banks
Key stone
Punnayuddethevoo
Devils Pt.
Pearl Bank
Mooramshulleethevoo
Pearl Banks
Pulliacoil
Penacoil
Pearl Banks
Coilnapatam
Breaks in heavy weather
Virandnapatnam
Pearl Banks
Trichendore
Pagoda
Allendalle
Doubtful
Heavy Breakers
Coilsinnipatam
Manapaud
Lon. 78°11′17″E.

violence, stretch to the distance of $\frac{1}{4}$ mile from the shore. They are steep-to, and may with a fair wind be approached within $\frac{1}{4}$ mile in 8 or $8\frac{1}{2}$ fathoms, but with a scant wind caution is necessary, as the current sets rapidly round the point, and may drift a vessel into danger. Captain Hope, of H.M.S. *Thalia*, saw breakers N.W. $\frac{1}{2}$ W., $\frac{3}{4}$ of a mile distant, cape Comorin bearing W. by S.; extreme eastern land N.E. by N.; sounded, and shoaled suddenly from 11 to $3\frac{1}{2}$ fathoms.

The **Tinevelly Coast,** which forms the west side of the gulf of Manaar, is more or less foul from the parallel of 8° $14\frac{1}{2}'$ N., and thence to the northward; the shoal spots in many places extend as much as 9 to 11 miles from the land.

Manapaud Point, situated E.N.E. $\frac{2}{3}$ N., 36 miles from cape Comorin, is a high sandy promontory, jutting out boldly into the sea. It has a small whitewashed church on its summit, visible in clear weather 12 to 13 miles off, which appears at first like a ship under sail. Some foul ground (4 to 10 fathoms) is situated off this point extending E.N.E. and W.S.W. 10 miles, with an average breadth of 1 mile. The following are the bearings of the two shoalest parts:—

Inner shoal part	Manapaud church . . . N. 54° W. 5 miles		$4\frac{1}{2}$ fathoms sand.
	Trichendore pagoda . . . N. 1° W. $10\frac{1}{4}$ „		
Centre shoal part	Manapaud church . . . N. 54° W. 8 „		4 fathoms sand.
	Trichendore pagoda . . . N. 12° W. $12\frac{1}{2}$ „		

There are many other patches with $5\frac{1}{3}$ and 6 fathoms, over which a vessel might pass, yet the safest plan when going between the reef and the point, is not to bring the church to the West of North till within 2 or 3 miles of it; an E.N.E. course will then take a vessel out clear.

Trichendore Point, in Lat. 8° 29′ 55″ N., is $8\frac{1}{3}$ miles N.N.E. $\frac{1}{4}$ E. of Manapaud point, and 18 miles S. by W. (westerly) of Tuticorin light, and may be known by its having a high dark pagoda on its extremity, seen in ordinary weather 12 to 15 miles off.

TUTICORIN.—This port is a place of resort for ships of the largest class to fill up with cocoa-nut oil, cotton, &c.; but being fronted with some extensive mud-banks, the anchorage is a considerable distance from the town.

Light.—On Hare island, $2\frac{1}{2}$ miles E. of Tuticorin, a *fixed white* light is exhibited on an obelisk, at an elevation of 43 feet above the sea; it is visible between the bearings of N. by E., round by W., to S. by E., or 202° open to the East; it may be seen at the distance of 12 miles; position, Lat. 8° 47′ 17″ N., Long. 78° 11′ 17″ E. The following are the instructions relative to it:—

Directions.—A vessel making the port at night may anchor with the light bearing from W.N.W. to W. by S. about $1\frac{3}{4}$ to 2 miles off shore, where good holding-ground will be found in 6 to $6\frac{1}{2}$ fathoms. At $3\frac{1}{2}$ miles distance with the same bearings, the ground is foul on pearl banks.

Approaching from the *southward*, the light may be kept about N.N.W. till within 3 or 4 miles, when the above anchorage may be selected; but should a vessel suddenly deepen her water from 7 or 8 fathoms to 12, 15, or 20, she should immediately steer North till she makes the light, taking care to keep farther to seaward if it bears North of N.N.W. The outer part of this deep water lies a little to the North of the head of the Coilnapatam reef, and bears S. by E. 10 miles from the Tuticorin light.

Approaching from the *northward*, a vessel may keep the light about S.W. till within 3 or 4 miles, when she must steer more out for the anchorage; but in no instance ought the water to be shoaled under $6\frac{1}{2}$ fathoms, excepting with the bearings on for the anchorage, and then not under 6.

During the N.E. Monsoon, vessels should lie with a good scope of cable out; as, although the seas are not heavy, they are sharp, and occasion a chain to jerk. The sea-breeze at this time blows on the reef, and a second anchor (with chain ranged) ought always to be kept ready for letting go.

During the S.W. Monsoon, which usually lasts from the middle of May to the middle of August, the port may be made without fear, for, although the winds are very violent, they are invariably off shore (from W. to S.W.), accompanied by smooth water. At this time vessels may approach the reef to 5 fathoms, but should always have a stream anchor to seaward, as occasionally, during the lulls of the Monsoon, a light air comes in from the eastward.

As a rule, large vessels ought not to approach the land above Tuticorin nearer than 6 or 7 miles, as $2\frac{1}{2}$ or 3 fathoms are found 5 miles off, in some places. When some large clumpy trees at Putnurmadoor, seen 10 miles off, bear North of West, no other object on shore being visible, the shoal water is to the northward.

There are two channels for small craft into Tuticorin harbour, but that to the north is so intricate as to be seldom used. The Southern channel leads between the southernmost island and the main land, the reef connecting them being crossed in 12 to 14 feet at a distance of $\frac{1}{2}$ to $1\frac{1}{2}$ miles of the island. This being passed, a course may be steered for Devil's point on the main, after closely rounding which a small vessel may stand direct for the town of Tuticorin, carrying 11 to 9 feet. Before passing Devil's point $2\frac{1}{2}$ fathoms are found, sand and mud.

At the distance of $2\frac{1}{2}$ miles due East of the Penacoil tope, a scanty tope to the south of a large ruined building, 9 miles from Devil's point, is situated the inner edge of an extraordinary natural basin in the rocks, $4\frac{1}{2}$ miles east and west, and averaging $1\frac{1}{4}$ miles in breadth; the outer part being the broadest and deepest. The bottom is composed of fine sand and mud in 7 fathoms on the Western to 18 and 20 fathoms on the Eastern extreme, from which it suddenly shoals to 9, 8, and $7\frac{1}{2}$ fathoms on a pearl bank. In standing up the coast during the night with a scant wind, this is good ground for ascertaining a vessel's position, as no similar spot exists from Paumben to Comorin. From the outer part in 15 to 20 fathoms, the anchorage off Tuticorin bears N. by E. $9\frac{1}{2}$ miles.

Good anchorage in 3 to 4 fathoms mud, with this tope bearing west 1 to $1\frac{1}{2}$ miles, is to be found here during southerly winds under the lee of a reef which commences $2\frac{1}{2}$ miles N.E. by N. of the next point (Coilnapatam), and continues with little exception to cape Comorin. As far as Manapaud point, this reef varies in its distance from the land from 1 to $2\frac{3}{4}$ miles, but thence to Comorin it seldom exceeds $\frac{1}{2}$ mile. The head of this reef lies S. by W. $10\frac{1}{2}$ miles from Tuticorin light.

The following remarks and directions (pp. 444 to 447) are by Mr. J. T. Franklin, who had charge of the Manaar Survey (1846).

Sailing Directions for Palk's Bay.—There are two good entrances into Palk's

bay from the eastward: one between point Calimere and the northern end of the Middle banks, having 19 to 24 feet; the other between the southern end of the same banks and the north coast of Ceylon, with $5\frac{1}{2}$ to 8 fathoms. Sailing directions were published some years back for the northern passage, but I would strongly recommend all commanders, with a vessel drawing 12 feet, to make use of that to the southward, except with a leading wind or with the aid of steam.

Paumben bears from point Calimere S. 31° W. 73 miles; and after rounding the spit that stretches off to rather more than a mile east of the latter place in about $3\frac{1}{2}$ fathoms, 3 miles off shore, a vessel may stand S.W. $\frac{1}{2}$ S., keeping in $3\frac{1}{2}$ to 4 fathoms, till two tall detached palmyra trees to the westward bear about north. She is then clear of the banks. This channel, through the centre of which the foregoing directions lead, is 3 miles wide, having a small sandy knoll, with only $2\frac{1}{4}$ fathoms on, about a mile inside its southern boundary, and 4 miles S.S.E. of the point. The depths on each side vary from 2 to 3 fathoms, with a bottom of hard sand, while that of the channel itself is mostly mud.

The Middle banks from this stretch in a southerly direction, to within 8 miles of the Ceylon coast, having an average breadth of 3 miles, with uneven soundings from 2 to $3\frac{1}{2}$ fathoms; and in one place only 9 feet. This is situated $8\frac{1}{2}$ miles S. 20° E. from point Calimere, and $9\frac{1}{2}$ miles S. 44° E. from the two remarkable trees already noticed. It is composed of hard, fine sand, and should be carefully avoided. There is always what is called a swash over these banks, which renders it hazardous to be on them in an open boat during a breeze.

In beating into the bay against the S.W. Monsoon, a vessel should stand over to the north coast of Ceylon, and work down to the island of Delft, or Nedoen Teevo, whence a stretch may be made across the bay to its western side, where land and sea breezes will be met with, accompanied by smooth water. In the N.E. Monsoon, a vessel bound against it should also work upon the Ceylon side as far as Kayts; when she may stand over to the coast of India, and creep to windward in smooth water. With the strong currents ever attendant on the Monsoons in the middle of the bay, it is impossible to contend against them without thus taking advantage of smooth water and weather shores.

A well-known shoal extends from about 17 miles S.S.E. of point Pedro to about 6 or 7 miles N.W. of it, having a good channel of $2\frac{1}{2}$ to 3 miles wide, with 7, 8, and 9 fathoms mud, between it and the shore. The most dangerous part on its northern end bears from the point due east, $4\frac{1}{2}$ miles off shore, to E. 28° S., 4 miles off shore. It has in some parts as little as $2\frac{1}{4}$ fathoms, and a vessel in passing it ought not to shoal her water on the bank to less than 6 fathoms, when she will be about 3 miles off shore, with deep water inside.

To clear the north end of this bank, having $3\frac{3}{4}$ fathoms on, the break in the trees at Tondimanaar, which is plainly perceptible some few miles at sea, ought not to bear west of S.S.W. till within 4 or 5 miles of the land. Inside this, a vessel working to the westward may approach the shore with safety to within half a mile, carrying from 6 to 8 fathoms sand and mud, till abreast of Kangasenthoray, which may be known from its two bungalows, each built on a rocky platform washed by the sea. To avoid some foul ground which, diverging from the beach at this place, reaches to a distance of 2 miles from the shore a little farther west, she must now be careful not to shoal her water to less than 6 fathoms on her in-shore tack, or to less than 5 fathoms on her seaboard; as the southern end of the Middle banks, with $2\frac{3}{4}$ and 3

fathoms over it, lies to the north. The channel is 6 miles broad from the foul ground to the end of the banks, with 5½ to 8 fathoms, sand and mud, in it. When the opening between Kara Teevo (Amsterdam island) and the main leads due south the foul ground is passed; and when Fort Hammonhiel is well open of the N.W. point of Kara Teevo, the banks are to the eastward. A vessel can then shape a course to any part of the bay, having good anchorage in 4 to 5 fathoms, ½ to ¾ of a mile outside any of the islands. If bound to Jaffna, she should, after passing Kayts, stand southerly, rounding Elewa Teevo, Anella Teevo, and Naina Teevo, at a distance of 1 to 2 miles, till within 2 or 3 miles of Nedoen Teevo (Delft), which she will make ahead. She may then steer easterly, keeping about a mile off Poongree Teevo, and taking care not to haul to the North of East till that island has been left 4 or 5 miles behind; and anchor according to the directions about to be given. Following out these instructions, a vessel from point Pedro ought not to shoal her water to less than 4¼ fathoms; but more generally have a depth of 5 to 6 fathoms.

Directions for Kayts.—No vessel drawing more than 8 feet should attempt to enter the harbour of Kayts; for, although there are 7½ feet in the channel at low-water springs, the greatest rise is not more than 15 inches. To avoid the foul ground, extending 1½ miles to the westward of the N.W. end of Kara Teevo, a vessel ought to keep in 5 fathoms till Elewa Teevo bears S. by W. She may then stand for that island, shoaling her water to 3 fathoms, till Fort Hammonhiel, built on a rock at the north side of the entrance, bears S.E. by S., when she can steer for it, keeping the Custom House point, on which is a large clumpy tree, over the low sandy point of Kara Teevo till within a quarter of a mile. She will now be in 9 feet smooth water, and, keeping more to the south, may round the fort at a distance of from 200 to 700 yards, according to circumstances; care being taken, when inside, to borrow over on the north side of the harbour till past an old bungalow on that side. Any anchorage may then be selected, but the best is off the Custom House, in 11 or 12 feet mud.

Outside, good anchorage is obtained in either Monsoon in 13 or 14 feet smooth water, with the fort bearing S.E. 1½ miles; the north end of Elewa Teevo S.W. 1¼ miles; and the N.W. end of Amsterdam island N.E. In the S.W. Monsoon the bank off Elewa Teevo may be approached a little closer; and in the N.E., the foul ground off Amsterdam, which will give a vessel a little more room for weighing. Large vessels should of course anchor farther out.

Directions for Jaffna.—A rock was supposed to exist in the approach to Jaffna from the westward; but after a careful examination no such danger could be discovered; and, although some pilots declare that it is still there, they are unable to point out the precise spot. This, added to the testimony of some divers, who declare that they never met with it, although employed in the neighbourhood from childhood, may lead us safely to infer that the pilots are in error, and that no impediment is offered to the safe navigation of this part of the coast. A small vessel, having Calmoene point E. by N. to N.E., may steer for it till she opens Jaffna Fort church clear of the island of Mande Teevo; when she can stand freely for the opening, carrying from 4 to 2½ fathoms over a rocky ledge to 2¾ and 3 fathoms inside on sand; and anchor with the following bearings:—Calmoene point, East; Fort Church, N. ½ W. to N. by W. ½ W. But care must be taken not to approach Calmoene point within 600 or 700 yards, as there are some rocky heads some distance from it.

The best anchorage for a large vessel is outside the rocky ledge, with the Fort

church bearing N. by E., over the centre of a small island called "Small Pox island," just clear of the small cocoa-nut tope on Mande Teevo, and Calmoene point N.E. by E. She would then be in 4½ fathoms, sand, about 2 miles off the island. It must be borne in mind, however, that this anchorage ought not to be used from the middle of May to the middle of August, when the S.W. Monsoon, from which there is no shelter, blows with great violence.

Dangers in Palk's Bay.—1. The Middle Banks, already described.

2. A long sandy spit, with from 1 to 2 fathoms over it, stretching E. by S., 13 miles from a low point above Kotipatnam, on the coast of India. It has generally a heavy swash of a sea over it, and should not be approached from the eastward nearer than 6 fathoms. Captain Powell places its eastern extremity in Lat. 9°59′ N., and Long. 79° 29⅓′ E. Its bearing from Paumben is N. 22° E. 45 miles; and from point Calimere S. 49° W. 29 miles.

3. The foul ground off the N.W. end of Ceylon, to the eastward of the opening between that and Kara Teevo, where the coast ought not to be approached nearer than 2 miles, for although at present there are 12 to 15 feet over the knolls, the depths may decrease, as they are composed of coral.

4. A detached rock, about the size of a ship's boat, with only 2 feet water over it, between Paale Teevo and the Devil's point, having the following bearings:—Devil's Point, South 3 miles; South end of Paale Teevo, E.S.E. 2⅓ miles.

Lastly.—Some rocks awash which lie about 1½ miles off the N.E. end of Rameseram island, where the soundings ought not be shoaled to less than 5 fathoms. Care should be taken in the N.E. Monsoon not to get into the bay to the east of this island, as it becomes a difficult matter to work out again.

Adrampatam.—The town of Adrampatam (Lat. 12° 20′ N.) is situated about 28 miles west (northerly) of point Calimere. A vessel, after passing through the North channel as above directed, may steer about W. by N. She will make the Shallavenaikapatam pagoda, which can be seen 15 miles off, ahead, and should anchor with the town of Adrampatam north, from 3 to 3½ miles, and the pagoda west about 6 miles. She will then be in 2½ to 3 fathoms, sand. Small craft drawing 6 or 7 feet water may approach to within 1½ miles of the town, bearing N.N.W., and anchor in 2 fathoms.

The anchorage is good at this port during the N.E. Monsoon, but with S.-ly and S.E.-ly winds a heavy swell sets into the bay of Adrampatam, rendering it less secure at those seasons.

The **Light** on the east side of Paumben Pass, Palk's Bay, is visible all round the compass to the distance of 12 miles; position—Lat. 9° 17½′ N., Long. 79° 12½′ E.

The directions from pages 440 to 447 are principally from the observations of Mr. J. T. Franklin and the Officers engaged in the survey of the Gulf of Manaar and Palk's Strait.

EAST COAST OF INDIA.

Calimere Point, in Lat. 10° 18′ N., Long. 79° 52½′ E., is low, and covered with cocoa-nut trees; off it a shoal flat projects some distance seaward, in consequence of which it should not be approached in passing, under 6 to 7 fathoms. Two pagodas, near each other, about a mile from the shore, and 5½ miles N.W.-ward of the point, are in Lat. 10° 22½′ N. (For a description of the shoals off this point, see p. 445.)

Negapatam Shoal, the centre of which is in Lat. 10° 35′ N., is about 7 miles long, but only a few cables wide, having on it 24 feet water at its S. extremity, and 19 feet at its N. end; and it consists chiefly of hard sand and stones: between the shoal and the main the channel is from 3 to 4 miles in width, having 3½ to 5 fathoms in its deepest parts, near the inner edge of the shoal; outside, there are 6 to 7 fathoms close-to, consequently it ought not to be approached under 8 fathoms; some knolls near the N. part of the shoal have overfalls of 7 to 5 fathoms on them.

NEGAPATAM is a place of considerable trade for small coasting vessels.

Light.—A *fixed white* light, visible between the bearings of N.N.W. to S.S.W., by the westward, is exhibited S. of the town from the bastion of the fort, on a flagstaff 100 feet above the sea, and may be seen 12 miles; during the N.E. Monsoon it is lowered to 88 feet. Position—Lat. 10° 46′ N., Long. 79° 50′ E.

The coast being very low, a *black* pagoda 1½ miles N.N.W. of the fort is a conspicuous object on approaching it.

The **Anchorage** during the fine season is 1½ to 2 miles off shore in 5 to 5½ fathoms, with the flagstaff bearing W. to W. by S., soft bottom. But ships must keep farther out in unsettled weather, at which time, in 6 to 7 fathoms, with the flagstaff W. ½ S., and the highest of the five *white* pagodas N.W., there is good holding ground.

Supplies.—Water, fresh provisions, fruit, vegetables, rice, &c., may be procured here; but firewood is scarce.

Coming from the *southward* during the S.W. Monsoon, keep in soundings, otherwise it will be difficult to make the coast between Calimere point and Negapatam, owing to the prevalent westerly winds and strong northerly current. Negapatam shoal is cleared by keeping in 8 fathoms, and when a *white* house (5 miles south of Negapatam) bears W. (southerly) you may haul in with safety towards the anchorage

Nagore, in Lat. 10° 49′ N., and 4 miles northward of Negapatam, has a large trade, carried on by natives, with the ports on the east side of the bay of Bengal, and with Sumatra; it is readily distinguished by five *white* pagodas; the coast is low and swampy, and at times inundated near the mouth of the river.

The anchorage in the roadstead is 2⅔ miles off the entrance to the river, in 5 to 6 fathoms, with the five *white* pagodas bearing W.S.W. or W. by S.

Carricall.—Ships anchor abreast the river in 5 to 6 fathoms. There is a *fixed white* light, exhibited from a flagstaff 65 feet above the sea, and visible 8 miles. Position—Lat. 10° 55′ N., Long. 79° 49′ 36″ E.

At **Tranquebar,** in Lat. 11° 1′ N., there is said to be a shoal opposite the mouth of the river, 10 miles off shore, but it is unknown to the fishermen of Carricall.

Coleroon River is in Lat. 11° 23′ N.; Coleroon shoal fringes the coast for several miles, and projects seaward 5 or 6 miles from the entrance of the river: here a large

ship should not come under 12 to 14 fathoms by day, nor 16 to 20 fathoms by night. The south end of the shoal is marked by the southernmost of the Chalambaram pagoda on with the south part of Coleroon wood; the two pagodas in one (W.S.W.), and Porto Novo flagstaff, bearing W. by N. ½ N., marks the north end of the shoal.

Porto Novo, in Lat. 11° 30′ N., is sheltered to the S.E. by the Coleroon shoal; ships anchor here in 6 fathoms, 2 miles off shore—the flagstaff bearing W. ½ N., and the southernmost of the Chalambaram pagodas S.W. ¼ W.; rounding Coleroon shoal bring the flagstaff to bear W. by N. ¼ N., or if in 18 to 20 fathoms water, haul in when the flagstaff bears W.N.W.

Cuddalore is in Lat. 11° 43′ N.; the anchorage is in 5 to 6 fathoms, with the flagstaff N.W. by N. to N.W. ½ N.; the river is small and barred. Supplies of all kinds may be procured. Off the ruins of Fort St. David, 2 miles northward of Cuddalore, a bank projects from ½ to ¾ of a mile seawards.

PONDICHERRY, in Lat. 11° 56′ N., is a French town standing on a flat, sandy plain, close to the sea. The first conspicuous object on making the coast hereabouts is a grove of trees on a flat hill, N.W. of the town; the river is small, and can only be entered by small country vessels.

Light.—A *fixed white* light is exhibited from the square in the town, at an elevation of 130 feet above the sea, and visible 15 miles on all points of the sea horizon. Position.—Lat. 11° 55′ 40″ N., Long. 79° 49′ E. Take care not to confound this light with that from the chimney of the foundry at Porto Novo.

Anchorage.—During the S.W. Monsoon, and in fine weather, the anchorage is in 7 to 8 fathoms, abreast of and ¾ of a mile from the town; but small ships come into 5½ or 6 fathoms; at night, bring the lights bearing West to W. by N. before anchoring. During the stormy period of the N.E. Monsoon, the anchorage is in the outer roadstead in 12 to 14 fathoms. During the night, there is convenient anchorage in 10 to 12 fathoms, with the light bearing W. to W.N.W.

Directions.—Coasting along from point Calimere to Pondicherry, 10 to 14 fathoms may be kept, except when approaching Coleroon shoal, where it is not safe to come under 14 or 15 fathoms, since the water shoals very suddenly in places thereabouts. Between Cuddalore and Pondicherry there are 7 fathoms at 1 to 1½ miles off shore, and 40 to 45 fathoms 18 to 20 miles off; the bank thence becoming very rapidly steep.

The coast between Pondicherry and Sadras is generally low, with sand-hills here and there fronting the sea; and off Conjimeer, in Lat. 12° 8′ to 12° 11′, a bank of 5 fathoms is stated to exist about 5 miles off shore.

Sadras is in Lat. 12° 32′ N. The coast may be known by an irregular ridge of hills (Sadras hills) inland, at the back of the town; some of these are very rugged, and when the highest bears N.W. the ship is nearly abreast of Sadras.

About 7 miles northward of Sadras are the seven Moolivaram pagodas, two of which are now close to the sea, though it is stated that at one time they were some distance inland; they are not clearly discernible unless well in with the land.

Tripaloor Shoal.—To the northward of the seven Moolivaram pagodas, between them and Covelong, the rocky shoal of Tripaloor, with very foul ground near it, stretches from 1 to 3 miles off shore; the *Rockingham* was wrecked on it in Lat. 12° 43′ N.

Soundings of 5 to 7 fathoms were also reported in 1820, by Captain Barclay, of

the *Bulmer*, stated to be on a bank in Lat. 12° 26′ N., 10 miles off shore; and another bank of 4 to 6 fathoms, in Lat. 12° 45′ to 12° 47′ N., about 40 to 45 miles off shore; neither of these seem probable.

The distance from point Calimere to Pondicherry is about 97 miles, and the course nearly due north, except to the northward of the Coleroon shoal, where the coast curves slightly inwards. From Pondicherry to Sadras the distance is about 43 miles, and the direction of the coast nearly N.N.E.; thence to Madras the distance is about 34 miles, and the coast line first N. by E. and then N. ½ E. The shore is generally low and sandy—with occasional sand-hills—and the surf at all times beats heavily on the shore, so that there are few spots where a landing can be effected from the ship's boats; hence the peculiar boats of the natives, called Masoolah boats, are everywhere in requisition. Although the shores are low, they are generally well-wooded, generally with Palmyra and cocoa-nut trees, and the aspect of the country is fertile. To the northward of the parallel of 12° N., the country inland becomes mountainous—the eastern Ghauts, with several offshoots, stretching towards the sea shore.

St. Thomas, or Milapore, is a small town close to the sea, in Lat. 13° 1′ N.; the country inland is hilly; the northernmost hill, 4½ miles from the sea, in Lat. 13° 0½′ N., has a church on it, by which it may be distinguished when sailing along.

MADRAS.

MADRAS is the seat of Government of the Madras Presidency, and the principal town on the Coromandel coast. Fort St. George, in which is the Governor's house and the Government offices, stands close to the sea, and is strongly fortified. The native town is to the north of the fort, separated from it by the esplanade, and though extensive is not well built. Madras is a place of extensive trade—both the exports and imports being large. The limits of Madras roadstead (in 8 or 9 fathoms) are comprised within the following bearings—viz., from the northward, the lighthouse will bear S. 56° W.; and from the southward, N. 81° W., or from S.W. by W. to W. ¾ N.

Light.—The lighthouse, 125 feet high, stands on the esplanade, N. of the fort, and exhibits a *fixed white* light, varied by a *flash* every two minutes, visible from 17 to 24 miles. Position.—Lat. 13° 5′ 10″ N., Long. 80° 16′ 30″ E.

Pulicat Shoals.—With the original light notice the following *caution* was issued respecting the Pulicat shoals to the northward of the roadstead:—From the S.E. extremity of the Pulicat shoals the new lighthouse bears S. 23° W., distant 13 miles; but no ship, when hauling in from the northward for Madras roadstead, should bring the light to bear to the southward of S. 28° W., or S.S.W. ½ W., unless her position is well ascertained. Commanders are warned of the serious risk they incur by incautiously approaching the dangerous vicinity of the Pulicat shoals, as hazy weather, or other causes, may obscure the light; true soundings, therefore, and a vigilant look-out are imperatively called for.

The Master Attendant's **Instructions** are to the following effect:—

All ships, other than native vessels, are to anchor with the following bearings—viz., the Master-Attendant's flagstaff from N.W. to W. ½ N., which will be found convenient anchorage for merchant vessels, and the southern limits of the roadstead

usually resorted to by men-of-war may be ascertained as within the position denoted by bringing the lighthouse to bear from W. by N. to W., in from 9 to 7 fathoms—which is the range of soundings throughout. Ships should take up such a berth as will enable them to wear clear of all danger in the event of casting in shore when they weigh or part from their anchors—especially as the ground-swell, so prevalent here, tends (against all precaution) to cast a vessel in shore.

Bringing-up in Madras roads, a buoy should always be attached to the anchor, whereby giving foul berths may be avoided, and the position of lost anchors will be indicated. Ships have frequently parted, and accidents have happened by riding with too short a scope; no vessel, therefore, is safe with less than 60 fathoms of cable in moderate weather, and 80 fathoms or more when there is a swell. Also, to those who are not acquainted with the roadstead, should any jerk be felt when riding with a chain (from the heavy swell that rolls in at times), either on the windlass or bitts, cable should be veered until the jerk is no longer felt; and a second anchor should always be ready. Efficient ground tackling is essential to the safety of vessels in Madras roads.

Signals.—When the surf is so high as in the opinion of the Master Attendant, or his assistant, to render communication with the shore dangerous, a *red* and *white chequered* flag will be hoisted at the Master-Attendant's flagstaff; when the surf is impassable, the *first distinguishing pendant* will be displayed *under* that flag; when the current is too strong, the *rendezvous* flag will be hoisted.

Should the weather assume such a threatening appearance as may in the opinion of the Master Attendant indicate an approaching gale, and render it advisable that ships should put to sea, the following signals will be hoisted at the Master Attendant's flagstaff, but the commander is not to wait the display of signals if he deems it prudent to put to sea;—

1. The weather is suspicious, prepare to put to sea—*White* flag, with *blue* cross.
2. Cut, or slip—*Red* flag, with swallow-tail.

Upon the indication of an approaching gale of wind after sunset, three good lights will be hoisted at the Master-Attendant's flagstaff—one at the mast-head, and one at each yard-arm; and a gun will be fired from the ramparts of Fort St. George every five minutes for an hour, or such time as may be deemed necessary; these signals are to be acknowledged by hoisting a good light at the peak, or other conspicuous place.

Commanders are warned of their own extreme responsibility if these signals do not receive timely attention; and they are also advised to have their ships always prepared to put to sea, especially on or about the change of each Monsoon, and to pay strict attention to the necessity of having good sails bent, which, in the event of being driven to sea, or compelled to slip, is of the utmost consequence. Their first object should be to gain a good offing, under treble or close-reefed topsails and reefed courses, carefully attending to the lead and soundings, and guarding against a strong current, which generally varies its course according to the strength and direction of the wind. When the weather is threatening or doubtful, commanders should repair on board their respective ships before sunset.

Anchorage.—The roadstead of Madras is open to all winds, except those from the westward (or off the land); and the prevalent swell causes vessels to labour and roll

considerably at times. Vessels discharging cargo often moor in 8½ to 9 fathoms abreast the flagstaff, with it bearing W., or W. by N. A good position for large vessels is with the flagstaff bearing N.W. ½ W. to W.N.W. in 9 fathoms, 2 miles from the shore. In many parts the bottom is stiff mud, from which the anchor is extricated with difficulty.

The caution to anchor well out, and to be always prepared to proceed to sea, is essentially requisite, for the gales generally commence at N.W., blowing strong from the land, with which an offing can be gained before the wind veers to N.E. and E., when it would be impossible to do so. The most dangerous season for all the ports on this coast is from the beginning of October to the middle of December; heavy gales have occurred in April and May, but not frequently. If a vessel is ready to weigh or slip, and gets to sea at the approach of the gale, little danger is likely to befal her, and it often happens that the wind is not so strong as near the land; but if she remain, she may possibly be driven on shore, with very little chance of saving even the lives of those on board.

Currents.—DIRECTIONS: At the beginning and during the strength of the N.E. Monsoon, the current sets to the southward along the coast at the rate of 1½ to 2 miles, consequently the land should be made to the northward of Madras at that season; this current slackens towards January. During the S.W. Monsoon, and generally after the beginning of February, the current frequently sets as strongly to the northward, therefore the land should be made direct if possible, or even to the south of the port—say on a N.W. bearing—never to the northward of the port, at this period.

Both the strength and direction of the current on this side of the bay of Bengal are however variable, and liable to uncertain changes. COMMANDER R. HOBSON, H.M.S. *Vigilant*, in a letter from Madras, dated August, 1864, reports, that during a passage from Cuddalore to that place, an unusually strong N.E.-ly current of at least 3 knots an hour was experienced.

Madras Observatory is estimated, from a vast number of observations, to be in Long. 80° 14′ 19″·5 E.

The breakwater, commenced some time since at Madras, is now completed, and ships' boats land passengers there.

Pulicat Shoals.—About 9½ miles N. by E. ½ E. from Madras is a conspicuous house close to the sea, and 1¼ miles south of a village; this is Enore House, to the northward of which position commences a bank on which are the Pulicat shoals, that have always been so notoriously disastrous to shipping. The southern extremity of the bank is in Lat. 13° 15′ N., whence it stretches in a general N. ¾ E. direction to Lat. 13° 33′ N., and on this bank the shoals lie in patches.

The first dangerous patch is 2 miles long, in a N.E. ½ E. and S.W. ½ W. direction, its outer edge being about 2 miles from the shore, and having on it from 1½ to 2½ fathoms water. The southern extremity is in Lat. 13° 16′ N.; its northern extremity, in Lat. 13° 18′ N.; here the water breaks 1½ miles from the shore.

The next patches are 3 miles more to the northward, in Lat. 13° 20½′ N., extending about 1½ miles in a N. by E. direction, and lie from 2 to 2½ miles off shore; these have from 2½ to 3½ fathoms on them, and are *very* dangerous, inasmuch as there are 6 to 10 fathoms close-to.

The northernmost patch of $3\frac{1}{2}$ fathoms, in Lat. 13° 23′ N., lies about $3\frac{1}{3}$ miles off shore, with $4\frac{1}{2}$ to 7 fathoms close-to.

Between the southernmost and middle patches there is a channel leading to Pulicat road, but large ships should keep outside, and not shoal their water under 13 to 14 fathoms, which clears all danger; then, if bound to Pulicat, haul in when the flagstaff bears W. by N., crossing the N. part of the bank in $5\frac{1}{2}$ to 6 fathoms.

The southernmost of the Pulicat shoals is 12 miles from Madras flagstaff, and the northernmost nearly 20 miles; when passing along, they should not be approached under 16 to 17 fathoms for safety; and if Madras light is visible, it should not be brought to bear to the southward of S.S.W. $\frac{1}{4}$ W.

The depths on approaching the bank decrease rapidly from 18 to 15, 11, $4\frac{1}{2}$, and 4 fathoms. On the outer edge of soundings the depths are 40 to 50 fathoms at the distance of 18 to 20 miles off shore, and 18 to 20 fathoms 4 to $4\frac{1}{2}$ miles off.

Pulicat roadstead is $20\frac{1}{4}$ miles from Madras flagstaff.

Light.—A lighthouse exhibits a *fixed red* light, 56 feet above the sea, visible 6 or 7 miles. Position.—Lat. 13° 25′ N., Long. 80° 19′ 40″ E.

Approaching Pulicat, when the light bears W. $\frac{1}{2}$ N., you are to the northward of all the shoals. The anchorage is in 7 to 8 fathoms abreast of the lighthouse, $1\frac{1}{2}$ to 2 miles off shore.

The chain of mountains inland, known as Pulicat hills, has, near the southern end, a piece of flat table-land, usually called the Kettle Bottom, which bears West from Pulicat flagstaff, W. $\frac{1}{2}$ N. from the middle of Pulicat bank, and W.N.W. from Enore house. Naggery Nose, in Lat. 13° 22′ N., is another remarkable hill to the southward of the Kettle Bottom.

From Pulicat to Poondy point, in Lat. 13° 47′ N., the distance is 22 miles, and the coast is slightly concave. Off the point, shoal ground of 1 to 3 fathoms stretches to the S.E.-ward for the distance of 2 miles.

Armogham Shoal. — Immediately northward (N.N.E. 2 miles) of Poondy point, commences a bank which in some parts has not more than $1\frac{1}{2}$ to $2\frac{1}{2}$ fathoms water on it. This is the Armogham bank, extending from Lat. 13° $48\frac{1}{2}$′ to 14° 7′ N. It does not exactly follow the line of the coast, being $6\frac{1}{2}$ miles off it at its northern end, while at its southern extremity it approaches within $1\frac{1}{3}$ miles, nearly joining the shoal off Poondy point: its shoalest parts lie between Lat. 13° $48\frac{1}{2}$′ and 13° 57′ N.

Light.—Near the village of Moona or Moonapolium, 1 mile from the shore, there is a lighthouse, 95 feet high, showing a *fixed white* light, visible 15 miles. Position. —Lat. 13° 52′ 50″ N., Long. 80° 12′ E.

This light is due West from the shoalest part (9 feet), which is 6 miles off shore, and where it occasionally breaks. On the outer edge there are from 7 to 10 fathoms, deepening to 28 or 30 fathoms 3 or 4 miles off.

Blackwood Harbour is the name given to the space included between the inner edge of the Armogham shoal and the coast; it is from 3 to 4 miles wide, with depths varying from $4\frac{1}{2}$ fathoms near the shore to 6 or 7 fathoms contiguous to the edge of the shoal. The entrance is by the north end of the shoal, in not less than 6 fathoms, with Armogham hill bearing W. $\frac{1}{4}$ S.; and there is safe anchorage in the fine Monsoon off the entrance to Armogham river, with the hill bearing W. $\frac{1}{4}$ S. There is

often a haze on this part of the coast, partially obscuring it, and making it appear more distant than it really is. The channel by the South of the shoal should not be attempted.

Bound northward from Madras, do not approach the Armogham shoal under 12 to 14 fathoms. Armogham hill is in Lat. 14° 3′ N.

Shoals.—Northward of the Middy river, in Lat. 14° 15½′ N., and thence to Lat. 14° 24′ N., a bank of 2½ fathoms stretches to the N.E.-ward,—in some places 2½ miles off shore.

From the parallel of 15° N. and to False Divy point (in Lat. 15° 45′ N.), where the coast forms an extensive bight, there are several shoal spots inside the line of 11 fathoms soundings, on what is known as the **Mootapolli Bank.** The most dangerous spot is the Mootapolli shoal, opposite Kuttowputtam, on the parallel of 15° 25′ N., and 8 miles off the coast, having on it only 2½ fathoms water; the patch lies N.E. and S.W. between Lat. 15° 23½′ and 15° 27′, having on it from 4 to 6 fathoms; inside this shoal there are others of 2½ to 3 fathoms, 3 miles off shore.

The Mootapolli bank, which extends many miles around these shoals, is generally of coarse sand and broken shells, and has on it overfalls in places. Passing here at night do not come under 20 to 24 fathoms, nor under 15 fathoms during the day. Immediately outside this bank the depths shelve to 18 or 20 fathoms within a short distance, and to 60 fathoms 6 miles off.

False Divy Point is in Lat. 15° 45′ N., Long. 80° 51′ E.; it is a low projecting flat, with an extensive mangrove jungle, through which the Kistna river discharges its waters into the ocean. The bank, of 3½ to 4 fathoms soundings, extends 4 and 4½ miles off the coast hereabouts; thence the increase of depth is rapid to seaward, there being 15 fathoms 8 miles off the shore—and consequently the more dangerous, as a ship approaching the land shoals her water very suddenly. The coast is also frequently enveloped in haze, which gives a false appearance as to distance.

POINT DIVY is low, and bears N.E. by E. distant 20 miles from False Divy point.

Light.—Two miles to the N.W. of point Divy, in Lat. 15° 58′ 55″ N., Long. 81° 9′ 30″ E., there is a lighthouse 90 feet high, which exhibits a *fixed white* light, visible when bearing North to S.W. by the westward, and may be seen to the distance of 12 miles.

The shoal flat which has been described in connexion with False Divy point extends to Divy point, and thence to the northward beyond Masulipatam and Narsapoor point.

MASULIPATAM was at one time the principal place on the Coromandel coast; it is still a populous town, with a very considerable trade. The fort is 1½ miles from the sea-shore. The coast is very flat all round the bay, and liable to inundation when the cyclone winds of the bay of Bengal make it a dead lee shore.

Light.—A *red* light is exhibited from a flagstaff on the fort, at an elevation of 95 feet, visible from all parts of the sea horizon, to the distance of 7 or 8 miles. Position.—Lat. 16° 9′ 6″ N., Long. 81° 8′ 12″ E.

The **Port Instructions** (dated 1860), are to the following effect:—Two first-class buoys have been laid down to mark the anchorage in Masulipatam roads; a *red* buoy is placed in 3½ fathoms, with the flagstaff on the fort bearing West

(northerly); and in-shore, due West from the red buoy, is a *white* one, placed in 3 fathoms low water. The best anchorage at all times of the year will be in a line with the buoys; but when strong westerly winds prevail, in May and June, ships should anchor to the southward of the buoys.

Anchorage.—The best anchorage in Masulipatam roads is with the flagstaff bearing W. ½ N. to W.N.W.,—the ship's draught of water being the guide as to how close she may approach; with the above bearings a vessel in 3½ fathoms will be about 3½ miles from the mouth of the river. Commanders should bear in mind that with these bearings the water shoals very gradually, and that coming in as close as the ship's draught admits will go far to expedite the loading or discharging of cargo, and lessen the cost of boat-hire. The holding ground in the roads is good, and with good ground-tackle a vessel may ride out very heavy weather.

No cargo can be landed in ships' boats; any attempt to do so is attended by a penalty of 50 rupees and confiscation of boat.

No ballast is to be thrown overboard in less than 10 fathoms; nor is any to be discharged on the beach or elsewhere, from which it might be washed into the port; the penalty for infringing this is 200 rupees.

Signals.—When the surf is so high as to render communication with the shore dangerous, a *red* and *white* chequered flag will be hoisted at the Master Attendant's flagstaff; when the surf is impassable the *first distinguishing pendant* will be displayed under that flag. Should a boat be urgently required during the night, three lights should be hoisted horizontally; and in case of danger from fire or other causes blue lights should be burnt and guns fired.

Directions.—A ship from the southward rounding Divy point in 6 to 8 fathoms (according to draught of vessel), after bringing Divy light to bear West, should make a northerly course, when she will carry regular soundings, shoaling gradually as she approaches Masulipatam; great care, however, is necessary, as the currents between point Narsapoor and point Divy are at times very strong, and the lead is the only sure guide. Vessels shoaling to 4 fathoms should haul to the eastward during the daytime; as a ship approaches Masulipatam the flagstaff and buildings will be seen if the weather is at all clear. At night the light at Masulipatam will not be seen until 4 or 5 miles north of Divy light. Coming to Masulipatam from Madras, although a ship should keep in soundings, yet when passing Armogham and Mootapolli shoals during the night, these should not be approached under 20 fathoms.

A memorandum by Mr. W. Blow mentions that the light on Divy point is very bad at times; that the lead is the only guide for any vessel approaching this part of the coast, and that its indications ought to receive careful attention, as the sandbank off the point extends much further out than laid down on any chart; also, Masulipatam light can scarcely be seen from the shipping, especially if the atmosphere is thick.

Narsapoor Point is in Lat. 16° 18′ N., Long. 81° 42′ E.; it bears N.E. by E. 36 miles from point Divy. Masulipatam is situated in the bight between these two points and the bank of shoal soundings, which commences south of the parallel of 15° N., terminates 12 miles to the N.E.-ward from Narsapoor point. There is anchorage in Narsapoor roads in 4½ to 5½ fathoms to the westward of the shoal that projects off the mouth of the river,—but the river itself is barred.

The coast from Narsapoor point to Gordeware point, in Lat. 16° 49′ N., Long. 80° 20′ E., is first N.E. by E. for the distance of about 27 miles, then N.E. for 14 miles, and lastly N. by E. for 9 miles. Round Gordeware point and Hope island, to the westward, is Coringa or Cocanada bay.

CORINGA AND COCANADA.—The principal mouths of the Godavery river enter the bay of Bengal, in Lat. 16° 15′ N.; here there is an accumulation of sand-banks and mud-flats, a large proportion of which is flooded at high water. Having made Gordeware point or Hope island lighthouse, great caution is necessary in approaching the coast if bound to either Coringa or Cocanada; for not only are the banks and shoals dangerous, but it is quite possible hereabouts to misjudge distance from the land, owing to its being so very low. If not bound to either port, a ship in passing ought not to come under 20 to 30 fathoms.

Lights.—The Gordeware or Godavery point lighthouse stands on the south side of Hope island; it exhibits a *fixed white* light at an elevation of 73 feet above the sea, and is visible when bearing from South round by the westward to N.N.W. to the distance of 15 miles. Position.—Lat. 16° 49′ 5″ N., Long. 82° 18′ 25″ E. The lighthouse is painted in horizontal black and white bands to distinguish it during the day from that on point Divy, which is white.

A lighthouse has also been erected at Cocanada, as a guide for the anchorage; it exhibits a *fixed white* light.

Buoys have also been placed as a guide to Cocanada anchorage. Their position is as follows:—

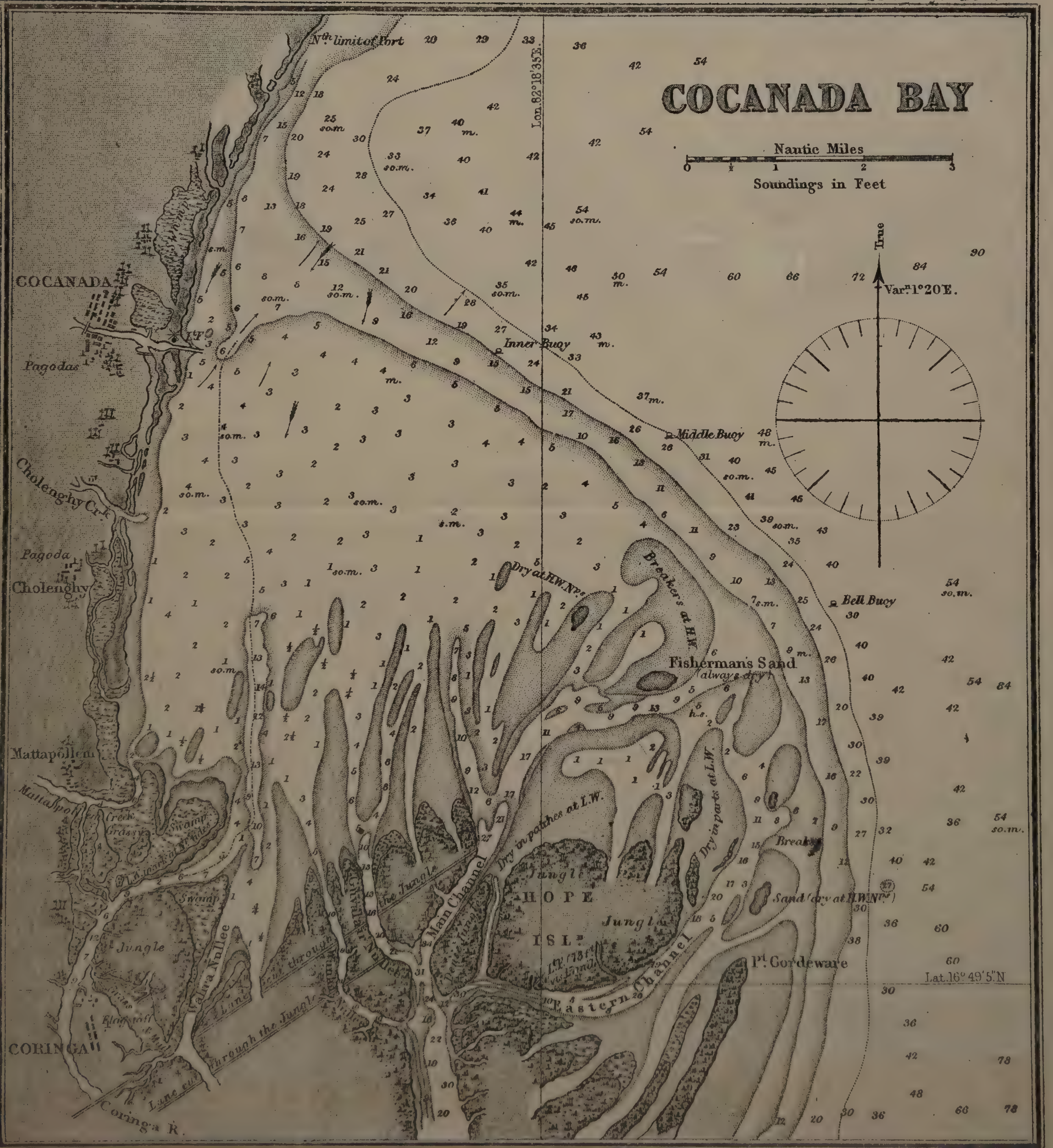
1. The *Outer*, or *Bell* buoy bears from Hope island lighthouse N.E. ¾ N. about 6 miles, and lies in 6 fathoms. 2. The *Middle* buoy bears from Hope island lighthouse N. by E. about 8 miles, and lies in 5 fathoms. And 3, the *Inner* buoy bears from Hope island lighthouse N. ½ W. about 9 miles, in 3 fathoms.

Vessels should on no account attempt to go inside, or to the southward and westward of any of these buoys.

On approaching the Godavery or N.E. point of Hope island from the southward by night in the S.W. Monsoon, vessels should on no account attempt to round the point till the lighthouse on Hope island bears S.W. by S., and the Bell buoy S. by W. ¼ W.; and not come under 8 fathoms. They can then haul in N.W. ½ N. in about 7 to 8 fathoms, and when Hope island lighthouse and Middle buoy bear S. by W. in about 7 fathoms, they can haul in N.W. by W. ½ W., which will bring them past the Inner buoy—the lighthouse bearing S. ½ E. The shipping in Cocanada roadstead will then be distinctly seen, and they can anchor with Hope island lighthouse from S. by E. ½ E. to S.S.E. in 4 to 6 fathoms, according to the vessel's draught.

It is advisable for ships in the N.E. Monsoon to take up a position in the S.E. quarter of the anchorage, with the lighthouse on Hope island, bearing S. by E. to S. by E. ½ E., and the tower of the new lighthouse at Cocanada S.W. by W., in about 5 fathoms; and in the S.W. Monsoon, a little further to the N.W. in about 4 fathoms, with the lighthouse on Hope island bearing S. by E. ½ E. to S.S.E. and tower of the new lighthouse S. W. ¼ S. (See also p. 459-460.)

If captains would adhere to the above suggestions, communication with the shore and the shipping would be more readily obtained, and ships would be in a better position for getting under weigh when required, than they usually now are, and would be in smoother water for loading and discharging.


COCANADA BAY
Nautic Miles
Soundings in Feet
True
Varn. 1°20'E.
Lon. 82°18'35"E.
Nth. limit of Port
COCANADA
Pagodas
Cholenghy Cr.
Pagoda
Cholenghy
Mattapollem
Inner Buoy
Middle Buoy
Bell Buoy
Breakers at H.W.
Fisherman's Sand (always dry)
Dry in patches at L.W.
Dry in parts at L.W.
Main Channel
Eastern Channel
HOPE ISLD.
Jungle
Pt. Gordeware
Lat. 16° 49' 5" N
Coringa R.
CORINGA
Swamp

Ships coming in the N.E. Monsoon during the night must pay every attention to their lead and look out; and they are recommended, when approaching the shipping, to anchor in 8 or 10 fathoms till daylight, when they can run in and pick up a berth as above recommended.

Commanders should on no account throw ballast of any kind out of their vessels to the westward of a line with the Middle or large *black* buoy on with the lighthouse on Hope island bearing S. by W., and in not less than 10 fathoms, or they will incur a penalty for so doing.

The Coringa river cannot be entered without a pilot; indeed, it is now closed for large vessels, and these generally bring up opposite Cocanada.

Bound to either place from the northward, during the S.W. Monsoon, haul in towards the land when just south of the Dolphin's Nose, off Vizagapatam, and beat to windward as close along shore as possible; not, however, coming under 12 to 14 fathoms, until past Wattara and Pentacotta (Lat. 17° 19′ N.)—the latter known by a conical hill a short distance inland. Here the coast may be approached to 9 or 10 fathoms; and when approaching Cocanada (within 10 or 12 miles), stand in shore to 5 fathoms. During the N.E. Monsoon, there is a strong southerly current along this coast.

Bound from the southward, during the S.W. Monsoon, the land may be made about Narsapoor point, but do not come under 9 fathoms; after which haul out, and do not make Hope island lighthouse under 12 or 14 fathoms.

The coast is very dangerous hereabouts, and must be approached with caution.

During the N.E. Monsoon, work well to the northward of your port.

The bay is only open from N.E. to S.E. by S., and the anchorage is on good holding ground.

Coringa is 10 miles southward of the anchorage off Cocanada.

Pillar Rock.—In Lat. 17° 26′ N., Long. 82° 52′ E., is the small town of WATTARA, near the entrance to a small river; N.E. by E. ½ E., and distant 9 miles from that place is the Pillar rock, about ¾ of a mile from the shore; it is also 20 miles S.W.-ward of Vizagapatam; its position is, Lat. 17° 29¾′ N., Long. 83° 0¼′ E.

Pigeon Island, in a small bight on the coast, is in Lat. 17° 38′ N., Long. 83° 13¾′ E.; it being low, it is not seen until near it.

VIZAGAPATAM, in Lat. 17° 42′ N., Long. 83° 17′ E., is distant 74 miles from Coconada roadstead in a N.E. by E direction. The river is barred, and the sand shifting. From seaward, Vizagapatam may be known by the bluff promontory on the S.W. of the roadstead, called the Dolphin's Nose. The village of Waltair is 3 miles to the N.E.-ward of the flagstaff.

Anchorage.—In the N.E. Monsoon there is anchorage in 8 fathoms 1½ to 2 miles off shore, with Waltair house on with the west side of Sugar-loaf hill; and the top of Green-hill, open with the Dolphin's Nose. During the S.W. Monsoon, the anchorage for large vessels is in 8 to 9 fathoms, with the Bar battery bearing N.W. by W.; the Sugar-loaf hill in one with Waltair house; and Green-hill to the southward of the Dolphin's Nose; small vessels may go into 6 fathoms. The anchorage further out in 11 to 12 fathoms cannot be recommended, for the bottom in those depths is stiff mud, and there is danger of losing the anchors.

Between Coconada roadstead and Vizagapatam the coast is safe to approach to 14

or 16 fathoms, within 2 or 3 miles off shore, but approaching Vizagapatam anchorage, the water shoals very rapidly. The land is higher in the vicinity of Wattara and Vizagapatam than at Coringa and Cocanada, but at a short distance inland there is a conspicuous ridge of mountains nearly parallel with the coast.

Bimlipatam is in Lat. 17° 53′ N., Long. 83° 27′ E., and lies 16 miles N.E.-ward of Vizagapatam; the anchorage is off the mouth of the river, in 6 to 9 fathoms.

During the N.E. Monsoon, it is advisable to anchor a little to the northward of the usual place of bring-up in the S.W. Monsoon.

The Santipilly Rocks.—About E.N.E. $\frac{1}{3}$ N., distant 15 miles from the anchorage of Bimlipatam, and 5 miles from the nearest point of the coast, are the dangerous Santipilly rocks, having $1\frac{3}{4}$ fathoms least water on them.

Light.—To mark the position of these rocks, a lighthouse has been erected on Conada hill, $\frac{3}{4}$ of a mile from the coast; it exhibits a *fixed white* light, at an elevation of 150 feet above the sea, and is visible 14 miles; its position is Lat. 18° $3\frac{1}{2}$′ N., Long. 83° $36\frac{1}{2}$′ E.,—N.W. by W. $\frac{1}{2}$ W. from the rocks.

The centre of these rocks is in Lat. 18° $0\frac{1}{2}$ N., Long. 83° $42\frac{1}{2}$′ E.; they are steep-to, on all sides, and their extent is not above 200 yards in length. When there is but little wind, and the sea is smooth, this shoal presents no indication by broken or discoloured water; as Lieutenant Fell, when in search of it during very fine weather, brought the surveying brig *Kristna* to anchor within 100 yards of the rocks before he could observe the slightest appearance of a shoal. Proceeding in a boat over the rocks, $10\frac{1}{2}$ feet was found on the shoalest part, 7 and 10 fathoms on the eastern side, and on the western limit $10\frac{1}{2}$ fathoms, rocky bottom.

Subsequently (1846) the Master Attendant of Madras (Captain Biden) surveyed the Santipilly rocks during fine weather, having a moderate breeze from S.W., with a ground swell; the breakers were clearly discerned from the masthead at the distance of 6 or 7 miles, bearing due South. When in 7 fathoms, about 2 miles off shore, Santipilly peak bearing W. by N., the breakers were soon after seen from the deck. Approaching the reef, which broke with considerable force, the vessel was anchored in $9\frac{1}{2}$ fathoms, coarse sand and shells, distant from the coast 3 miles, the reef bearing from S. 56° E. to S. 57° E., and distant 2 miles, Santipilly peak bearing N. 43° W.;—latitude, by an indifferent observation, 18° 1′ N.

Two boats, under Captain Crawford, went to examine the reef, and from the vessel they carried regular soundings of 9 and $9\frac{1}{2}$ fathoms, until within a quarter of a mile; at less than 100 yards from the breakers, found $10\frac{1}{4}$ and $10\frac{1}{2}$ fathoms rocky bottom. The breakers being too high to admit of the boats crossing the reef, Captain Crawford pulled round it, and gave as his opinion that the shoal, which lies N.N.W. and S.S.E., is in circumference about a quarter of a mile, with 10 fathoms close-to all round; from the surveying vessel the breakers seemed to extend the length of 200 yards.

The Inner channel is safe for ships of every class, as soundings of 5 fathoms within a mile of the coast, and $9\frac{1}{2}$ fathoms within a $\frac{1}{4}$ of a mile of the rocks, afford a clear space of nearly 4 miles in breadth.

In fair weather, when Santipilly peak is visible, that lofty and remarkable landmark affords an infallible guide to the true position of the Santipilly rocks; this peak is at least 2000 feet above the level of the sea, and presents a striking contrast

to all the hills in its vicinity; it bears N.W. from the rocks, and the base of the mountain is not more than 7 or 8 miles inland. In cloudy weather, when the peak may be obscured, there are two remarkable hillocks close to the beach, which are named the Great and Little Conada, appearing like a saddle-hill at 3 miles S.W. from the anchorage already mentioned as near the rocks. The northernmost, or Little Conada hill, on which is the lighthouse, is not more than $\frac{1}{2}$ a mile from the beach, and 150 feet above the level of the sea; when it bore N. $\frac{1}{4}$ W., the Santipilly reef was then plainly visible from the deck bearing E. $\frac{1}{4}$ N., distant 4 miles; at the same time, Sanitpilly peak bore N. 29° W., the vessel being in 8 fathoms about 2 miles off-shore. But in thick weather, when no defined landmark is discernible, great care and caution become absolutely necessary in approaching the coast between Ganjam and Vizagapatam. Change of current, and the absence of all means by night or day of obtaining a single observation, may, without strict and unremitting attention to soundings, place a vessel in imminent peril close to or upon the Santipilly rocks, which should not be approached from the eastward by day or night, under 17 to 20 fathoms.

Later observations have not added to the information given above, with the exception that the patch is rather larger than was supposed, and that it carries 7 to 8 feet least water; its limits are Lat. 17° 59¾′ to 18° 1¼′ N., Long. 83° 41½′ to 83° 43′ E.

The following Notes on Madras, Cocanada, Vizagapatam, Bimlipatam, and Pondicherry, are by Capt. Lewis Bilton, R.N.R.:—

"**Madras,** with the bright sun above, and the blue sea dashing in thunder on the beach, was delightful after the burning ghaut at Calcutta; every one felt a sense of life and enjoyment he had long been a stranger to—a feeling which was experienced, more or less, all the time we were on the coast. Madras, with its park, museum, and many pleasant drives, is a place to remember; there is more resemblance to home than in any other place I have seen in India. A railway is now in full operation, running to Beypur, on the west coast. The station at Madras is equal to, if not superior to some of the best in England; the pier, which has been run out to facilitate landing, is nearly finished. I got all my cargo out by the 8th of May, and fixed my ship again to load a cargo on the coast at Cocanada, Vizagapatam, Bimlipatam, and Pondicherry, for London. I took the sand off the beach for ballast, which is supplied at about 3*s.* per ton, including boat-hire; the sea being very rough I had great difficulty in getting the boatmen to bring it off, but at length resolved to give no rice to any who did not bring ballast, otherwise I should have been detained an indefinite time. The sailing directions recommend anchoring in 9 fathoms; a ship, however, would lose much time by doing so; I went into 6 fathoms—close to the pier—and found my advantage in doing so, by getting discharged quickly, as the boatmen will always flock to the nearest vessel—being paid by the trip. With one day's exception we had tolerable weather. The surf was high on the beach at times, but generally we could land cargo at some pier during the day. On the one day mentioned, the wind set in from the East and N.E., and after blowing a few hours and knocking up a terrible dust on shore, it veered round to the old quarter—viz., S.W.-rd.

"I left Madras on the 9th of May, for **Cocanada,** arriving there on the evening of the 11th, and was obliged to anchor in the offing in 9 fathoms, on account of a

heavy north-wester, which came on as I was nearly in with the shipping. There is a good *fixed* light on Hope island, near Coringa, to guide ships clear of the dangers off cape Gordeware and the entrance of the river Godavery—which is one mass of sand banks and breakers. This is the only safe port on the extensive line of coast, during the S.W. Monsoon, and the anchorage is completely protected from the heavy sea which constantly rolls along it at that season; but in the N.E. Monsoon it must be equally bad. The harbour of Coringa is fast filling up, and no loaded vessel (of any size) can go there; they have docks, however, and continue to build and repair ships; and numbers of large native craft are owned and lie up there during the S.W. Monsoon.

"A new lighthouse has been built at Cocanada, as a guide for the anchorage off that port. I found Mr. Thompson, the Master-Attendant, very obliging. He informed me that Cocanada harbour is also rapidly filling up. Two piers have been built along the entrance of that branch of the river on which Cocanada stands, and every effort is made, by dredging, to keep the navigation open; none but small vessels, however, enter the river. The shipping lie a long way from Cocanada, which is very inconvenient. There are no streets, that can be called such, in the place, nor, with the exception of about half a mile, is there a road on which a carriage of any description can drive. The town consists for the most part of native huts, and, indeed, the bulk of the trade is in native hands; there are, however, a few European merchants (so called). There are two very indifferent hotels, and a small, neat church, but no parson, the collector (as at Karachi) being everything, and in addition to his regular duties acts as parson and notary public. I was detained at this place from sheer neglect and carelessness on the part of those who ought to have facilitated my despatch. The shipper was a native, who seems to rule the place, and no one dared interfere with him; to save a few rupees he was allowed to detain the ship in a most shameful manner.

"I left Cocanada gladly, on the evening of the 26th, about 9 P.M., for **Vizagapatam,** where I arrived next day about noon. The high mountainous coast of Orissa commences a little to the north of Cocanada, and is a good guide, from the offing, to make the port—in the absence of observations. I found but one ship here—a Frenchman—loading seeds. I anchored in 9 fathoms outside of him—the land south of the Dolphin's Nose just open to the eastward of it, and the centre of Green hill bearing W. ½ N.; a heavy swell was running along shore, and the ship rolling, gunwales under. The entrance to the inner harbour is by a small river, with a very bad bar. Here we had the Masoolah boats, each of which, as at Madras, brings off 35 bags, and other goods in proportion, as established by a regular tariff, by the Master-Attendant, who is expected to see that they are kept in repair, and a sufficient number allotted to each vessel. The boatmen are the same merry, reckless fellows as at Madras, and their occupation is a hard and dangerous one. Finding the ship too far out, and detention in loading likely to occur therefrom, I got under way, and stood out under easy sail to enable me to go further in shore ahead of the Frenchman; when I had got off about 4 or 5 miles, the wind fell light and variable, and I was unable to reach the anchorage again till 9h. next morning, bringing up in 7 fathoms with 60 fathoms of cable—Dolphin's Nose S.W. ½ S., and centre of Green hill W.N.W. This is undoubtedly the best berth for a large ship during S.W. Monsoon; but no part of the road is protected, consequently, a ship rolls fearfully, and much of the cargo gets very wet. Inside the bar

there are about 4 fathoms in the river, and numbers of large native vessels were laid up there during the Monsoon, completely land-locked. The town is prettily situated. It is a military station, clean, and well-built, and the native houses had not that generally ruinous look so common in the East. There is but one hotel here, kept by a native Christian, named David; he and his brother are also Dubashes, and are very decent, honest, obliging men. The scenery around is magnificent, and I have seldom seen a finer view than is visible from the anchorage.

"I had good despatch at Vizagapatam, and sailed again on June 2nd, for **Bimlipatam**, which I reached in $2\frac{1}{2}$ hours, anchoring in 6 fathoms (with 50 fathoms of cable to the water's edge), the flagstaff in one with the Master-Attendant's office, bearing about W.N.W., and well to windward of all the other ships, of which I found four there. I found my advantage in every case on this coast in taking up a berth to windward of all the shipping, as the boatmen prefer coming to a ship in that position; they can pull easily to windward when loaded, and get back easily after discharging; generally they are awfully afraid of falling to leeward. Also, should a cyclone set in, you are *then* to leeward of all the shipping, and can get to sea without danger of collision, as the wind generally blows from a direction opposite to that of the prevailing wind. Here they have about 40 Masoolah boats—too few for the number of ships frequenting the port. I think the landing at Bimlipatam much better than that at Vizagapatam, as a projecting reef of rocks protects the landing-place, and a small outlay would make the port good in both Monsoons, by running out a short pier on the before-mentioned reef. I found the Master-Attendant, Mr. Meppin, very obliging.

"There is no light either at Vizagapatam or Bimlipatam, and ships occasionally run past them, causing a tedious beat to windward again, with an adverse current. Both are easily recognised, however, during the day: the former by the Dolphin's Nose and Pigeon island, and the latter by a detached round hill, close to the beach, having a large and very old pagoda on the face of it, and a few scattered trees on the summit. Bimlipatam is built between the beach and this hill, on an inclined plane, and is very picturesque, though small and insignificant. The merchants, however, are effecting great reforms, draining and making good roads, and they are building a small church capable of containing about 150 sitters. There are two sugar refineries here, one belonging to Messrs. Arbuthnot and Co., of Madras, the other established by a Frenchman, but now stopped for want of funds. Bimlipatam is a place of considerable trade in sugar, seeds, hides, and horns. There are two hotels here, one French, the other English; the latter, a very good one, is kept by a native, and is well frequented. I got quick despatch here, notwithstanding that the weather was extremely unfavourable, with a heavy sea. Away again on the 11th June, bound to Pondicherry. I must here certify a matter which ought to be made known to ship-masters; the Dubashes at Madras, and all the other ports, will tell them that a ship can get no bazaar at Vizagapatam or Bimlipatam, and advise them to carry bullocks, sheep, and potatoes, &c. with them, having a view to their own emolument in supplying them. This, however, is nonsense; every description of fresh provisions, except, perhaps, potatoes, are to be procured at both places, and at reasonable prices.

"June 11th I sailed for Pondicherry, finding it a tough job working along the coast against the Monsoon and an adverse current, which ran about 36 miles a day to the N.E., and had in addition heavy squalls at night, requiring constant close

attention. A ship working to windward along this coast, should not approach the land till near her destination, but keep about a degree off. By so doing, better weather is experienced, the current is weaker, and advantage can be taken of the shifts, to tack as the wind favours her. I reached Pondicherry on the 22nd at daybreak, and followed my usual custom of anchoring to windward, and well in, and found the advantage of doing so by getting off boats when no other ship could. Here we have Masoolah boats again,—and a heavy S.E. sea constantly rolling in on our port bow, rendering the ship very uneasy. Pondicherry is a pretty clean town, and well laid out; the streets all at right angles, wide, and kept in beautiful order, with an avenue of trees shading the side-walks, and even the centre in some of the wider ones; the houses are spacious and well built. There is a good light here; indeed, the lights along all this coast are good. Supplies, however, are neither so good nor so reasonable as at the British ports; and many articles required not to be got at all. A steamer from Calcutta touches here, and at all the other principal ports on the coast, and stores can be got down by her from Madras, every fortnight. There are two passably good hotels, which are generally well filled. This was the first time in my life I ever had business with Frenchmen; I found them very pleasant and agreeable. There are seldom less than 14 or 15 ships in the roads, and trade seems to be carried on with all parts of the world. They ship extensively indigo, blue cloths, rice, seeds, oil, ground nuts, hides, skins, horns, &c.; they also send coolies to Mauritius and the West Indies.

"I finished loading on the 8th July, having in two months, since leaving Madras, visited four ports, with awkward passages between them; discharged about 500 tons of ballast, and loaded about 2000 tons of cargo, weight and measurement, in the face of many difficulties. A heavy thunder squall came on the evening previous to my sailing, in which the ship dragged her anchor, which afterwards turned out to be foul, and we narrowly escaped falling athwart a country ship, just bringing up in her hawse with a second anchor; I was therefore obliged, next morning, to drop through the whole fleet, not having room to pass to windward, and the wind was very faint, with a high swell on our port bow, as usual; I, however, got away safely, and out in the offing, when it fell dead calm till noon. The S.W. Monsoon was moderate at the bottom of the bay, but with the usual amount of squalls and rain."

N.E.-ward from Conada point, distant about 18 miles, is **Chicacole** river; the coast between is high, and may be approached to 10 or 12 fathoms at about 2 or 3 miles off shore.

Calingapatam is, E.N.E.-ly, distant about 14 miles from Chicacole; the sandy point, at the southern entrance of the river, is in Lat. 18° 19′ N. It may be recognised in clear weather by Garah hill, having a pagoda on its declivity, near which is a single tree; a stone beacon, 64 feet high, has also been erected on the sandy point, —which is long and low, having a reef of rocks extending ½ a mile seaward. There is **anchorage** in 6½ to 7½ fathoms, with the extremity of the sandy point bearing S.W. by S., distant 2 to 3 miles, and the highest upper-roomed house near the shore bearing from W.N.W. to N.W. by W., distant 1½ to 2 miles.

Bapanapadoo, in Lat. 18° 34′ N., is a small port 23 miles N.E. of Calingapatam; the coast is low,—with a succession of sand drifts; the village, consisting principally of fishermen's huts and godowns, is marked by a column 50 feet high, standing near the beach, coloured black and white; the usual anchorage is S.E. of the column.

Poondy, in Lat. 18° 40′ N., is 7 miles N.E. of Bapanapadoo; it is marked by a white obelisk 50 feet high, to the eastward of which is a flagstaff 75 feet high; also to the northward of the obelisk stands the traveller's bungalow. The three objects close together form good marks for the usual anchorage, which is S.E. by E. of the obelisk; hereabouts several rocks project a considerable distance seaward.

Barwah, in Lat. 18° 52½′ N., is a small port 16 miles N.N.E. of Poondy; to the S. and W. of Barwah are large topes of cocoa-nut trees; to the northward is a plain of sand drifts. It is marked by two columns, coloured black and white, 50 feet high, and bearing N.W. from the usual anchorage.

Soonapoor.—This place, in Lat. 19° 5½ N., is marked by a white obelisk and a white column, each 50 feet high, built nearly at sea-level; at 120 feet from the column, and N.E. of it, stands the flagstaff, 75 feet high, and between the column and flagstaff is the Custom-house, all nearly at sea-level. The flagstaff bears W.N.W. from the anchorage.

Monsoorcottah, or **Gopaulpore,** in Lat. 19° 13′ N.; the anchorage, 1½ miles off the shore, is in 9½ fathoms, bottom of sand and mud, with the flagstaff on the beach bearing about N.W. by W., and Saddle hill S.W. by W. ½ W.; closer in (in 7 fathoms) the bottom is sand, and the holding-ground not so good, and, in fact, too near the shore. In December, 1857, the *Alnwick Castle* (1200 tons), anchored in 9¼ fathoms with the flagstaff bearing W.N.W. ½ W. During the S.W. Monsoon the anchorage is a little further out (in 9¾ fathoms), with the flagstaff about N.W. by W. In March the S.E.-ly winds are often very strong, and send in a heavy sea towards the shore; the S.W. Monsoon blows *along* the land. At the periods of change—in October or November, and again in May or June—there is always bad weather here.

Ganjam is in Lat. 19° 22′ N. It is much frequented, and carries on a considerable trade by means of coasting vessels, many of which can enter the river. The anchorage in the roadstead is abreast the fort or river's entrance, in 8 to 9 fathoms, 2 miles off shore. Between Calingapatam and Ganjam the coast may be approached to 3 miles in 12 to 14 fathoms.

When *coasting* between Vizagapatam and Ganjam, a depth of 20 to 30 fathoms may be preserved with advantage when the wind is fair; at 12 to 15 miles off shore the bank of soundings gives 40 to 45 fathoms, speedily deepening to no bottom. Though the coast is generally low, it is backed by a chain of high hills, which gradually approach the sea towards the north, near Lake Chilka.

Manikpatam, in Lat. 19° 45′ N., is distant about 42 miles N.E. by E. from Ganjam. The inlet leads to the north end of Chilka lake; a sandbank is said to project 2 miles off the coast, the water shoaling suddenly from 10 to 4 fathoms. In passing do not come under 12 fathoms.

The **Juggernaut Pagodas** are the most celebrated in India. At a distance, and when bearing W. by N., they appear as one building; seen to N.N.W. and N.W. they show as three distinct buildings; the ground is low and well clothed with trees. Lat. 19° 48½′ N., Long. 85° 48′ E.

The **Black Pagoda,** in Lat. 19° 52′ N., Long. 86° 6′ E., stands by itself near the sea; it is on low ground destitute of trees, though there are three clumps to the N.E. and one to the S.W. Coasting along, do not come under 16 to 18 fathoms, about 4 or 5 miles off shore, though the steep sandy beach between the Juggernaut Pagodas and the Black Pagoda *may be* approached to 12 fathoms; but the land being low,

the lead must be used even with the greater depths, as the first indication of danger during the night will be the noise of the surf on the beach. All these pagodas, when viewed from a distance, appear as a ship under sail,—in some directions as a large black rock.

False point bears N.E. ½ E., distant 48 miles from the Black pagoda; it is low and wooded, with many outlying dangers near it, and several small sandy islets,—one of which, following the line of coast in a curved form, extends 8 miles.

Light.—About 2 miles S.W. of False point, in Lat. 20° 20′ N., Long. 86° 45′ E., a lighthouse 120 feet high has been erected, having a large white star in the centre; it exhibits a *fixed white* light visible 18 miles; to verify their position, vessels should never come under 8 fathoms when making the light or lighthouse, after which they should haul out into 13 to 18 fathoms.

In **False bay,** to the north of False point, the bottom is of soft green mud, shoaling very gradually to the shore.

Palmyra point, in Lat. 20° 44′ N., is fronted by shoals (Palmyra shoals) to the distance of 12 miles; the lighthouse has been long washed away, being undermined by the sea; on the shoals the depth varies from 1 to 4 fathoms, suddenly deepening to 10 fathoms. Bound to Balasore roads from False point, do not come under 12 to 14 fathoms; when Palmyra shoals are rounded, if the wind be strong from S. or S.W. there is anchorage to the north of them in 10 fathoms, with good shelter.

Kunka River.—To the N.W.-ward of Palmyra point is Kunka river, which is wide at its entrance, and navigable for vessels drawing 12 or 13 feet water; but it is necessary to employ a pilot. It is much frequented by the coasting-vessels belonging to the natives, who carry rice and various articles of trade from hence to Madras and other parts of the coast, during the favourable Monsoon. Latterly, vessels belonging to European residents at Calcutta have been employed in conveying stores from Fort William to the Kunka, returning with salt, corn, and rice. Some native vessels from the Maldeeves trade to the Kunka.

N.N.W. of the Kunka, distant 24 miles, is **Churinga** river, or Churrimoon Creek, situated in a bay affording good anchorage to small vessels in the S.W. Monsoon.

Balasore, in Lat. about 21° 30′ N., was formerly a considerable town, but at present is only a mile long, and half a mile broad in the widest part. It is built along the river Boorabullung, the entrance to which is in Lat. 21° 28′. Boats from the Maldivh islands arrive in fleets of twenty or thirty, in the months of June and July, bringing with them the produce of their islands, consisting of corn, cocoa-nuts, cowries, salt-fish, tortoise-shell, &c., and return in December, laden with broad-cloths, coarse cottons, cutlery, hardware, looking-glasses, rice, silk goods, sugar, tobacco, and other commodities,—the produce of Europe, India, and China.

Pipley is about 18 miles E.N.E. from the entrance of Balasore river. It is situated on the banks of a river, and is known by a pagoda to the west, and a thicket of trees very near it. Pipley was once the mart of this country; but the waters washing away a great part of the town, at the same time that a dangerous bar was formed at the mouth of the river, the merchants removed to Balasore.

THE SUNDERBUNDS.—The province of Bengal is intersected by the Ganges, which in its lower course joins the Brahmapootra. About 500 miles from the sea, the Ganges is deep and rapid, but in its progress seaward it widens, becomes more sluggish, and separates into a vast number of streams—all which causes combined, deprive it of the force necessary to sweep away the banks of sand and mud thrown across its mouth by strong southerly winds. The delta of the Ganges commences about 300 miles from the sea, reckoning the windings of the river, and the Hoogly, on which is the port of Calcutta, is formed by the union of two of its westerly branches. That part of the delta bordering on the sea is composed of a labyrinth of rivers, creeks, and inlets, all of which are salt except those that immediately communicate with the principal arm of the Ganges. This tract, which presents a sea front of 250 miles in a direct line nearly East and West, is known as the **Sunderbunds**; it consists of a multitude of low islands covered with jungle, and from which project the low and dangerous banks which make the navigation hereabouts so precarious.

It would be a work of supererogation to minutely describe either the banks or channels of the Ganges, or any of its branches; they are subject to such great and rapid changes that a good chart and accurate local knowledge are at all times necessary for their navigation. A pilot is required for the Calcutta river.

ENTRANCE TO THE HOOGLY OR CALCUTTA RIVER.

Lights.—Five lights mark the entrance to the Hoogly :—

1. The Pilot Ridge Lightvessel, a brig, is moored in 21½ fathoms during the S.W. Monsoon, from March 15th to September 15th: it exhibits a *fixed white* light from the fore yardarm; a blue light is burnt every hour, and a maroon at the intermediate half hours; a gun is fired when a vessel is visible. Position.—Lat. 20° 49′ 30″ N., Long. 87° 40′ E.

2. The Lower Lightvessel, at the entrance to the eastern channel of the Hoogly, is moored in 7½ fathoms, and exhibits a *fixed white* light; a blue light is burnt every half hour, and a maroon every quarter of an hour, commencing at 7h. P.M. during the S.W. Monsoon, from March 15th to September 15th; during the N.E. Monsoon, from October to March, a maroon or torch is burnt every half hour, and a blue light every hour. Position.—Lat. 21° 3′ 30″ N., Long. 88° 12′ E.;—but during the S.W. Monsoon, the vessel is moored in Lat. 21° N.

3. The Upper Lightvessel in Gaspar channel, N. by W. 25 miles from the Lower Lightvessel, and S. 16° E. 12 miles from Saugor light, is moored in 3½ fathoms; it exhibits a *fixed white* light, and blue lights and maroons are burnt at intervals throughout the night. Position.—About Lat. 21° 26′ 15″ N., Long. 88° 5′ 20″ E., but it is slightly altered as the channel shifts.

4. Saugor island lighthouse is on Middleton point, the S.W. extremity of Saugor island, 200 yards from low-water mark; it exhibits a *fixed white* light, *flashing* every 20 seconds, at an elevation of 88 feet above the sea, and is visible 15 miles. Position.—Lat. 21° 38′ 43″ N., Long. 88° 2′ 10″ E.

5. Cowcolly, or Kaokali lighthouse is 2 miles S.W. of Kedgeree point; it exhibits a *fixed white* light at an elevation of 62 feet above the sea, visible 15 miles: it is now used as an anchoring light. Position.—Lat. 21° 50′ 12″ N., Long. 87° 57′ 47″ E.

For a description of the lightvessel at the entrance to the Mutlah river, see p. 470.

Tides.—The tides in the channels have a rotatory movement with the sun: first-

quarter flood W.N.W., round by North to the last quarter E.N.E.; first-quarter ebb E.S.E. round by South to the last quarter W.S.W. The strength of the tide runs in the direction of the channels N.N.W. and S.S.E., about 3 knots at springs, and 1½ at neaps.

The Pilot's Ridge is the bank of soundings—shelly sand and gravel—varying from 15 to 20 fathoms, lying to the S.W.-ward of the Pilot's Ridge lightvessel.

The Western Channel lies between the Western and the Eastern Sea Reefs; southward of the entrance is the principal pilot's station.

The Eastern Channel is between the Eastern Sea Reef and Saugor Sand; at the entrance is the Eastern Channel lightvessel.

Caution.—Hoisting of Signals by Vessels passing Signal Stations:—

1. The master of every inward or outward bound vessel, on arriving within signal distance of any signal station established within the limits of the river Hoogly, or within the limits of any channel which may be made subject to the provisions of Act XXII. of 1855, shall, on the requisition of the pilot who may be in charge of the vessel, signify the name of the vessel by hoisting the number by which she is known, or by adopting such other means to this end as may be practicable and usual, and shall keep the signal flying until it be answered from the signal station.

2. Any master of a vessel arriving as aforesaid, who shall refuse or neglect to conform to the above rule, shall be liable on conviction, for each instance of refusal or neglect, to a fine not exceeding 1000 rupees.

3. Every pilot in charge of a vessel shall require the number of the vessel of which he is in charge to be duly signalled as provided under section I. of this Act. When, on a requisition from the pilot to that effect, the master of a vessel, not employed in the service of Government, shall refuse to hoist the number of a vessel, or to adopt such other means of making her name known as may be practicable and usual, the pilot in charge of such vessel may, on arrival at the first place of safe anchorage, anchor the vessel in question, and refuse to proceed on his course until the requisition shall have been complied with.

4. Any pilot in charge of a vessel, who may be proved guilty of neglect to obey or of connivance with the master of such vessel in disobeying the provisions of this Act, shall be liable to a penalty not exceeding 500 rupees for each instance of neglect or connivance, and in addition shall be liable to dismissal from his appointment.

5. This Act shall be taken and read as part of Act XXII. of 1855, and the penalties provided by this Act shall be recoverable under section 55 of that Act.

The Pilot's Station is a little to the southward of the *south buoy*, which lies in 12 fathoms at the entrance to the Western channel into the Hoogly, and bears from False point lighthouse N.E. by E. ¼ E., distant 83 miles. Vessels approaching the station during the day must show the usual signal for a pilot, and by night fire guns, burn blue lights, and exhibit two lights in a vertical position where best seen; but avoid as much as possible running for the station at night, or in threatening bad weather; under such circumstances put the vessel under snug canvas while well out in deep water, and keep the sea. To mark the station one of the pilot vessels will show during the day a large flag (*white with red cross*) at the maintop-gallant masthead, and a good masthead light at night, and will burn a blue light and torch alternately every half hour, and fire a gun at 8 P.M., at midnight, and at 4 A.M.

In the N.E. Monsoon the pilot vessels are found at the entrance of the Eastern channel, and they generally anchor on the Eastern Sea reef at night, or during the flood in the day.

Directions.—With the lighthouse on False point, bearing W.S.W. 12 or 15 miles, steer E.N.E. so as to increase the soundings from 13 to 23 fathoms, when some of the pilot vessels are sure to be met with. If a vessel gets accidentally on the tail of any of the Sea reefs, she ought to tack and haul off immediately into deep water, or anchor until the ebb tide enables her to work to the southward; the sea runs high upon the reefs in the S.W. Monsoon.

Mr. D. Robertson, the Master Attendant at Calcutta, gives the following directions:—A vessel after making the lighthouse on False point (in passing which she ought not to go into less than 12 fathoms), should bring it to bear about W.S.W., 10 or 15 miles distant, when she will be in 11 or 12 fathoms; and then steer E.N.E., when the soundings will gradually increase to 23 fathoms on the eastern edge of the Pilot's ridge. She should then regulate her course so as to keep between the ridge and the depth of 27 fathoms; when, by attention to the lead and to the nature of the soundings, as well as to the course and distance run, it will be almost impossible to avoid making the pilot-vessels, as their cruising ground is immediately to the N.E. of the light-vessel, which, during the S.W. Monsoon, is stationed close to the buoy on the ridge. The soundings to seaward of the ridge are, in general, a greenish or olive-coloured mud, with (occasionally) a few bits of broken shells among it; while those on the ridge are of a shelly sand, or minute gravel, of a reddish or rusty-brown colour. Vessels approaching the station are warned to be careful in avoiding collision, when either communicating with the light-vessel or the supplying pilot-vessel; and on making the former at night they are recommended to heave-to, at a proper distance, till daylight, by which they will avoid the probability of passing the supplying pilot-vessel in the darkness of the night.

Directions for Approaching the Mouth of the River Hoogly.

Bound to Calcutta *in the strength of the S.W. Monsoon* the land should be made about Poondy, Lat. $18\frac{3}{4}°$, or between it and Ganjam, where it is high, for in the latter part of March, or early in April, the weather is generally hazy, from which cause the land cannot be discerned, unless it is very near; a vessel certainly ought not to get to the northward of the Juggernaut pagodas before getting in with the coast.

When to the northward of 18° N. and the vessel's position is not correctly known, haul in and sight the coast. In the night or in thick weather the lead will be a good guide if attended to with care; for although the bank of soundings extends but a few leagues from the coast, there is generally from 30 to 35 fathoms about 6 or 9 miles off, between Poondy and the Black pagoda; about Ganjam the water shoals fast under 20 fathoms towards the shore. When the position is known, steer along the coast, (keeping in 18 or 20 fathoms in the night, or with unsettled weather) until abreast of Manikapatam; then if it be daylight and the wind favourable, haul into 14 or 15 fathoms to sight Juggernaut and the Black pagodas in passing;—they will be seen in hazy weather when in 17 or 18 fathoms, but with a commanding breeze the coast may be approached with safety to 12 or 13 fathoms, about 3 or 4 miles from the shore. At night do not come under 15 fathoms, nor deepen above 17 or 18 fathoms, for the coast is low and sandy close to the sea, and it will not be seen unless close to

it, and in hazy weather the noise of the surf on the beach would probably be the first indication.

When about 10 miles past the Black pagoda, steer so as to obtain proper soundings off False point. The depths decrease gradually towards the bank surrounding False point, but keep in 14 or 15 fathoms at night when passing it, or in 16 fathoms if the wind is S.E. As the flood inclines towards the shore, and the ebb from it, 14 and 15 fathoms are good depths to preserve with a fair wind when steering from False point. (For the description of the light on False point, *see* p. 464.)

When False point bears W.N.W. and the vessel in 14 or 15 fathoms, steer N.E. 30 miles to pass outside Palmiras reef, keeping in 14 or 15 fathoms with a commanding breeze, or in 16 fathoms if the wind is S.E. If blowing strong from the S.W. in rounding Palmiras reef in daylight, a vessel may steer along the edge of it in 12 or 14 fathoms, taking care not to approach the north-east part under 12 or 13 fathoms, where it is dangerous and steep-to under 10 or 11 fathoms. When past the reef she may haul to the N.W. and anchor to the northward of the Mypurra sand, where she will be sheltered from the sea by the reef. False point has sometimes been mistaken for Palmiras point, and the latter sometimes for the former, whereby several vessels in the first case have been wrecked by hauling into False bay instead of Balasore bay, and others have got to the eastward of the Sea reefs by keeping too far off shore. A lighthouse being now on False point, this can rarely be the case.

If the coast or the pagodas have not been seen, and in steering along in 14 or 15 fathoms, the bottom is sand, shells, and black specks, which are thought to be those off False point, but uncertain whether they may not be those off Palmiras point, then bear in mind that the water will not deepen in steering N.E. from the depth of 15 fathoms off False point, but in steering that course from the depth of 15 fathoms on the edge of the bank off Palmiras reef it will deepen gradually to 17 and 18 fathoms; a vessel ought then to steer N.N.W. or N.W. until the soundings are 16 or 17 fathoms, in which depths the pilot vessels generally anchor at night in Balasore roads during the S.W. Monsoon.

The above directions are given while the Monsoon prevails steady from the S.W. and westward; but towards the close of the Monsoon, or in September, this route is likely to cause inconvenience and delay, for the wind then often hangs to the eastward, and the current sets strong to the S.W. through False bay. During that month, if the latitude can be observed, or the lighthouse or light on False point can be recognised, there can be little occasion for making the land so far to the southward.

During the N.E. Monsoon a vessel will generally have to beat up the bay. After passing about 100 or 150 miles to the westward of the north-west coast of Sumatra, the west side of the Nicobar islands may be approached. If the wind inclines to keep to the westward, give the islands a good berth; if at E.N.E. or N.E. steer up the bay, close hauled, to the westward of the islands. On the parallel of 16° or 17° N. the wind often veers to the northward, and favourable tacks may then be made to the eastward, at times, to keep from the western coast of the bay. Neither should the eastern coast be approached, but vessels should work to the northward in the open sea, where there is smooth water and moderate breezes, which will enable them speedily to reach the Sea reefs, at the entrance of the Hoogly.

It has frequently happened in the strength of the N.E. Monsoon, that vessels, by passing close along the western coasts of the Nicobar islands, have reached the Sea reefs without making a tack. If the equator is crossed late in February or in March, keep well to the westward in passing up the bay, for the current at that time runs to the northward along the Coromandel coast, and the winds will be found between S.W. and S.E.; in the middle of the bay they are light and variable from N.W. to N.E. during these months, with a drain of current at times setting to the southward.

The **MUTLAH RIVER.**—Within the last few years a new port (PORT CANNING) has sprung up in the Mutlah branch of the Ganges. It is thus spoken of by CAPT. W. S. FITZSIMONS, of the *Fulwood* :—

"I will now point out to you the advantages which I experienced there last year (1858), and what they are as compared with those of the Hoogly. When I arrived at the Sand Heads I found a pilot brig doing duty as a lightvessel; on speaking her, it appeared they had no pilots on board for the river. Seeing that was the case, I immediately made sail, and proceeded upwards by the Bulcherry channel; while proceeding through the Channel, made the buoys out distinctly, and after passing through between the Western Spit buoy of the Roymutlah Sand and the Bulcherry Sand, we anchored for the night a little to the northward of No. 3 Bulcherry buoy. At daylight the following morning weighed anchor and proceeded northward for the entrance of the river. When abreast of Halliday island we got a pilot on board, and continued on all day with a light wind, and in the evening passed the Cattalee, and anchored for the night off Ward's point. Now, one thing I would point out to you in our progress upwards was the absence of any obstruction in the shape of bars or shoal places in any portion of the Channel, and the facility with which we entered the river. Take the entrance of the Hoogly and compare them, where you most probably would not have got over the Gaspar sand until you very likely would have had to anchor (for the flood-tide coming in to allow you to pass over), obstruction first, in one of the most exposed anchorages known to seamen; then, again, you have Lloyd's Channel, another stopping-place, if you had not a strong favourable wind, or a powerful steamer to assist. Next in turn comes the Rangafulla, most probably another stoppage. In all of these places a ship is lying much exposed, and very likely sheering about in a strong tideway. All these places are a much less distance from sea than we got during our first day's progress with very light winds. See the delay which has already taken place in a ship's progress thus far up the Hoogly, where a ship will have had the assistance of an experienced pilot all the time. Then, again, see the advantages which ships have in hard weather during the S.W. Monsoon on arriving at the Sand Heads. Where, when bound to the Hoogly, a ship comes on the pilot station, and no pilots out (which is a frequent occurrence), she is signalled to from a pilot vessel that they cannot put a pilot on board, or that there are none on the station, and the vessel is recommended to stand to sea again, probably continuing that way for several days, or until the weather moderates sufficiently to enable them to place a pilot on board; and it frequently occurs that ships have to proceed to sea even with a pilot on board. Compare all these with the channels leading to the Mutlah, and you will see that it will not often occur, in which a perfect stranger to the place may, with common

prudence, proceed upwards, and be able in a few hours to have his ship in safety.

"Then, again, without particularizing the upper parts of either, you take the chart of the Mutlah, you will nowhere find less than 4½ fathoms water in the proper channel, even at dead low water spring tides, as high up as Ellengunge. Although I acknowledge it to be necessary, when proceeding up or down from Cattalee in a large ship deeply laden, to have the assistance of a steam tug, yet as she will be able to proceed with all safety from morning to evening without stopping, a vast expense of time and money is saved. Then, again, the tides run with little more than half the velocity which they do in the Hoogly; you will be able to acknowledge it to be a much safer navigation; you will be able to recollect that I had a steamer round from Calcutta to tow the *Fulwood* to sea, and I believe her to have been one of the poorest boats belonging to Calcutta, yet she took the ship to sea in much less than two days, although the wind was blowing strong from the southward nearly all the time. I can with all confidence assure you that there are few such navigable rivers as the Mutlah without having some great drawback to their safe navigation."

Light.—A temporary lightvessel has been moored in 9 fathoms; it exhibits a *fixed white* light, visible 7 miles. A red flag is shown at the mainmast-head by day; and if in her position, a rocket is fired from March 16th to October 16th, at 8 P.M., at midnight, and at 4 A.M.

The following **Sailing Instructions** FOR ENTERING THE **River Mutlah from Sea,** are by MR. T. HILL, Assistant Master-Attendant, 1856:—

"The channels leading from sea into the river Mutlah having been buoyed off, the following notice is published for general information:

"The Western (or Ward's) channel is bounded on the west by the Bulcherry reef, or sand, extending southerly from the island of that name, and on the east by the Roymutlah sand, part of which dries at low water. This channel is from 2 to 5 miles wide, and is marked off by six buoys, four *red* or western, and two *black* or eastern.

"The outermost or Reef buoy is a first-class spire buoy, with two baskets on it; it is painted *red* and marked with the letter M; it lies in 4½ fathoms low water spring tides; Lat. 21° 11′ N., Long. 88° 42′ 45″ E., and bears from the eastern channel floating light buoy, E. by N. ½ N., distant 32 miles.

"The centre Bulcherry buoy is a second-class spire buoy, with one basket on it; it is painted *red*, and marked Mutlah in full; it lies in 4 fathoms low water, about 7 miles N.N.W. from the outer or Reef buoy.

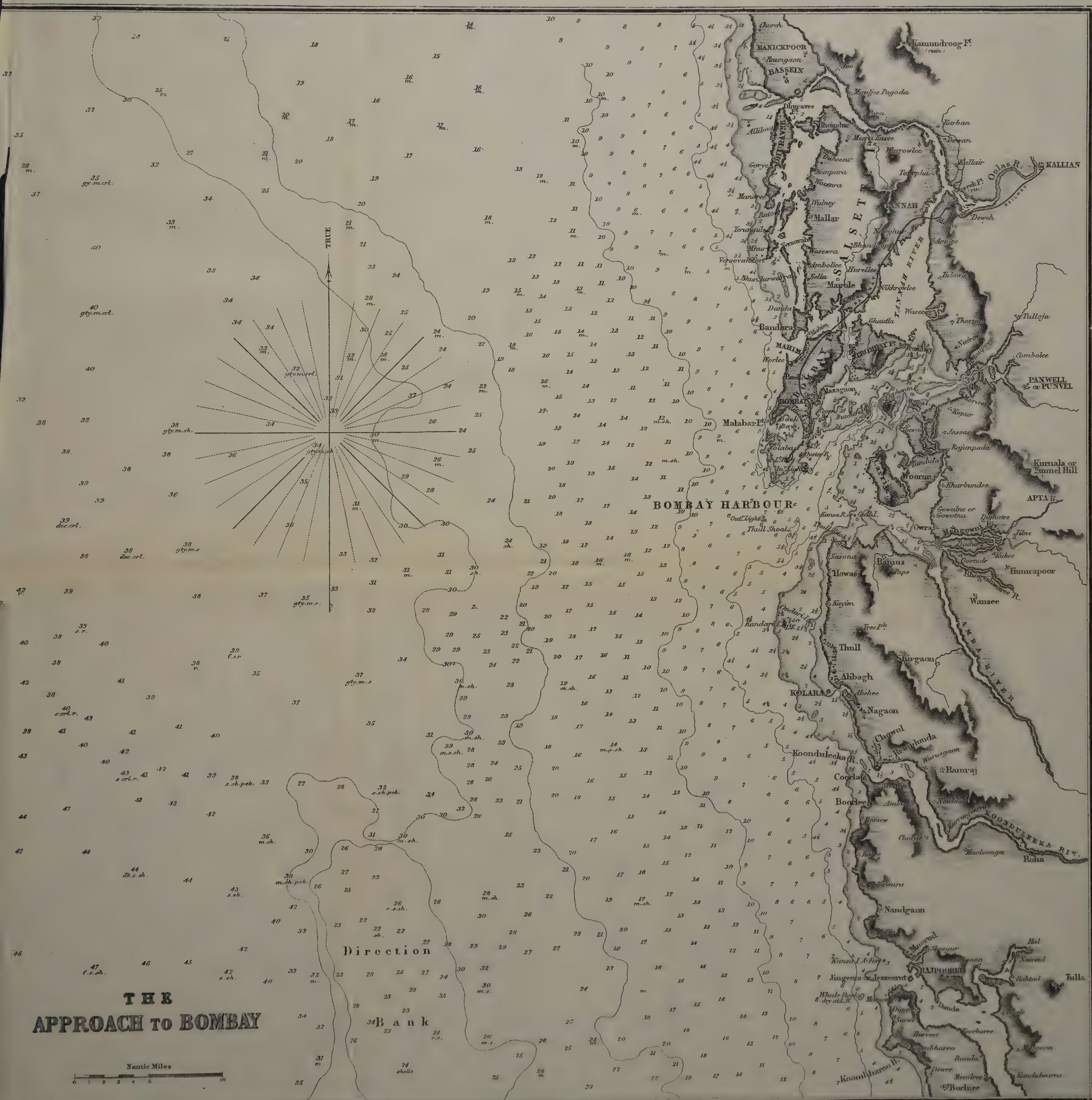
"The Bulcherry spit buoy is also a spire buoy, painted *red;* it lies in 4 fathoms low water on a spit of the sand, about 9 miles N. ½ W. from the centre buoy.

"The upper Bulcherry buoy is also a spire buoy, painted *red;* it lies in ¼ less 4 fathoms, about 6 miles N. by W. from the Spit buoy, and W. by S. ¾ S. from the flag-staff on Dalhousie point.

"The outer Easternmost buoy of this channel is a second-class spire buoy, painted *black*, with one basket on it; it lies in 4¼ fathoms low water, on the S.W. verge of the Roymutlah sand, N.E. by N. from the Reef buoy distant about 5½ miles.

"The Roymutlah Western spit buoy is a second class spire buoy, painted *black;* it lies in 4 fathoms low water N.W. ½ N. from the outer black buoy, distant about 10 miles, and North about 6 miles from the centre Bulcherry buoy.

"The mid-channel course from sea to abreast of the above Spit buoy is


THE
APPROACH to BOMBAY
Nautic Miles
TRUE
Direction
Bank
BOMBAY HARBOUR
BASSEIN
MANICKPOOR
SALSETTE
TANNAH
KALLIAN
BOMBAY
MAHIM
Malabar Pt.
Colaba
Mazagaon
Bandora
Worlee
Elephanta
Tannah River
Oolas R.
Panwell or Punvel
Apta
Kurnala or Funnel Hill
Thull
Alibagh
KOLABA
Nagaon
Chowul
Revadunda
Koondulee R.
Coorla
Boorlee
Roha
Koondulika Riv.
Nandgaon
Rajpoori
Jingeera or Jezeerut
Tulla
Koondhairoo Il.
Barlaee
Amba River
Ramraj
Wansee
Shirgaon
Oondaree
Kandaree
Sassona
Howas
Kayim
Karunja
Oorun
Thull Shoal
Kanunndroog Ft.
Dharavee
Bhewndy

N.N.W. ½ W. 15 miles. From that point, North 15 miles will carry a vessel up to Halliday island.

"The Eastern or Roymutlah channel, is bounded by the Roymutlah sand to the westward, and the Bangadoon or Dalhousie sand or reef to the eastward, and is marked off with four buoys, three *red* or western, one *black* or eastern.

"The outermost buoy is a second-class spire buoy, with one basket upon it; it is painted *red*, marked $\overset{R}{\underset{MUTLAH}{}}$; it lies in 5 fathoms low water, on the S.E. verge of the Roymutlah sand, N.E. by E., about 10 miles from the Bulcherry Reef buoy.

"The Roymutlah Eastern spit buoy is painted *red;* it lies in 5 fathoms low water, N.N.W. ½ W., about 6 miles from the outer buoy.

"The upper Roymutlah buoy is painted *red;* it lies in 4¾ fathoms low water N.W. of the Spit buoy, distant about 5½ miles.

"The innermost buoy of this channel is painted *black;* it lies in 5 fathoms low water on the south verge of a flat extending from Dalhousie point to the S.S.E.; it bears from the upper Roymutlah buoy N. by W., distant about 4 miles.

"The mid-channel course in the Roymutlah channel is N.W. ½ N. to the black buoy, and from that point N.N.W. to N. by W. to Halliday island.

"Vessels resorting to the River Mutlah during the S.W. Monsoon should adopt a similar route, and conform to the directions for making the pilot station at the entrance to the River Hoogly, taking their departure from the Eastern Channel floating light, steering E. by N. ½ N. to cross the tail of the eastern prong of Saugor sand in 5 fathoms, off which they would deepen into 7 fathoms, shoaling again on the light house sand to 5½ or 6 fathoms, deepening off into 6½ or 7, and crossing the Bulcherry reef in 4½ to 5 fathoms a little south of the Reef buoy.

"Commanders of vessels doubtful about crossing the tails of sands in a heavy swell, could steer more to the southward, and keep in 8 or 9 fathoms soft ground; but great care would be requisite not to overrun the distance.

"During the N.E. Monsoon, commanders of vessels confident of the correctness of their reckoning, should work up direct for the Bulcherry Reef buoy; but during cloudy or thick weather, crossing the swatch of no ground in about the latitude of the buoy, and running down upon it would be advisable.

"It is high water full and change about 9 hours 15 minutes; at the Bulcherry Reef buoy the tides set round, as in the channels to the Hoogly; the floods making to the west, the ebbs to the eastward, having a velocity during the springs from 2½ to 3 miles per hour, and a rise of 9 feet.

"The bottom throughout the channels is mud; the sands exceedingly hard, and the lead an excellent and safe guide towards them. The least water in the Western or Ward's channel is 4 fathoms; in the Roymutlah 5 fathoms, low water springs.

"From Halliday island the course continues North, up to the "Cattalee," where the river takes a sharp turn to the westward, and the channel contracts. Up to this point a stranger, with Ward's chart and ordinary care, could, without a pilot, conduct his ship with safety, attending to the set of the tides, leaving the red buoys to the westward, and black buoys east of his course."

Houses of Refuge.—Houses of Refuge for shipwrecked mariners, cast ashore on the sea face of the Sunderbunds, have been put up as follows:—

No. 1.—*Painted Red.* Just to the northward of Jackson's grove on Seyers' point, forming the eastern entrance to Channel creek. It is on an extensive plain,

covered with short grass, inside or to the eastward of some high sand-hills that here line the shore.

No. 2.—*Painted White.* At the eastern entrance to the Subtermookey channel, 400 yards to the northward of the point that forms from Bulcherry island, and 200 yards from high-water mark. It is in the midst of thick low jungle.

No. 3.—*Painted Black.* At the eastern entrance to the Jumera channel, 400 yards to the north of the point that forms from the entrance of the Subtermookey channel, and 200 yards from high-water mark.

No. 4.—*Painted White.* On the south-east part of Dalhousie island, at the eastern entrance of the Mutlah river, on a sandy patch, about five feet above high-water mark, and about 100 feet in shore, distinguishable by a White Flag from a long spar and bamboo, which have been put up close alongside of the house, visible above the surrounding trees.

No. 5.—*Painted White.* On Bangadoonee island, about seven miles eastward of No. 4. It stands on the south-eastern part of the island, above a small sandy beach about 100 feet from high-water mark. A long spar and bamboo, with a flag, have been put up alongside, and may be seen considerably above the trees.

In each house there is a supply of water and biscuit, a catamaran and paddles, a letter of instructions, and a chart of the Sunderbunds.

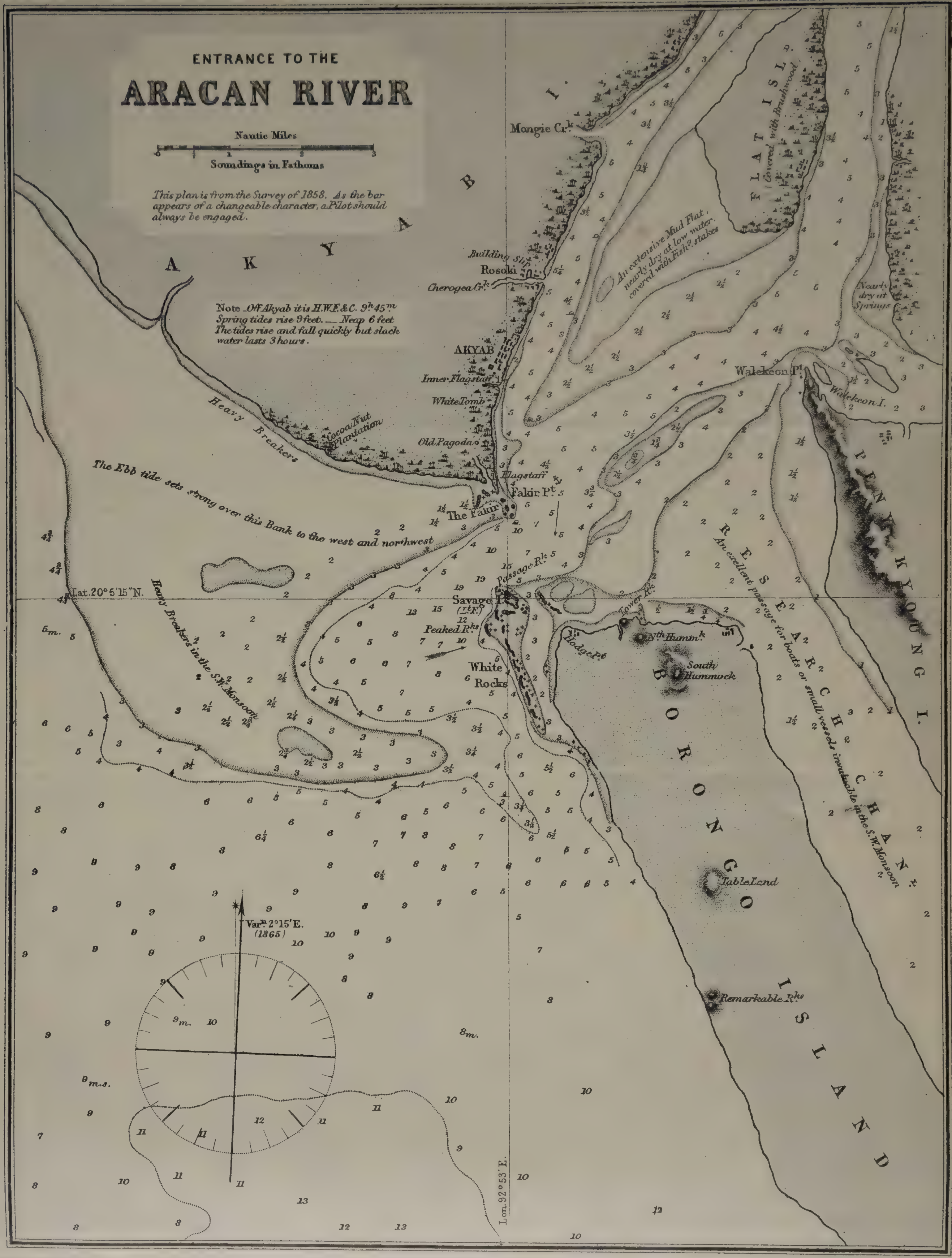
Persons cast away, reaching land to the east of Saugor, should make search for the Houses of Refuge; and it should be borne in mind, that when a vessel is lost with a pilot on board, the fact would soon become known at the Pilot Station, and in Calcutta. Parties, therefore, finding their way to the houses, should remain there, and husband the means of subsistence, in the assurance that succour will speedily reach them; or if compelled to leave, endeavour to travel westward to Saugor island, and travel along the beach until they arrive at the lighthouse; or make their way to a large fishing village, situated on the south-east side of Saugor island, using the catamaran as far as practicable.

EAST COAST OF THE BAY OF BENGAL.

CHITTAGONG RIVER.—The entrance to this river is in Lat. 22° 14′ 24″ N., and Long. 91° 50′ E. It is less than a mile in width, and (according to the survey of 1840) has soundings over the deepest part of the bar of 6 to 10 feet at low water spring tides, this deepest part being close under the north point of the river. Inside the bar the depth increases to 3¼, 4, and in some places 5 and 6 fathoms. The town is 8 miles from the sea, following the course of the river, and is situate on its north shore. We believe that two white buoys mark the north side of the bar, and two black ones the south side.

Owing to frequent changes in the banks of the Chittagong river, instructions for entering are useless; the assistance of a pilot is therefore indispensable.

Between the Chittagong river and the north end of Kootubdeah island, a distance of 17 miles, the bottom is represented to be stiff and good for holding. When waiting for a pilot to take the vessel into the river, it used to be customary to anchor abreast of the Fakir's tree in about 4½ fathoms, at 2 miles from the shore, and then to fire a gun, which could be heard in the river, when a pilot would come


ENTRANCE TO THE
ARACAN RIVER
Nautic Miles
Soundings in Fathoms
This plan is from the Survey of 1858. As the bar appears of a changeable character, a Pilot should always be engaged.
Note _Off Akyab it is H.W.F.&C. 9h 45m Spring tides rise 9 feet. _ Neap 6 feet The tides rise and fall quickly but slack water lasts 3 hours.
AKYAB I.
Mongie Cr.k
Building Slip
Rosoli
Cherogea Cr.k
AKYAB
Inner Flagstaff
White Tomb
Old Pagoda
Cocoa Nut Plantation
Heavy Breakers
The Ebb tide sets strong over this Bank to the west and northwest
Flagstaff
Fakir Pt.
The Fakir
Passage Rk.
Savage I.
Peaked Rks.
White Rocks
Lat. 20° 5' 15" N.
Heavy Breakers in the S.W. Monsoon
Tower Rk.
Hodge Pt.
Nth. Hummk.
South Hummock
BORONGO ISLAND
Table Land
Remarkable Rks.
An extensive Mud Flat, nearly dry at low water, covered with Fishg. stakes
FLAT IS. Covered with Brushwood
Nearly dry at Springs
Walekeon Pt.
Walekeon I.
PENYKYOUNG I.
RESEARCH CHANNEL
An excellent passage for boats or small vessels unsuitable in the S.W. Monsoon
Varn. 2°15'E. (1865)
Lon. 92° 53' E.

out; this custom may still be followed, although the recommendation to anchor does not appear to be good, as there is a very heavy, short, breaking sea, dangerous to small vessels when the wind blows with any strength. The Fakir's tree, thick and bushy, is situate at about 3 miles southward of the entrance to the Chittagong, and is easily recognised, being close to the shore.

Kootubdeah Island.—At about 18 miles southward from the Chittagong river is the north end of Kootubdeah, a low wooded island, which extends southward 13 miles in a direction parallel to the coast from which it is separated by a narrow but difficult channel of 8 fathoms to 9 feet.

Light.—A lighthouse near the north end of the island shows a *fixed* light, visible from a distance of about 15 miles.

Following the coast southward from Kootubdeah island, we pass Matrabari and Muscal islands, which are also separated from the shore by a narrow channel sufficiently deep to be navigated by native vessels.

The west and south coasts of Kootubdeah island are dangerous to approach, as foul ground extends from them a considerable distance. These reefs are rendered the more dangerous by the circumstance that there is a depth of so much as 10 and 8 fathoms close to their outer edges, decreasing seaward to 5 and 6 fathoms at about 7 leagues westward from them. From the south end of Kootubdeah island, the south extremity of the Kootubdeah reef (10 feet) bears S. by W. $\frac{1}{2}$ W. 12 miles. The reef surrounding Muscal islands extends from the south end of the southernmost and largest island about 7 miles.

In lat. 21° 20′ there are some white sandy cliffs, which are valuable as a landmark in fine weather when the sun shines brightly upon them, as although they have not much elevation, they can then be seen from a distance of 15 to 18 miles.

AKYAB.—The principal mouth of the Aracan river, that which forms the port of Akyab, is in Lat. 20° 5′ N., and Long. 92° 52′ E. It is here $2\frac{1}{4}$ miles wide, reckoning from Fakir point, on the north shore, to Hodge point, the north end of Borongo island, on the south shore; but the navigable channel has a breadth of less than a mile, being narrowed by reefs from each shore. On the edge of the southern reef, and in nearly the middle of the river, there is a small islet, named Savage island, upon which is a lighthouse.

The bar of Aracan river, according to the survey of 1858, has soundings upon it of 12 feet to 6 fathoms at low tide. Having crossed this, the depth increases to 10 and 20 fathoms, the last being in the middle of the stream, immediately opposite Savage island; thence it rapidly decreases to 3 and $4\frac{1}{3}$ fathoms off the town of Akyab, which is situate on the western bank at about 2 miles from the sea.

Aracan river, like other barred rivers on this coast, brings down large quantities of soil in the rainy season, and the banks at the entrance are subject to frequent changes; hence *strangers must obtain a pilot's assistance* when bound in.

Light.—The lighthouse on Savage island, on the south side of the entrance to the river, shows a *fixed* light at 106 feet above the sea, visible 12 to 14 miles. A lighthouse was also building in 1859 on the table land of Borongo island, at about 5 miles south-eastward from Savage island; this, we believe, is now lighted.

When approaching the port of Akyab from north-westward there are some dangerous reefs, situate at various distances from the coast, which require great care to

avoid. These are named St. Martin's, Asseergurh, Oyster Island, and Oyster Reef;—the two last-mentioned reefs lie about 9 miles from the shore, and in the immediate vicinity of the port.

St. Martin's Reef.—This reef is in Lat. 20° 37¾′ N., and Long. 92° 14′ E. It has not been thoroughly examined, but is believed to be of considerable extent in a N. by W. and S. by E. direction. The depth close to its western edge is about 10 fathoms, and close to its eastern edge about 8 fathoms, which thence gradually decreases to the reef surrounding the shore of St. Martin's island, about 5 miles distant. Its position is usually indicated by breakers. When in the vicinity of this reef the ship should be put about immediately the soundings become less than 20 fathoms.

Asseergurh Reef.—Upon this reef there is a depth of only 8 feet at low tide; it is consequently sufficiently shallow to endanger even a small vessel. It is situate 6 miles from the shore, in Lat. 20° 28′ N., and Long. 92° 30′ E., at about 9 miles south-eastward from the south end of St. Martin's island. Close to its western edge are soundings of 7 and 8 fathoms, and there are soundings of 7 fathoms immediately off its eastern side, which thence gradually decrease to the bank bordering the shore. Breakers generally indicate the position of this reef.

A bank of 3½ to 6 fathoms exists between the Asseergurh reef and St. Martin's island, upon the northern end of which there is a rock,—we believe, awash.

Oyster Island and Reef.—Oyster Island is a small islet situate in Lat. 20° 12′ N. and Long. 92° 32½′ E., and distant about 10 miles from the mainland. It is, or was, covered with brushwood, and is said to be visible from a distance of 5 or 6 miles. Vessels can pass between this island and the coast, as there is a deep channel of 5 to 6 fathoms, but a shallow flat extends off from the land at least 4 miles; hence the passage inside the island is not recommended, and vessels bound to Akyab *always* keep outside, passing the island on its west side. The shallow flat fronts the entrance of the river Myou, and forms the bar to that river; thence it continues south-eastward along the shore, and fronts also the Aracan river.

The shoal or reef surrounding Oyster island extends from its east, north, and west sides about a mile, but on its south-east side about 3½ miles; its direction therefore corresponds with the coast-line. The depth on the shoal is 4 to 12 and 18 feet, and its edge is steep on all sides except the south-east, where the soundings probably increase gradually to 4½ and 5 fathoms. To avoid this reef vessels should not approach its west side nearer than a depth of 15 fathoms.

Oyster Reef.—This is a dangerous reef of 4½ to 10 feet at low tide, situate in Lat. 20° 5½′ N. and Long. 92° 38½′ E., or about 14 miles West from the lighthouse on Savage island at the entrance to Aracan river. It is probably not more than 1½ miles in extent N.N.W. and S.S.E., and has soundings of 6 fathoms almost close to it; at 2 miles westward from it the depth is 12 fathoms. Its position is generally indicated by breakers except in fine weather during the N.E. Monsoon. So formidable is this reef to vessels approaching or leaving Akyab, that it should always have a wide berth. It has been proposed to moor a lightvessel off its south end.

Heckford Shoal.—This shoal is inserted in charts on the authority of Mr. N. Heckford, of the Mercantile Marine, who discovered it in 1855, and described it as follows:—

"Heckford's shoal (composed of rock, coral, and pebbles), is 13 miles S.W. ½ W. from Savage island lighthouse; W. by S. ½ S. from the table-land of Borongo island and W.N.W. from the south extremity of that island. It has 4¼ fathoms upon it

(probably less), is in the direct track of vessels, and is surrounded by the following (mud and mixed) soundings—viz., 20 fathoms 1¼ miles to the westward and southward of it, 15 to 13 fathoms to the eastward, and 12 to 13 fathoms 2 miles from its north-east end; shoaling towards Oyster reef. Commanders of vessels of heavy draught are therefore advised to be particular in the bearing of the table-land when approaching it from the westward, and warned not to pass over the shoal, as the lighthouse is not visible when you are close to the south-west of it."

Although it has been mentioned that Aracan river should be entered only with a pilot's assistance, the changes of the bar being frequent, we add the following instructions (copied from the Admiralty chart of the river, No. 1884, ed. 1865), as they may be useful in an emergency :—

"Ships of heavy draught coming from the westward in the south-west Monsoon, should steer East for the Table lighthouse until Savage island lighthouse bears N. by W., then haul up for it, and when abreast of the Bar buoy steer N.N.W. ½ W. until Passage rock bears E.N.E., when haul over to the north-eastward for the anchorage. A vessel may anchor with the Savage light S.S.W., or the North and South Hummocks in one, in 5 fathoms. The deepest water for large ships is off the Cherogea creek, within 70 yards of the shore.

"An excellent and safe passage for boats and small schooners is found between Savage island and the north end of Borongo island, sheltered from all seas in the south-west Monsoon.

"**Caution.**—When coming in with the flood, great care is required in allowing for it, as it sets right on to the White rocks. In coming out with the ebb tide, keep as close to these rocks as prudence will allow, in order to prevent being set on the western bank."

A reef projects from Fakir point, the north side of the river, some distance in a south-easterly direction, the extremity of which is, we believe, marked by a buoy ; upon it are some rocks above water. The official instructions for entering the river, issued in 1844, say :—

"Ships sailing for Akyab during the south-west Monsoon should steer for the south end of the western Borongo, in Lat. 19° 50′ N., Long. 93° 1′ E., and then stand along the coast northward and westward at 5 or 6 miles off shore until the light on Savage island at the entrance of Aracan river is sighted." (Here follow instructions for entering, which are superseded by those just given). "Having entered the river, Fakir point should be brought to bear N.W. by N. to N.W., when you may anchor. A stranger should not attempt to run in at night, particularly in the rains, except at high or low water, as the ebb tide runs very rapidly in strong eddies off the Passage rock, over the dangerous flat to the westward, and the flood in strong eddies upon the rocks.

"During the north-east Monsoon ships bound to Akyab from northward, should endeavour to make the table land of the western Borongo in Lat. 20° 1′ N., then by steering due East they will avoid the Oyster reef in Lat. 20° 5′ N., Long. 92° 38½ E., which is distant from the Savage light fifteen miles due West. This course is recommended, as, although in favourable weather, Savage light is seen outside the reef in 16 to 17 fathoms water, the depth suddenly decreases, and the probability of hazy or rainy weather would prevent the light being seen ; and steering boldly in to sight it, to the northward of Lat. 20° 1′, would endanger the safety of the vessel by suddenly falling upon Oyster rock or reef before sighting the lighthouse.

"Strangers are advised never to make use of the channel inside of Oyster rock or reef."

The south end of western Borongo island has a reef extending from it about 3 miles in a southerly direction, upon parts of which the sea breaks when there is a swell. The water is very deep close to the edge of this reef, soundings having been obtained there of 15 and 18 fathoms.

Terrible Rocks.—This very dangerous group of rocks extends from Lat. 19° 21½′ N., and Long. 93° 17½′ E., to Lat. 19° 28¾′ N., and Long. 93° 20′ E. It is distant from the nearest shore (north end of Ramree island) about 11 miles, and at about midway between there is a shoal of 2 to 4 fathoms, named Irawaddy. At a mile westward of the rocks the depth is not less than 18 fathoms; hence they require the utmost care to avoid when sailing down the coast. It has been proposed to erect a lighthouse on the south rock.

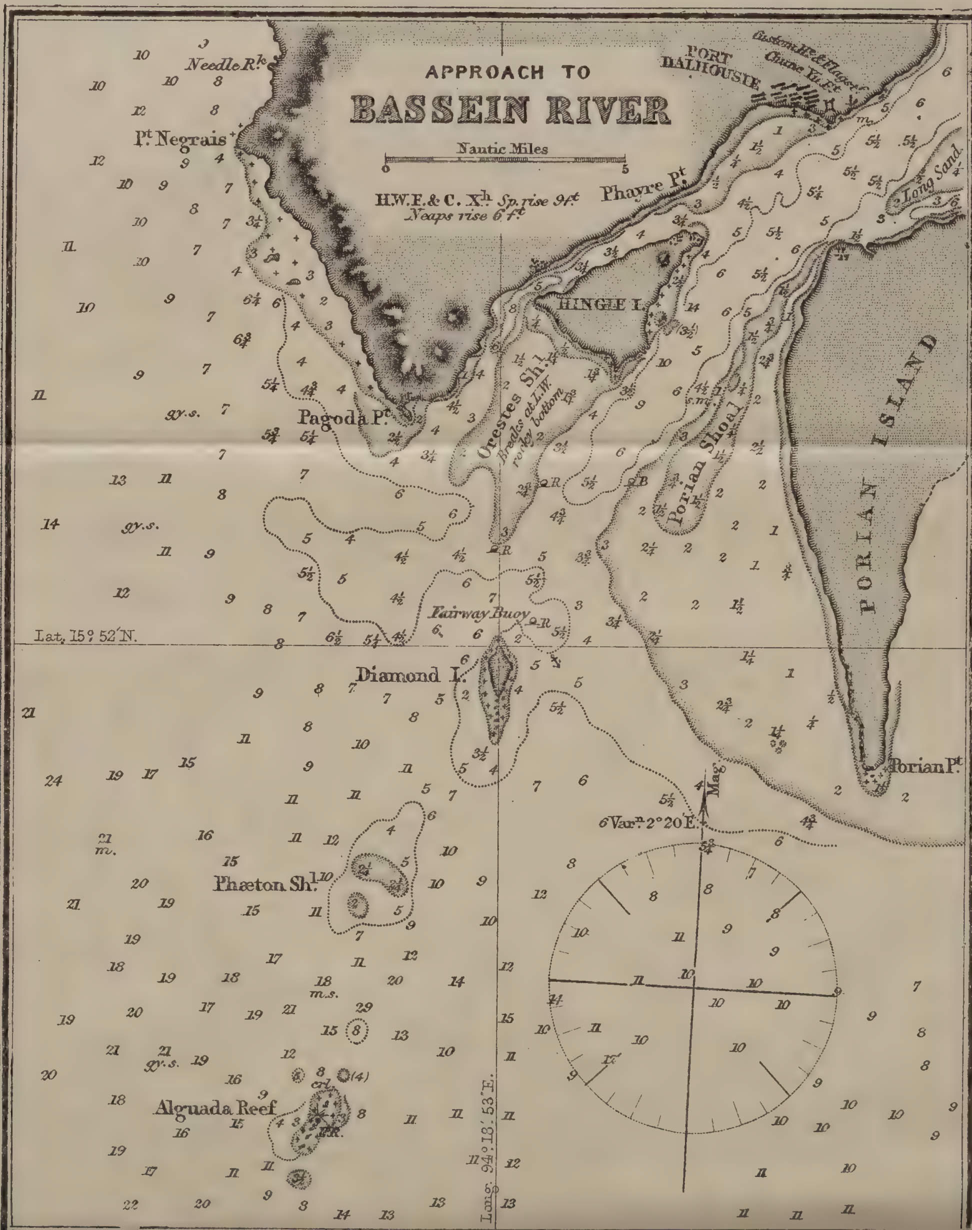
The Terribles consist of three groups of rocks, extending in a N.N.E. and S.S.W. direction, some of which are about 14 feet above the water at low tide; between and around them, or scattered about in their vicinity, are many rocks under water. The northernmost reef is probably at 1¾ miles northward from the northern rock, and the southernmost reef at about the same distance S. by E. from the southern rock. From the north rock the high peak of Nondogee island (Combermere bay) bears N. 49° E. (*true*) 19½ miles.

The Terribles were partially examined in 1841 by Commander Halstead, R.N., by whom soundings of 18 and 19 fathoms were obtained at 1¾ miles westward from the south rock; this depth is believed to increase gradually seaward, bottom having been obtained in 20 fathoms at 9 miles West from the same rock. Until there is a more complete survey of the rocks, a nearer approach to them than 30 or 28 fathoms should not be made at night.

Cape Negrais, the S.W. extremity of the coast of Ava, is situate in Lat. 16° 1½′ N., and Long. 94° 13½′ E. The high land in the vicinity and northward of the cape is visible from a distance of 27 or 30 miles. No part of this coast has been thoroughly examined, hence it will be prudent when running down it from northward to keep outside the depth of 12 fathoms, by adopting which course, a ship (according to the chart of Capt. Crawford, of the Bombay Marine) will go clear of danger.

At about 6 miles S.S.E.-ward from cape Negrais is Thay-gin, or Pagoda point, on the west side of the entrance to Bassein river. On this point there is a pagoda—hence its name. From this point red cliffs extend towards cape Negrais, and are fronted by a reef, which runs out 1¾ miles seaward. This reef terminates at the north end of the red cliffs near the cape, and should not be approached nearer than the depth of 10 fathoms in a large ship. Northward of the red cliffs the shore is more bold, there being from 11 to 12 fathoms soft ground within 2 or 3 miles of the cape; but between the latter and the Brother hills, a distance of 6½ miles, straggling rocks or reefs project 1½ miles from the shore, and should not be approached nearer than a depth of 12 or 11 fathoms.

Bassein River.—This large river is 12 miles wide at its entrance, Pagoda and Porian points, its seaward boundaries, being that much distant from each other on a N.W. by W. and S.E. by E. direction; but it rapidly decreases to 2½ miles opposite the town of Dalhousie, only 9 miles from the sea. Hingie, an


APPROACH TO
BASSEIN RIVER
Nautic Miles
H.W.F. & C. X[h] Sp. rise 9f[t]
Neaps rise 6 f[t]
Needle R[k]
P[t] Negrais
Pagoda P[t]
PORT DALHOUSIE
Custom H[e] & Flagstaff
Chance Y[d] F[t]
Phayre P[t]
HINGIE I.
Orestes Sh.
Breaks at L.W.
rocky bottom
Porian Shoal
Long Sand
PORIAN ISLAND
Porian P[t]
Fairway Buoy
Diamond I.
Phæton Sh.
Alguada Reef
Lat. 15° 52' N.
Long. 94° 13' 53" E.
Var[n] 2° 20' E.
Mag.

island of considerable size, just within the entrance, divides the stream into two navigable channels, of which that on its eastern side, being wider and deeper than that on its western, is generally used by sea-going vessels. Opposite the town the depth is 6 to 4 fathoms in the middle of the river. The edges of the shoals are buoyed, notwithstanding which it will not be prudent to attempt to enter without a pilot. Outside the river are the following—Diamond island, Phæton shoal, and Alguada reef; and at 36 miles from the latter, in a south-westerly direction, Thalia reef, in Lat. 15° 15′ N., Long. 93° 48½′ E. As these are met with in the approach from westward, we describe them before offering remarks upon the navigation of the river.

Diamond Island faces the entrance of Bassein river, and its position is Lat. 15° 52′ N., Long. 94° 18′ 53″ E. It is about a mile in extent North and South, and half a mile broad, is low, and covered with trees, but of sufficient elevation to be visible from a distance of 15 miles. A reef surrounds it, and extends from it in a southerly direction about a mile. Vessels occasionally anchor in 5 fathoms at about a mile eastward from it, and wait until they can conveniently enter the river; they are then near the fairway buoy, and in the immediate vicinity of the principal channel into the river.

Diamond island must be approached with great care, especially in a large ship. The west and east sides of the reef extending southward from it, do not appear to have been closely examined; and Lieutenant Ward's chart shows a sounding of only 2 fathoms at half a mile westward from the island; hence the necessity of extra caution when in its near neighbourhood. On the authority of Captain Fell, of the Indian navy, the best leading mark for passing northward of the island between it and the flat extending from Porian island, is the bluff of Pagoda point a very little open with the extreme point of cape Negrais.

Phæton Shoal.—In a S.S.W. ¼ W. direction from Diamond island about 3 miles, is the north end of the Phæton shoal, which thence extends in the same direction 3¾ miles. It is 1½ miles broad, has soundings upon it of 4 to 8 fathoms, but in its centre, for about 1¼ miles, a depth of only 12 to 15 feet; this shoal part lies between the bearings of N. ½ E. and N.N.E. from Alguada lighthouse.

The passage between Diamond island and Phæton shoal should never be attempted except in great necessity, there being no good mark as a guide, and the bottom being very irregular. The best mark is said to be the extreme point of cape Negrais, N. by W. ⅔ W.; keep the lead going, and maintain a good look-out.

Alguada Reef.—This very dangerous reef is situated 15 miles in a S.S.W. direction from the entrance to Bassein river. Its extent is 1¼ miles North and South, and many of the rocks are only just above the water at low tide. Close to it all round are soundings of 3 to 8 fathoms, which rapidly deepen to the westward and southward; there is also a patch of 3½ fathoms at nearly a mile from its south end. It should not be approached nearer than a depth of 15 fathoms on its southern and eastern sides, and 20 fathoms on its western side, and the channel north of it (between it and Phæton shoal) should only be attempted in an emergency, there being no good leading marks to carry a vessel through; should, however, circumstances compel a vessel to go through this northern channel, it will be well to borrow on the Alguada reef side, passing about half a mile from the north-eastern most visible rock, and not lessening the water under 11 fathoms,—if at high water the breakers

will show the rocks. On the eastern side of the reef the high land of Hingie island well open eastward of Diamond island clears all danger.

The tides, when uninfluenced by the wind, set across Alguada reef, and with considerable strength between the reef and Phæton shoal. It is chiefly for this reason that vessels are recommended not to approach its north-western side nearer than a depth of 20 fathoms; moreover, the soundings decrease suddenly on this side, especially towards the south-west part of the rocks.

Light.—A lighthouse, 160 feet high, has been erected on Alguada reef; it shows a light revolving every minute at 147 feet above high water level, visible 18 or 20 miles. Its position is Lat. 15° 42′ N., Long. 94° 14′ E., and from it cape Negrais bears N. ½ W.; the pagoda on Pagoda point N. ½ E.; extremity of Porian point N.E. ¾ E.; and the centre of Diamond island N. by E. ¾ E.

In Horsburgh's Directory, vol. i., is the following:—

"The bottom is chiefly uneven and rocky between Diamond island and Alguada reef, with a heavy turbulent swell, occasioned by the sea beating on the reefs, and the strong tides, about 2 knots per hour, which here set the flood to the E. by S., and the ebb to the W. by N. The rise of tide is about 9 to 12 feet on the springs; high water about 10½ hours on full and change of the moon, in the entrance of the river. From the heavy confused swell that generally prevails in this dangerous channel, even during calm weather, it is often called the Race of Negrais, and certainly should be avoided by ships; for by rounding the south end of Alguada reef, they are but a few miles farther out in a safe and spacious channel, about 17 leagues wide, between it and Preparis island.

"When the sea is smooth in the North-east Monsoon, the breakers on Alguada reef are not high; but when the weather is clear, the approach to it may always be known by the bearing of the land; for when the west end of Diamond island is coming into contact with the east end of the hill on Hingie island, Alguada reef is then in the same direction, bearing N.N.E., and the western extreme of cape Negrais will bear nearly North. At 4 or 5 miles distance from Alguada reef, both eastward and westward, the depths are generally from 15 to 18 fathoms, blue mud, and southward from it at the same distance, 19 and 20 fathoms. It is prudent not to approach Alguada reef nearer than 2 leagues on the east side, nor under 3 leagues on the N.W. side, on account of the rock situated to the S.W. of Diamond island. Soundings extend from Alguada reef to Preparis island, and the depths increase to 40 and 50 fathoms in the track between them; near to Preparis island they are irregular in some places, but on the east side of the island decrease to 8 fathoms within less than a mile of the shore."

Captain N. Heckford says:* "If, on approaching Alguada reef from the N.W. in thick weather, and without observations, you try for soundings and find 36 to 40 fathoms, mud, broken shells, and specks, steer to the southward until the nature of them are shells, stones, and rotten coral. You may then shape a course to the S.E., provided your depth of water is above 25 fathoms, or you have no means of ascertaining the nature of your soundings, to know when you are in the fair track for passing the reef in thick weather. If in steering to the south-east you do not shoal, you may proceed with safety; but if from 40 to 35 you decrease to 30 and 25

* "Sailing Direction, and Coasting Guide from the Sand Heads to Rangoon, Maulmain and Akyab, and *vice versâ*," by N. Heckford. A work that should be in the hands of all shipmasters bound to the ports on the east coast of the Bay of Bengal.

fathoms, haul to the southward until you deepen, then keep away to the south-east as requisite.

"The nature of the soundings west, south-west, and south of the Alguada reef, is so various that it is impossible to particularise them with any degree of clearness; they may be summed up in the fact, that with the reef bearing from E. to N.E., and N. by E., little or no mud will be found mixed with them. But it must be borne in mind that, with it bearing S.E. by E. you have mud and mixed soundings, and these extend northward until you are clear to westward of cape Negrais; moreover, you will not find two casts alike, although the lead be constantly hove. In mid-channel, or nearer the reef, they consist of stones, small broken shells, and sand, with black specks, in from 26 to 24 fathoms. The nearer the reef the coarser the bottom. When it bears due North in 22 fathoms, you will have coarse sand, stones, broken shells, and black and white specks; and when it bears N. by W. in 23 fathoms, a slight mixture of green mud; and N.N.W. in 23 fathoms, you will have dark green mud mixed with black and white specks. From this position until off the south-west limit of Bragu sand in 16 fathoms they will be the same, excepting that the mud shades lighter as you proceed eastward from the reef; these remarks are applicable to north of Lat. 15° 16′ N. And it is deserving of particular notice, that there are no pure mud soundings in the direct track until you are eastward of Bragu sand."

Thalia Reef.—This small coral patch is situated, as noticed (p. 477), in Lat. 15° 15′ N., and Long. 93° 48½′ E. Its extent is 1¾ miles N.N.W. and S.S.E., and close to its western side are soundings of 37 and 50 fathoms, and to its eastern side 23 to 28 fathoms.

The River.—In the entrance to the river is Hingie, a triangular-shaped island, having its apex to the north-eastward; it is about 3 miles in extent, and is easily recognised from seaward by a hill on its north-east end, the easternmost high land on the coast. A shallow flat of 6 to 18 and 21 feet, named Orestes shoal, extends out 4½ miles in a south-westerly direction from this island, and leaves between it and the northern shore of the river a narrow channel of 3½ to 6 fathoms depth, *or less;* but which is considered unsafe for vessels drawing more than 14 feet. The navigable channel on the east side of Orestes shoal and Hingie island is 1½ miles wide, and 4½ to 9 and 7 fathoms deep (reckoning from seaward), its eastern boundary being the extensive Porian shoal, a flat of 6 to 15 feet, which lines the eastern side of the entrance to the river; this eastern shore is low land, terminating in point Porian, a headland formed of white cliffs, sufficiently elevated to be visible from a distance of about 6 leagues. This eastern channel was buoyed in the following manner in 1859: a *red* buoy on the extreme south end of the Orestes shoal, and another on its extreme eastern limit; a *black* buoy on the extreme edge of the flat extending from the Porian shore; and a *red* buoy, marked "Fairway" in white letters, north-eastward from Diamond island. With the assistance of these buoys and Lieut. Ward's chart,* the river is not difficult to enter, still, strangers are recommended to obtain a pilot.

When the buoys were moored at the entrance to the river in 1859, the following information was officially issued by Lieutenant T. W. Aylesbury, Master-Attendant:—

"*Vessels coming from the southward* should bring Diamond island to bear N.W.,

* Published by the Hydrographic Office, Admiralty. No. 884.

then steer for it until the *fairway buoy* is visible, which is situated $1\frac{1}{2}$ miles N.E. of the island. From this *buoy* steer N.N.E. until the *black buoy* bears East, then N.E. by N.

"*Vessels entering from the westward,* in latitude north of Diamond island, should bring it to bear S.E., and steer in for it until the *fairway buoy* is made, then proceed as above directed for vessels entering from the southward. This passage, however, should be attempted by sailing vessels only in the North-east Monsoon.

"Vessels unable from stress of weather to distinguish the different marks, should anchor under Diamond island, where good anchorage and smooth water is to be found.

"**Hingie Island to Bassein.**—A vessel should proceed up the river about half a mile from the shore, until up to Yeajoue Creek; thence she should sheer over to the eastern bank, gradually, until the *black* buoy on the south end of the Ridge shoal is seen, which is to be passed, keeping it on the port hand about two cables' length, and keep the eastern bank until after passing the *red* and *white* buoys in the same manner as the *black;* then stand up mid-channel, passing Sesostris rocks, which are marked by a *red* buoy. *The rocks lie inshore of the buoy.* Keep on mid-channel until close up to Enterprise island, taking care to give the spit that extends a little way down from the south end of the island a good berth. There is a passage on each side of the island—one to the east and another to the west. The passage to the left is preferable for a ship of light draught, as it is wide, and there is more room to work.*

"The passage to the eastward is taken by vessels of large draught. Vessels should keep close to the eastern shore, in order to avoid the Pariah rock.

"In sailing up the passage to the left of Enterprise island, care must be taken not to approach too close to the spit that extends north of the island. Proceed up as far as the village of Tumam-Dewa, that lies in a creek on the port hand; then steer across to the eastern bank between the *red* buoy and Elephant island, *going nearer to the island than the buoy,* until you get into 7 fathoms; then steer up on the eastern shore, until abreast of the Pamawaddie river; from this steer over towards Ashby rocks *buoy,* giving the Cackatoo rocks a berth of at least two cables' length. These rocks are seen above water, except at spring tides, when they are covered. There are three patches: two of them show above water half ebb to half flood; one is sunken, and extends to 138 yards outside the others; the least water on it at dead-low water spring tides is 16 feet. Keep the port shore until you reach the second creek, when the channel becomes much wider.

"The 'junction' is so called from being at the top or north end of Napoota reach, where two branches of the river meet, the one from the east being the way to Bassein.

"At Napoota reach you may steer up until approaching the 'junction,' where, on the eastern shore, a mud bank extends a quarter of a cable's length from the bushes; there is also a bank extending from the port side. These can be avoided by keeping in nearly mid-channel. In the third reach there is a bank of mud, which will be known by a *white board* in the bushes. On the port hand this shoal extends nearly half way over, and the whole length of the reach in which it is, so that vessels must

* It is possible that the buoys alluded to in this notice of the navigation above Dalhousie may have been removed.

keep the starboard bank going up, and *vice versâ* coming down. The remainder of the passage upwards is without danger, and easy of navigation.

"There is deep water close to the bank, and the ground chiefly very soft mud. Vessels should have a small warp anchor in readiness to run out if required, and should use a light working anchor for dropping; this will relieve the crew of much labour.

"Vessels should show their numbers before arriving at the village of Takion, and Masters should report their arrival at the Master-Attendant's Office and Custom-house, as soon as possible."

Captain Heckford says of Dalhousie:—"The port is not safe in bad weather, nor during the change of the Monsoons, as the fearful loss of shipping will fully testify. Commanders are cautioned not to remain at this anchorage longer than is actually necessary in arriving at it from sea, and not to attempt to resort to it when bound out, without they are prepared to depart and the weather suited to this object."

COAST OF PEGU.—The coast of Pegu, from Bassein river to the Gulf of Martaban, is generally low and woody; it comprises, in fact, the delta of the great river Irawaddy. Fronting it to a considerable distance seaward are reefs and shallow flats; hence it requires considerable care to approach, especially when the wind is from southward. The land is seldom visible from any distance, which renders precaution when approaching the more necessary. An examination of this sea-board was made in 1850 by Lieutenant Fell, of the Indian Navy, and the following is his description of the soundings off it:—

"From Porian point, which forms the south-east extreme of the eastern shore of Bassein river, and which bears E. ½ S. from Diamond island, a bank extends off it to the distance of about 2½ miles, and continues in an E.S.E. direction, 52 or 53 miles, from whence it runs in an easterly direction, and gradually trends to E.N.E., then to N.E., on towards Rangoon. The southern extreme of the Baragu flat is in Lat. 15° 29½′ N., Long. 95° 12′ E., from whence the land is seldom visible, except in very clear weather.

"A vessel passing north of Diamond island, and bound eastward with a fair wind, ought to keep the large pagoda on with, or a very little open with, the north end of Diamond island, until she deepen to 10½ or 11 fathoms; she may then stand to the E.S.E., keeping in a line of 9½ or 10 fathoms, and altering her course so as to keep in this depth until abreast the south extreme of Baragu flat, when to keep in this water she will steer an east course, on which line she will (when eastward of Baragu point) deepen her water to 12, 15, and 16 fathoms. She may then, if bound to Rangoon, stand to the N.E., taking care not to come under 10 fathoms until northward of the Krishna shoal. If bound to Maulmain, she ought to steer E. by N. ½ N. or E.N.E. (altering her course according to the time of tide), when she will again shoal her water to 10 and 9 fathoms, which depth is the best line to keep in until sighting the eastern coast; but during the South-west Monsoon it would be advisable to keep more to the southward, in 14 or 15 fathoms, making the land near to Kalegouk island.

"**Krishna Shoal** extends from Lat. 15° 36 N. in a N.E. direction to Lat. 15° 47′ N., and is a bank of hard sand situated to the E.S.E. of Baragu point, distant from the nearest shore 10 miles. It is a narrow ridge about 1 mile wide, having

a channel between it and the shore, with $3\frac{1}{2}$ and 3 fathoms in it, bottom of soft mud. When to the N.E. of the Krishna shoal, a vessel ought not to come under $4\frac{1}{4}$ fathoms until in Lat. 16° 13′ N.; she will then be abreast of China Buckeer.*

"During the N.E. Monsoon, vessels from Bengal should make cape Negrais, and ought to endeavour to pass northward of Diamond island, by doing which they will save much time, as during the months of November, December, and January, there is little or no flood-tide south of Alguada reef, except during the springs. At other times there is a strong set to the W.N.W.

"The soundings westward of Alguada reef are generally even, with fine grey sand and mud, with 30 fathoms, 18 miles to the westward; to the S. and S.S.W., when near to the reef, the bottom is very uneven, coarse sand and mud alternately, until 8 or 10 miles to the S.S.W., when the soundings become more regular, with coarse sand, shells, and rotten coral, which bottom continues the same nearly on to Preparis island. This bottom is a good guide for vessels during the S.W. Monsoon, when it is not advisable to approach the Alguada reef. To the E.S.E. about 12 miles the bottom is all mud, and continues on to the Tanasserim coast. Vessels proceeding eastward with a working wind ought to be guided entirely by the lead, which should be kept going when approaching the Baragu flat, and ought not to stand under 7 fathoms, from which the soundings decrease quickly to 3 fathoms.

"The tides on the coast of Pegu are very irregular during the N.E. Monsoon, when there is scarcely any perceptible flood during the neaps off the Baragu flat, and during the springs not running more than three hours at the rate of 1 to $1\frac{1}{2}$ miles per hour. When to the N.E. of Baragu point, the tides become stronger—on the springs, running $3\frac{3}{4}$ and 4 knots, and during the neaps, 2 to $2\frac{1}{2}$ knots. The rise and fall of tide at Alguada reef is about 12 feet. H. W. on the days of F. and C. at 10h. 45m. Off Baragu flat the rise is only 7 feet, high water at 11h. A little northward of the Krishna shoal the rise is 12 feet, high water at 11h. Eastward of Rangoon river the tides run very strong during the springs, greatest velocity being upwards of 7 knots, and the rise and fall from 25 to 27 feet.

"Vessels from Amherst bound to Rangoon ought to endeavour to keep in a line of $5\frac{1}{2}$ to 6 fathoms low water, until they sight the land near China Buckeer, and then stand to the northward, as before directed."

Captain N. Heckford says:—"When approaching Baragu sand from westward (the vicinity of which in fine weather is ascertained by the eddies that prevail in this particular part of the gulf only), the best depths to preserve are from 15 to 16 fathoms, not less, and you will cross over the tail of it in 10 and 11 fathoms; the soundings will be of dark brown-coloured mud, mixed with very small *entire* shells, and this is the only spot throughout the track from outside the Alguada reef to the coast of Martaban, where this description of shell is to be found. In steering to the eastward, you will deepen again to 14 or 15 fathoms. After getting eastward of

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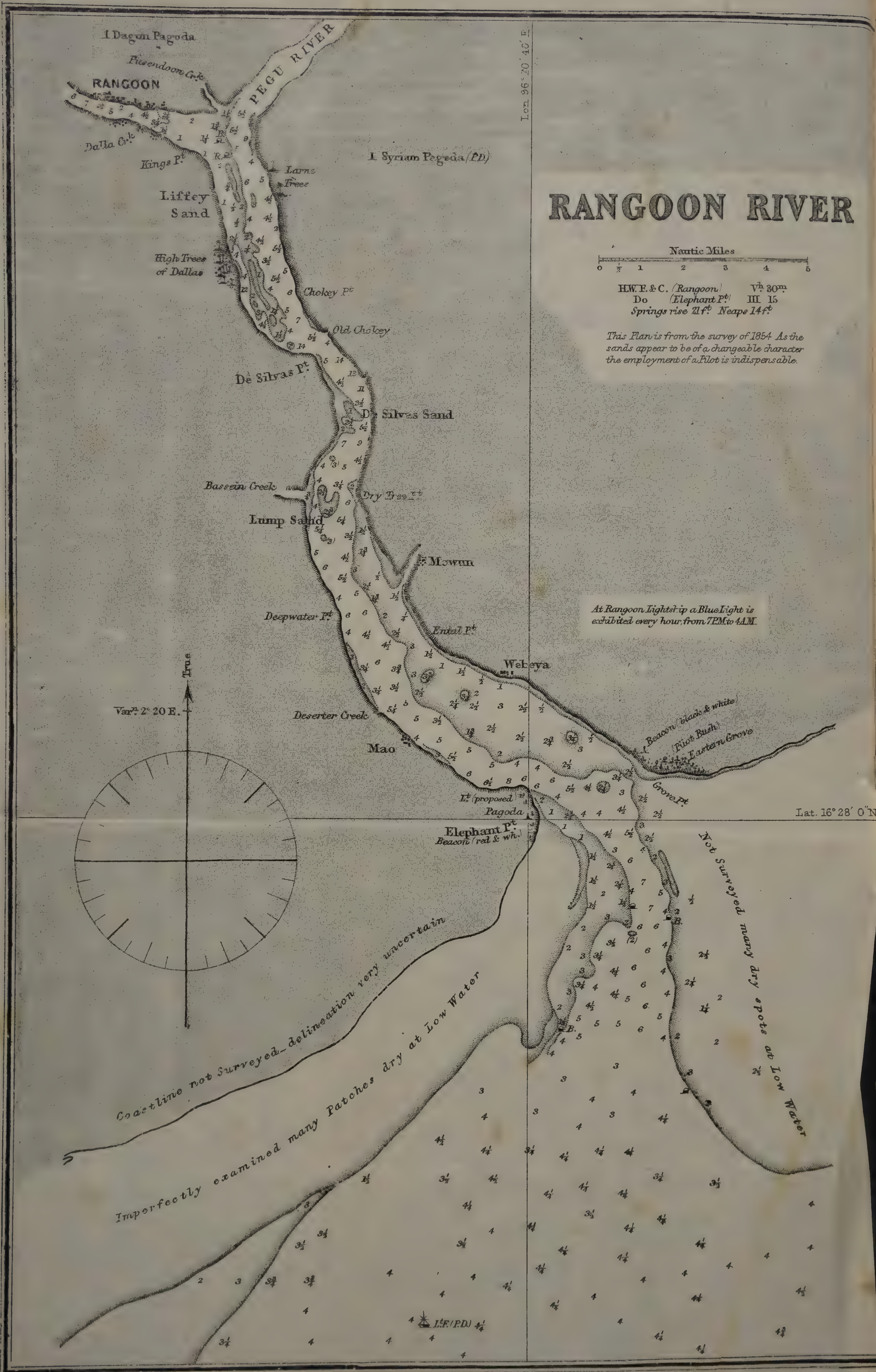
* Rangoon River is 18 miles N.E.-ward from China Buckeer River. In Horsburgh's Directory, China Buckeer is mentioned as appearing like a low island when viewed from soundings of not more than 6 fathoms. Captain Heckford says: "China Buckeer appears like a low detached island; being covered with dense jungle, makes it very conspicuous, and there is no land like it on this part of the coast; an opening between it and the main appears at its north-east end when just visible from the southward above the horizon. This is the only distinguishing mark south-westward of Elephant point."



RANGOON RIVER
Nautic Miles
0 ½ 1 2 3 4 5
H.W.F. & C. (Rangoon) Vh. 30m.
Do (Elephant Pt.) III. 15
Springs rise 21ft. Neaps 14ft.
This Plan is from the survey of 1854. As the sands appear to be of a changeable character the employment of a Pilot is indispensable.
At Rangoon Lightship a Blue Light is exhibited every hour, from 7 P.M. to 4 A.M.
Lon. 96° 20′ 40″ E.
Lat. 16° 28′ 0″ N.
Var. 2° 20 E.
True
Dagon Pagoda
Pusendoon Crk.
RANGOON
PEGU RIVER
Dalla Crk.
Kings Pt.
Syriam Pagoda (P.D.)
Larne Trees
Liffey Sand
High Trees of Dallas
Chokey Pt.
Old Chokey
De Silvas Pt.
De Silvas Sand
Bassein Creek
Dry Tree Pt.
Lump Sand
Mowun
Deepwater Pt.
Ental Pt.
Webeya
Deserter Creek
Mao
Beacon (black & white)
(Pilot Bush)
Eastern Grove
Grove Pt.
Lt. (proposed)
Pagoda
Elephant Pt.
Beacon (red & wh.)
Not Surveyed many dry spots at Low Water
Coastline not Surveyed, delineation very uncertain
Imperfectly examined many Patches dry at Low Water
Lt. F. (P.D.)

Baragu sand, which will be easily known by the nature of the soundings; if they be pure mud, of a light brown colour, you can steer to the N.E. and N.E. by N.

"If bound to Maulmain, after passing Baragu sand, and when about half way between the tail of that sand and the north end of Kalegouk island, you will have much deeper water. But the 10½ fathoms soundings extend across the gulf to Double island, and from the north end of Kalegouk the 12½ fathoms extend about 40 miles to the westward. These soundings, after getting well to the north-eastward of Baragu sand in 7 or 8 fathoms, consist of soft oaze; with the Rangoon river N.W., stiff mud; eastward of this, and towards the Martaban coast, they are of dark olive-coloured mud.

"I have never found any mixed soundings or sand eastward of Baragu sand in the Gulf of Martaban—clear of danger. And safety requires that you should find your mud soundings mixed; at the same time convinced that you are eastward of Baragu sand (with a flood tide), anchor without loss of time, as you are not far from danger. And, as all dangers must be N. or N.W. of you, a S. or S.E. course will enable you to get clear of them, should you be in their vicinity; except you are in the mouth of the Sittang river, which is ascertained by the overfalls, set and strength of the tide, and the high land to the N.E.-ward. Should you, through some extraordinary circumstance, get in the mouth of this river, and can ride out one flood-tide (although I have never heard of but two vessels escaping from it), weigh at high water, and work to the S.S.W., keeping the lead constantly going, as the channels between the sands are deep, though narrow, and anchor when the flood is in."

RANGOON RIVER.—This river is about 2 miles wide at the entrance, whence, to the town of Rangoon, a distance of 20 miles in a N.W. by N. direction, it gradually decreases in width, till opposite the town it is only one-third of a mile across. The shore on each side of the entrance is low, and can be seen only from a moderate distance; but a beacon, coloured black and white, has been erected on the eastern or Grove point, and another, red and white, on the western or Elephant point, as marks to show the position of the river from seaward. Shallow flats extend out a considerable distance from the shore on each side of the river, and the edges of these, in the immediate vicinity of the entrance, are marked by buoys, to indicate the channel-way in. The soundings in the entrance are 5 to 7 fathoms; thence up the river is a general depth of 5 fathoms, excepting at about 2 miles eastward of the town, where is a bar of 6 to 10 feet.

Spring tides rise 21 feet, and neaps 14 feet.

Light.—The entrance to the river is now (1859) indicated by a light-vessel, the position of which is Lat. 16° 19′ N., Long. 96° 20′ 30″ E.; it is moored in 3½ fathoms, soft mud, at low water spring-tides, and shows a fixed light, visible from a distance of 8 miles. A blue light is burnt every hour from 7h. P.M. to 4h. A.M.* In 1859, the following instructions for entering the river were issued by Mr. H. Lewis, the Master-Attendant of the port:—

"Commanders of vessels bound to the port of Rangoon should endeavour to make the coast well to the southward about the China Buckeer river, as many ships have been lost in consequence of having been swept by the strong flood-tide on to the

* The construction of a lighthouse on Elephant point, the west point of the river, is in contemplation.

extensive sands to the northward and eastward, and into the Sittang river, in which direction the spring flood sets with dangerous velocity. Pilots are usually cruising well to the southward of the light-vessel stationed at the entrance to the river.

"With the beacons on Elephant and Grove points bearing to the northward, steer for the light-vessel. Flood sets N.E. by N.; ebb S.W. by S. 3½ to 4 knots. From the light-vessel, with a fair wind, steer N. by E. ¼ E., about 5 miles for the outer black buoy, passing it to the westward a good cable's length; thence steer North for the upper black buoy till the upper red buoy is in sight, bearing N.N.W., pass to the eastward of this, with the western beacon bearing N.W., and steer in for Elephant point, which bearing from W.S.W. to S.S.W., distant half a mile, will give good anchorage. Care must be taken not to bring the black buoy to the westward of N. ½ E., nor the red buoy to the eastward of North.

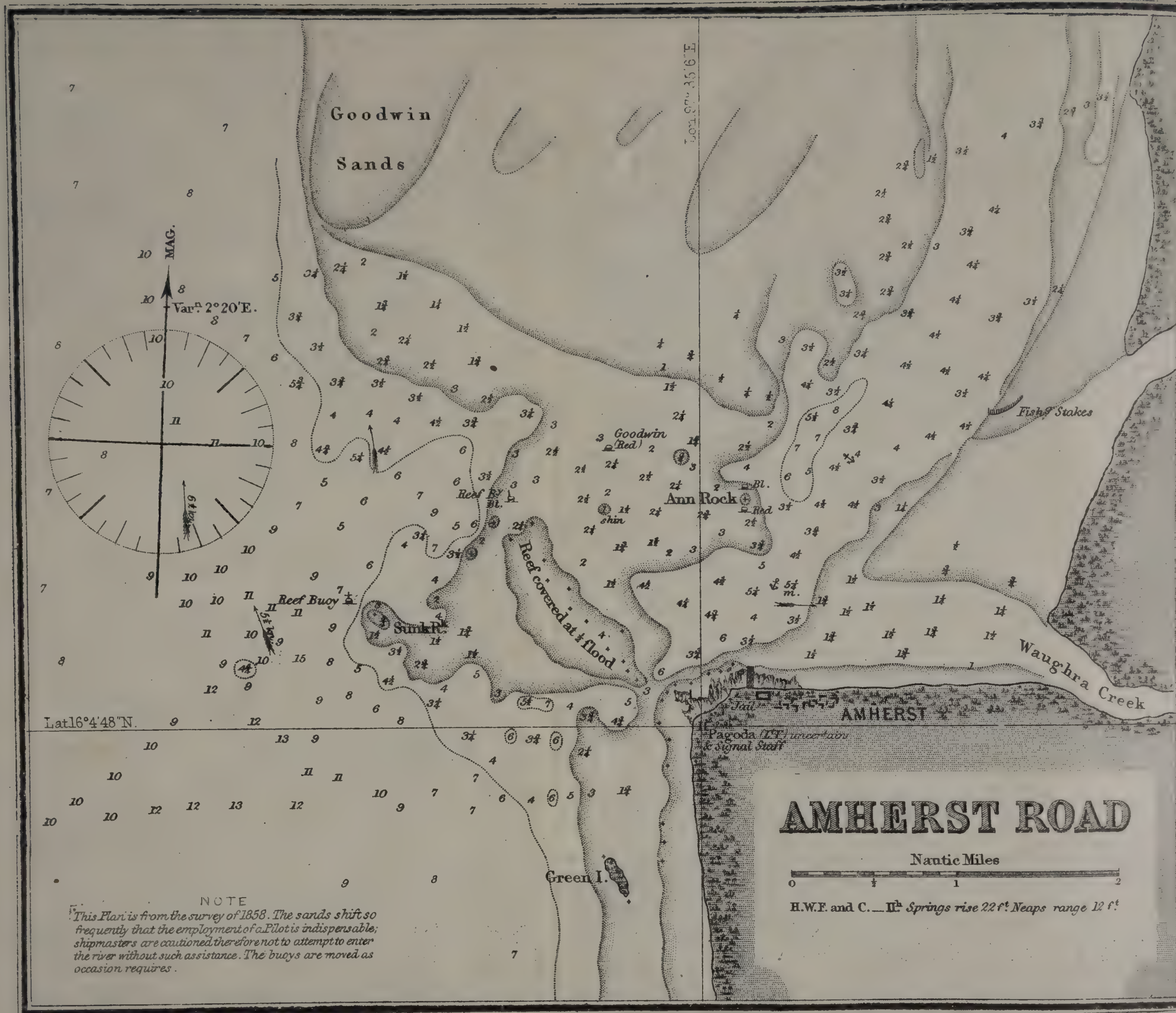
"From Elephant point to Rangoon steer along the right bank of the river, about a cable's length from shore, until close to Bassein creek, then cross over to the left bank, along which steer at a distance of 1½ cable's length from the shore, until Dagon pagoda bears about N.W., then steer in mid-channel, between the red and black buoys on the Hastings shoal, for the flagstaff in the town, and anchor opposite the dockyard."

SITTANG RIVER.—The coast eastward of Grove point is low, and fronted for a considerable distance seaward by a shallow flat, hence it cannot be approached in a large ship. Sittang river is 25 or 40 miles from Rangoon river: it is shallow at its entrance, but a survey of it might possibly discover some channels among its banks sufficiently deep for a ship of ordinary size. The river is quite unknown, as foreign vessels never enter it. On its eastern shore the country rises into hills, named the Zingaat or Martaban hills.

Tides.—The tides on the coast of Pegu generally run very strong; the flood sets East and E. by N., and the ebb in the contrary direction to the westward of Baragu point; but from that point to Rangoon bar the flood sets N.E. and N.E. by N., and the ebb to the S.W. Farther east, between Rangoon river and the coast of Martaban, the flood runs strongly N.N.E. and N. by E. into the bottom of the gulf, and the ebb with equal strength out of it, in the opposite direction. When the rivers are swollen, and the low country inundated by the rains at the end of the South-west Monsoon, the ebb tides run much stronger and run longer than the flood tides, occasioned by freshes from the rivers; the water then is very thick and muddy at a considerable distance from the land, which is more or less the case on this coast at all times, opposite to the numerous rivers that disembogue into the sea.

Abreast of Baragu point, and farther westward, the velocity of the tides is not nearly so great as off Rangoon river and in the bottom of the gulf; for here it is frequently in the springs 4 and 5 miles an hour, and sometimes more, near the edges of the shoal-banks. After the rains, the tides off Rangoon river are subject to a circular motion; the first of the flood sets East, changing gradually to N.E. about ½ flood, and to North in the latter part. The ebb sets just the reverse, beginning to run West; it changes gradually to S.W. and South, ending at S.E., but there is no slack water at these times, the tides continuing to run 1½ or 2 knots when changing from the flood to the ebb, and the same at the opposite change.

On the west part of the coast, off Porian point, the perpendicular rise and fall of the tide is only 9 or 10 feet on the springs, but off Rangoon bar it is frequently 20 or 21 feet, and from 21 to 24 feet farther to the eastward in the bottom of the gulf


AMHERST ROAD
Nautic Miles
0 ½ 1 2
H.W.F. and C. — IIh Springs rise 22 ft. Neaps range 12 ft.
Goodwin Sands
MAG.
Varn. 2°20'E.
Lat16°4'48"N.
Goodwin (Red)
Ann Rock
Bl.
Red
Reef By Bl.
Reef Buoy
Sunk Rk.
Reef covered at ¼ flood
Fishg. Stakes
Waughra Creek
AMHERST
Jail
Pagoda (L.T.) uncertain & Signal Staff
Green I.
NOTE
This Plan is from the survey of 1858. The sands shift so frequently that the employment of a Pilot is indispensable; shipmasters are cautioned therefore not to attempt to enter the river without such assistance. The buoys are moved as occasion requires.

near the banks at the entrance of Sittang river; it is therefore proper to be careful in making free with this part of the coast, and to acquire a knowledge of the tides, in order to prevent any mistake, by anchoring near high water in a situation where a ship would be aground at low water.

MAULMAIN.—Following the coast southward from the Sittang river, we reach in Lat. 16° 30′ the northern entrance of the river Salween, which is separated from the southern entrance by a large island, named Pelew Gewen. This island is 17 miles long from north to south, and 8 miles broad: it is moderately high, and is rather more elevated at its north and south ends than in the middle; at these ends are thick clusters of trees. A white pagoda stands on its south end upon the eastern part of the highest land, and appears just above the trees. The tops of the trees on the west side of the island are not visible at a greater distance than 12 or 15 miles; this coast is faced by a shoal which extends out 1 or 2 miles. The northern channel of the river is not navigable. The town of Maulmain is on the eastern bank of the river in Lat. 16° 30′, its situation being at the fork of the stream, where the north and south channels divide. According to the survey of 1842, the depth in the shallowest part of the river at low tide is 7 to 8 feet. The rise of spring tides is 22 feet; neaps range 12 feet.

The southern channel of the river Salween is that used by vessels bound to the port of Maulmain. It is 9 miles wide, but the greater part of this space is occupied by the Goodwin Sands, shallow flats extending southward from Pelew Gewen island, and by reefs jutting out from Amherst point, the south shore of the river; hence the navigable channel is less than a mile wide. The depth at low tide is 18 to 12 feet, and buoys, which are moved as occasion requires, mark the principal dangers. These sands are subject to frequent change; instructions for entering the river are consequently useless, and render the employment of pilots a necessity. Pilots are obtained from Amherst.*

The tides in the river Salween are strong, their velocity being about 5 miles an hour during springs, and 3 miles at neaps. Vessels drawing about 22 feet can ascend the river to Maulmain. We believe it is usual to employ a steam-tug, the channels between the sands being very narrow and tortuous.

Amherst Point (**Cape Kyai-kami**, or **Quekmi**), is low, so low that it cannot

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* Mr. Neat Major, agent for the Liverpool Underwriters' Association at Maulmain, wrote thus in 1862:—

"The entrance to this river is becoming so narrow and intricate, that it urgently behoves the Government to take some measures for the prevention of ships getting into difficulties similar to those of the ships *Laurel* and *Clara L. Preble*, which ships were both swept by the force of the tide on to Amherst reef, and, having received considerable injury, were compelled to return to Maulmain, discharge their cargoes, and be docked for further survey. These serious accidents have occurred within the present month, and I am credibly informed by some of the most respectable pilots that it is very dangerous to move a heavy ship out of Amherst road to proceed to sea without the assistance of steam power, or a strong commanding breeze, and even then it must be nearly high water.

"I am under the impression that if the lower part of the river, from Fishing village to sea, was carefully resurveyed by competent surveyors, a new channel would be found to the northward of the present one; and if so, and properly buoyed, would be a great desideratum for vessels passing in and out of this river. There are two narrow passages or gaps in the Amherst reef sufficiently wide for any ships to pass through with safety in cases of emergency—such as parting a cable, or drifting, &c. These passages are well known to the pilots, and only require substantial beacons erected to mark their positions; this would be the means of relieving many anxious minds, for, take an instance of a ship parting her cable, her commander or pilot, guided by these beacons, could steer boldly through the passage, and proceed to sea with confidence."

be seen from a greater distance than 7 to 10 miles;* the lands in its vicinity are high and peaked, and visible in clear weather from a distance of 9 leagues. On the point is a white pagoda, called the upper Quekmi pagoda; another pagoda (the lower one), also white, stands on the rocks off the point. There are also several pagodas along the coast. At a mile S.S.W. from the point is a little island named Green, situated half a mile from the shore; and 12 miles southward from it, in Lat. 15° 53′ N., is Double island, so named because a chasm in the trees upon it causes it to appear as two islands when viewed on any bearing between N.E. by E. and S.E. This island is about 100 feet high, as many long, sufficiently bold to be approached within a mile, and so thickly wooded that it resembles an immense bush —it is very inconsiderable as compared with the high lands behind it, and is not easily distinguished until well in with the shore. In a south-easterly direction from Amherst point are some remarkable hills, the Table land and peak, which are sufficiently lofty to be visible from a distance of 30 to 45 miles: these, with the high land of Martaban to the N.E., which comes into view when you are in about the depth of 15 fathoms, are excellent guides for the port.

Mr. Davy, R.N., says, 1836: "In the North-east Monsoon a ship leaving the Sand Heads should steer about S.E.; or if the current to the southward be found stronger than usual, steer more easterly, passing in mid-channel between cape Negrais and Preparis island; or if bordering on the weather shore, round Alguada reef in not less than 20 fathoms; the depth in this channel will be found deepest towards Preparis island. From this the soundings become regular, with mostly mud bottom, decreasing as you advance eastward. On no account make the low land, or steer higher than E.S.E., until the meridian of Baragu point is passed. After passing that meridian, stand on and make the land about Double island. The parallel of 16° N. should not be crossed until within five miles of the coast, as the tides there are at the strongest; and the shoals of Pelew Gewen island, also the flats at the mouths of the rivers, are very dangerous.

"In the South-west Monsoon shipmasters should endeavour to make the land a little southward of Kalegouk island; and in the event of bad weather, or if the weather has a threatening appearance—more particularly if it be at or near the springs—should not think of anchoring at Amherst, but should run inside Kalegouk, and anchor in 6 to 9 fathoms. Double island and the north end of Kalegouk bear from each other S. by E. ½ E., and N. by W. ½ W. 17 miles; when standing inshore, do not pass eastward of that line of bearing,—to a stranger, this will be the best possible guide. No part of the coast should be approached nearer than two miles, on account of the strong tides and the rocks and breakers extending out from the shore. When steering for Amherst great attention must be paid to the tides, and large vessels may anchor in 10 fathoms with the Reef buoy bearing N. by E., and the upper pagoda N.E. to E.N.E.

"It is high water on the days of full and change of the moon at Amherst point at 2h., and at the Reef buoy at 2h. 20m.; the greatest rise and fall of the tide is during the S.W. Monsoon, when it is often 26 and 28 feet, and the velocity 6 to 7 knots. Hence, during strong South-westerly winds, with a sea and so rapid a tide, the anchorage is unsafe. It is at this time that the value of the harbour within Kalegouk island can be properly appreciated. In the North-east Monsoon the rise and fall

* A small fixed light, visible 6 miles, is said to have been established on the point.

is 18 to 20 feet, and the rate of tide 3 to 4 knots per hour. The change of the tides is effected almost instantaneously; indeed, it may be said there is no slack water. The ebb-tide coming out of the river may be seen at some distance; it brings a vast accumulation of dark-coloured matter, which contrasts strongly with the sea,—it comes down with great force, and when it strikes the ship, makes it, as sailors say, "all grin again." The strongest tides are found on the parallel of the river, and are not felt at the distance of 60 miles from the land; their strength also decreases as you steer to the southward. A 6-knot tide at Amherst will be found to have lost half its rate at Kalegouk, and at 10 miles farther south it will have still further decreased."*

Captain D. Ross, of the Indian Navy, the Marine Surveyor, gives the following instructions for making Amherst: "It is proper to make the land between Double island in Lat. 15° 53′ N., and the small islet in Lat. 16° 3′ N., which is about 1½ miles southward of the Pagoda, as, without this precaution, the strong tides may sweep a ship past the buoy that is placed at the point of the reef, and carry her on the Goodwin Sand. When 1½ or 2 miles westward of this small islet, and if then the Reef buoy is seen bearing about N.N.E., endeavour to approach it on the bearing of about N.E., and anchor at about a cable's length north-westward of it, in 4½ or 5 fathoms at low water. The depths outside will vary from 9 to 13 fathoms, and when about three-quarters of a mile S.W. of the buoy, there are overfalls from 9 to 14 fathoms, quickly shoaling to 7 fathoms at the entrance between the Reef buoy and the Goodwin sand. It is almost indispensable to anchor in the situation mentioned above, to wait for a row-boat and pilot, as the channel is narrow, the bottom very uneven, and the soundings no guide. If the wind be from the southward or westward, high water is the time to weigh, or just at the commencement of the ebb; but if it be from northward or north-eastward, the last quarter of the flood is the proper time to weigh, in order to have a weak tide under lee, and be enabled to keep the row-boat on the port bow, while she proceeds along the sand and showing the depth of water by a flag. The extremity of the reef being very near the buoy, no ship must pass eastward of the latter. The anchorage at Amherst will admit several ships, but must be avoided by large vessels in the S.W. Monsoon (being open to all winds from S.S.W. by W. to N.W.), when a considerable swell sets in through the gaps of the reef."

Captain Maitland, R.N., says that a vessel should anchor at 1½ miles from Green island, with the pagoda on Amherst point, showing clear of it to the northward; thereby enabling pilots to come off during a flood-tide, by pulling along shore to the southward, and also giving plenty of room to weigh—a matter of some difficulty and danger in the strong tides off the Reef buoy close to the rocks and shoals. He also states that a pilot station is on the island.

As a summary of the foregoing it may be remarked, that it is advisable, generally,

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* Mr. Davy says:—"It may be useful to mention the extraordinary ripples so frequently to be met with in the upper parts of the Bay of Bengal, and near the entrance to the Strait of Malacca. These ripples resemble an impetuous tide bubbling and breaking in front of an obstruction, and yet, from the observations that have been made upon them, they appear not to have the effect of current, nor in any way to throw a ship out of her reckoning. They are most frequently met with in calm weather or in light winds; often they have the appearance of a dangerous shoal, rippling and surging with much force, and advancing towards the ship against a single-reef-topsail breeze at the rate of 2 or 3 knots an hour. In striking against the ship, the water often surges over the hammocks of small vessels, and fills the decks with water; in passing to windward, they may be traced to a considerable distance.

to approach Amherst on the parallel of 16° N.; when on this parallel, in Long. 96° 30′, the Zingaat mountains will be seen in clear weather. If soundings of 10 or 11 fathoms are obtained, a vessel will be on the Martaban coast; but if they decrease to 6 or 7 fathoms, she will be on the edge of the banks fronting the Rangoon river or the adjacent coast. If the coast about Amherst be made during the South-west Monsoon, which is the stormy season, commencing in May and terminating in October (the rest of the year being made up by N.E. winds, calms, and clear settled weather), there is good anchorage off the shore at from 5 to 10 miles distance, which continues for about 100 miles southward of the port. A ship sailing from Amherst in the S.W. Monsoon, before obtaining an offing, may probably be obliged to anchor two or three times during the flood-tide, with the risk of riding very hard, or parting her cable by the heavy sea.

KALEGOUK ISLAND.—From Cape Kyai-kami (Amherst point) to the north end of Kalegouk island the distance is 30 miles. Double island has already been noticed; the shore behind it is low and fronted by a shallow flat, for which reason vessels should always keep westward of the island. At about 6 miles from Double island, in a south-easterly direction, are two patches of rocks above water at about 3 miles from shore; in the channel between these and the land are soundings of about 5 fathoms, but as the projecting point of the coast has a reef extending from it some distance, it will be prudent to keep outside them; the depth at a very little westward of these rocks is 8 and 9 fathoms. The current hereabout, at 7 miles from the land, was observed by Captain Ross, of the Indian Navy (1828), to flow northward at the rate of 4 knots an hour, and to increase in strength as he approached Amherst.

Kalegouk island is an island 5⅓ miles long, in a N. by W. and S. by E. direction, and not more than a mile wide in its broadest part, its north end, whence it tapers to a point at its south end. Steep point, in the centre of the island, on its east side, is in Lat. 15° 33′ N. On Woodstock hill, 200 feet high, and 1¼ miles from its northern end, were some remarkable trees in 1862. Dr. Macpherson says—"The island is composed of primary rock, the superstratum being a rich mixture of open porous soil, composed of sand and vegetable mould. Its formation is very peculiar, the northern and southern portions differing considerably. The northern half on the western side is composed of a long granite ridge, with an average perpendicular drop to the sea. The eastern side descends to the shore in gentle or abrupt slopes, while the western is broken into isolated hills, with level, well-raised intervening spaces, forming three bays. Quarry bay, where the stones were prepared for Alguada lighthouse, is the deepest; the beach is sandy, but at ebb tide an extensive mud flat, covered in places with mangroves, is exposed, the somewhat narrowness of the channel between the island and the mainland tending to the accumulation of mud. Both sides of the island are broken into bays. To the west, Retreat, Rocky, Sea, and Fish bays, have beautiful hard, sandy beaches, well protected by high land on each side, and open to the ocean in front, with a fine rolling surf on the beach, and only divided from one another by projecting rocky points, and from the corresponding bays on the eastern side by well-raised necks of land, sloping east and west, free from all swampy ground, and ascending north and south to the hills which divide the bays. The eastern bays look on the distant mainland, rising in bold outline on the horizon. These very much resemble the western bays; in fact, differ

Sheet 4


PENANG
NORTH CHANNEL
SOUTH CHANNEL
Mooka Head
Tekoos I.
Bell Retiro
West Hill
GEORGE TOWN
R. Penang
Middle Bank
Riv. Roosa
Red River
China Bazar
Bittong I.
Garetah Sangool Pt.
Batumou Pt.
REMO I.
Kundit or Saddle I.
GREAT KRA
FLAT
North Kra
South Kra
Krian Bank
BATUCAWAN ISLAND
Alligator Pt.
R. Krian
R. Junjon
Sugar Cane Plantation
Tumbone Hills
Douro Hills
Thenga Hill
R. Jooroo
Mangrove Swamp
Prya
Riv. Prya
Stockade Hill
Pillar
Jermal
Cheena
Obelisk (wh.)
Lalong
R. Tawar
R. Roulea
Twelve feet Swatch
Fishing Stakes and Stages
Lat. 5° 24' 30" N.
Var.n 1° 40' E.
Lon. 100° 20' 10" W.
Nautic Miles
0 1 2 3 4 5

only by the mud uncovering at half-tides, the rise and fall at spring-tides being 22 feet. All the bays on the eastern side are perfectly protected from the south-west Monsoon, as are the bays on the western side during the north-east Monsoon; the entire island is clothed with fine primeval forest, with trees of immense dimensions and height. Water of an excellent quality is procurable at a depth of 15 feet; and a perennial spring of sweet water flows through the centre of the island."

At the south end of Kalegouk island is an islet, one-third of a mile long, named Cavendish, surrounded by a reef which projects from its south-west side about a quarter of a mile. In the narrow channel between these islands the depth is 8 and 7 fathoms.

The west shore of Kalegouk has not been surveyed; it is believed to be lined by a reef, and should not therefore be approached nearer than the depth of 11 or 10 fathoms. The east shore has shoal water from it to a moderate distance, beyond which are soundings of 5 and 6 fathoms.

At the north end of Kalegouk, and separated from it by a very narrow channel of 5 to 8 fathoms, through which the tide flows to the north-west at the rate of 5 knots an hour, causing a heavy race, commences the Galloper sand, a shoal extending thence 6 miles to the N. by E. in the direction of Pulo Cropic, a small islet situated about a mile from the mainland. This sand is dry at low tide over a considerable portion of its surface, other parts having a depth of not more than 6 to 12 feet, and its edges are moderately steep; consequently it should be very cautiously approached. The channel between its north end and Pulo Cropic is rather more than a mile wide, and has soundings in it of 5 to 10 fathoms; it is called North channel, the South channel being round Cavendish island, at the south end of Kalegouk.

The channel between Kalegouk and the shore is 4 to 5 miles wide, and the soundings midway are about 8 fathoms. Here vessels may anchor and find good shelter from all but southerly winds; the best place is said to be off the highest part of the island in 6 or 7 fathoms. Ingress and egress are easy. The North channel is very rarely used, being narrow.

When running for Kalegouk anchorage, give Cavendish island a berth of about a mile, and when it bears W.N.W., haul to the northward and pass up to the anchorage. The shore of Kalegouk island should have a moderate berth given to it.

According to Mr. N. Icely, R.N., who surveyed this anchorage in 1830, vessels drawing 10 feet may be laid on shore for repair at North creek, on the east side of the island, at about a mile from its north point. Wood and some fruit may be procured, and three or four tons of water per day in the dry season at Mahomed's well in Freshwater bay. Buffaloes and rice can be obtained from Dermonjai creek, on the mainland opposite the middle of the island.

COAST OF TANASSERIM, &c.—From Kalegouk island southward to Lat. 6° N., including the Mergui Archipelago, there are no ports frequented by foreign vessels, and as this coast is but very little known, no thorough survey of it (except one of the Mergui islands by Com. Lloyd, 1828) having yet been made, it seems superfluous to attempt a description of it, especially as the harbours are all of such a character that they cannot be entered without a pilot. We therefore conclude our description of the east coast of the Bay of Bengal with some remarks upon Penang.

PENANG.—Penang is an island having the form of a parallelogram, situated

between Latitudes 5° 16′ and 5° 28′ N. and Longitudes 100° 10′ and 100° 20′ E. It is very lofty, West hill, in the northern part of the island, its most elevated part, being 2713 feet above the sea. On the east side of the island is Georgetown, where a considerable trade is carried on with Singapore, and various ports of Eastern India. Fort Cornwallis is in Lat. 5° 24′ 30″ N. and Long. 100° 20′ 10″ E.*

The channel between Penang island and the shore is from 8 to 2 miles wide, the latter being the width of the channel opposite the town. The greater part of this space is occupied by the Great Kra Flat, an extensive shoal of 3 to 9 feet, which runs off from the main land in the direction of the island: this bank appears to be of a changeable character, as the South channel, the channel between it and the island, was found in 1863 to be about 10 feet less in depth than when it was surveyed by Lieut. Woore, R.N., in 1832—hence it will not be prudent to attempt to enter Penang harbour by this channel without a pilot. We believe that the edges of the sands are marked by fishing stakes and beacons.

The anchorage at Penang is off the town in 9 to 12 fathoms, and there is protection from all winds except those from north-westward. The best berth for large vessels is said to be at about a quarter of a mile south-eastward from the fort in about 10 fathoms; small vessels anchor nearer the town in 3 to 4 fathoms. The harbour has an extent of $1\frac{1}{2}$ to 2 miles; the fort point is nearly steep, having 5 to 9 fathoms immediately off it, in the middle are 12 to 14 fathoms, and the soundings off the main decrease from 7 to $1\frac{1}{2}$ fathoms. Ships of war anchor in 7 to 10 fathoms half a mile northward of the fort.

The best route to Penang anchorage is from the north-westward. The north shore of the island is high and bold, and has a shoal extending out from it 1 to 2 miles, on the edge of which are soundings of 3 to 4 fathoms; hence it should not be closely approached, nor should a large ship get nearer the coast of the main land than 2 miles, on account of the shallow flat extending from it. The soundings throughout this, the North channel, are $4\frac{1}{2}$ and 5 fathoms, deepening to 9 and 10 fathoms in the vicinity of Georgetown. The South channel in 1832 was safe for vessels drawing under 17 feet; the depth, as already observed, is said to have become considerably reduced.

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* This is considered to be a well-determined position, and has been taken as a secondary meridian in determining the position of various places in the Bay of Bengal and Strait of Malacca. A shipmaster bound to Penang should have the Admiralty chart (No. 1366) at hand for reference.

PRINCE EDWARD Ids

Nautic Miles
0 5 10

PRINCE EDWARD ISLAND

Mag.
Varn 33° 30' W.
(1865)

Lat. about 46°45' S.

The Prince

MARION ISLAND

Cascade

Long. about 37°36' 4 E.

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PART III.

SAILING DIRECTIONS

FOR THE

ISLANDS IN THE INDIAN OCEAN.

PRINCE EDWARD ISLANDS.*

THE two lofty islands known as the **PRINCE EDWARD**, are situated about 1000 miles from the continent of Africa, in a south-east direction from Algoa bay, in about Lat. 46° 50′ S., and Long. 37° 36′ E. They lie in a N.N.E. and S.S.W. direction, and are distant from each other 12 to 13 miles, the channel between being apparently clear of danger, excepting such rocks as may be off the shores on either side. The south-western and larger island is named Marion, from the Frenchman, MARION DU FRESNE, who discovered it in 1772; the more northerly island bears the name of PRINCE EDWARD.† CAPTAIN COOK considered the larger island to be about 45 miles in circuit, and its centre to be in Lat. 46° 53′ S., Long. 37° 46′ E.;‡ the smaller island in Lat. 46° 40′ S., Long. 38° 8′ E., and about 27 miles in circuit. They have not been surveyed, so it is not known if a bank of soundings surrounds them to any distance; and they are believed to contain no place of safe anchorage.

CAPTAIN COOK'S report of these islands is as follows:—"We passed midway through the channel between the islands, and could not discover, with the assistance of our best glasses, tree or shrub on either of them. They seemed to have a rocky and bold shore; and, excepting the south-east parts, where the land is rather low and flat, a surface composed of barren mountains, which rise to a considerable height, and whose summits and sides were covered with snow, which in many places

* So named by CAPTAIN COOK, in honour of the Duke of Kent, the father of Her Majesty.

† See Chart of Prince Edward Islands.

‡ COOK found the longitude of Cape Town to be 18° 32′ 10″ E., which is 6′ 10″ too much to the east, according to the most recent observations; hence rectifying the positions of Prince Edward islands as given by COOK, we find the centre of the western (Marion) island to be 37° 39′ 50″ E., and of the eastern (Prince Edward) island to be 38° 1′ 50″ E.

M. CECILLE made the Prince rock in Lat. 46° 45′ S., Long. 37° 36′ 4″ E. (see "Extrait du Rapport," &c. &c., par M. CECILLE, Capitaine du Vaisseau, Envoyée dans l'hémisphère Austral à la protection de la pêche de la baleine, 1837–1839), in which position it is placed in the French chart No. 955. CECILLE'S Longitude appears to be a mean between that of COOK and Ross and is probably correct.

seemed to be of a considerable depth. The south-east parts had a much greater quantity on them than the rest; owing, probably, to the sun acting for a less space of time on these than on the north and north-west parts. The ground, where it was not hid by the snow, from the various shades it exhibited, may be supposed to be covered with moss, or perhaps such a coarse grass as is found in some parts of the Falkland islands. On the north side of each of the islands is a detached rock; that near the south island is shaped like a tower, and appeared to be at some distance from the shore. As we passed along, a quantity of sea-weed was seen, and the colour of the water indicated soundings. There was no appearance of an inlet, unless near the rock just mentioned; and that, from its smallness, did not promise a good anchoring-place."*

Prince Edward islands have since been visited by various navigators; among others by M. Cecille, of the French ship *Heroine*, in 1838; and subsequently by Captain J. C. Ross, R.N., with the *Erebus* and *Terror*, in 1840, when on his Antarctic voyage.†

M. Cecille says, that "at 2 miles E.S.E. from the north cape of the larger or western island, there is a very high and remarkable rock, which I have named the 'Prince:' it is much darker than the rock on the coast off which it stands, and is visible at a great distance. From the northward its summit appears larger than its base; from the north-east it appears like a tower—as it does from the eastward also, but in the latter view with the summit cut off in an inclined line: it is at a short distance from the coast, which appeared hereabouts fit for landing. In order to examine the western shore of the island, we sailed along at a distance of 1 or 2 miles, from the north to the south cape. At 7 miles E. 27° S. from the 'Prince,' we found before us a bank of kelp, extending at right angles with the shore about 3 miles. The *Heroine* was put about, and after working round the bank, we approached the coast again to resume our operations. In all probability there is sufficient water under the kelp, at least I think so, for it appears to be of the same nature as that which surrounds Tristan dà Cunha and the Falkland islands—some pieces of which are 40 fathoms in length. It is not rare to find kelp at the depth of 25 to 30 fathoms; but it is also found on rocks at less depth, and I therefore did not think fit to cross this marine forest, and time would not permit of our sending a boat to sound. We met with another bank of the same kind extending a mile to seaward from the eastern point. The coast which from the north cape to this point trends in a direct line E. 40° S. and W. 40° N. now suddenly bends to the S.S.W. We found a considerable waterfall at about 2 miles in this direction, tumbling from the heights to the flat shore beneath. We kept continually sounding with 12 to 15 fathoms along our track without finding any bottom. The coast we passed rises abruptly towards the mountains, presenting no sandy beach, bay, landing-place, nor anchorage whatever; neither could we form any correct opinion of the height of this mountainous island, the summit of which was concealed by clouds. The heights were capped with snow, and we observed much more on the southern than on the northern part of the island, in consequence of its being less exposed to the sun. Not a tree or bush of any kind was seen; and the soil seemed dry and arid, but there

* "A Voyage to the Pacific Ocean, for making Discoveries in the Southern Hemisphere, under the Direction of Captains Cook, Clerke, and Gore, in H.M. ships *Resolution* and *Discovery*, in the years 1776-1780." Vol. I., p. 53, second edition, 1785.

† "Voyage of Discovery in the Southern and Antarctic Regions, years 1835-1843, by Captain Sir J. C. Ross, R.N.

appeared a green and red moss, resembling that on the Crozet islands, covering the pyramidal-shaped rocks—which at a distance had the appearance of trees.

"The eastern island is much smaller than that just mentioned, and has a very remarkable rock at its northern extremity. The entire length of the island did not appear to extend more than 5 miles from north to south, although longer from north-west to south-east; it is neither so elevated as the other, nor covered to the same extent with snow."

Captain Ross describes the islands as follows:—"The weather was so hazy that we could not perceive the land until we found ourselves within 2 or 3 miles of the southern point of the larger island. Sailing close along its south-eastern side, and at about 1 mile south of the east cape, we sounded in 86 fathoms, fine sand, coral, and corallines. This line of coast is composed of black, perpendicular, volcanic cliffs, much worn away by the action of the waves. We observed two or three conical hillocks, like the small craters of a volcano, of a deep red colour, whether arising from an oxide of iron, or vegetable matter, we could not discern. The south cape has a perpendicular face, the termination of a long terrace-like projection from the foot of the hills. The mountains in the centre of the island rise to a considerable height; but their summits being enveloped in mist, we could not determine their elevation, although we could see they were partially covered with snow. We imagined we could distinguish small trees; still of this there is considerable doubt.

"Long lines of seaweed extended 2 or 3 miles from the shore beyond the east cape, whilst strong eddies of tide, occasioned probably by their meeting at this point, seeming to indicate concealed dangers, and darkness now coming on, we hauled off for the night, having first seen a small cove a short distance to the northward, where we hoped to be able to land the next morning. This part of the coast was populated by vast numbers of penguins, in groups of many thousands each, and other kinds of sea-birds were abundant. Some seals that were playing in the surf about the small detached rocks were pronounced to be of the fur species (*Arctocephalus Falklandicus*), by those well acquainted with them; it is not improbable that on the western coast some of their haunts, or, as the sealers term them, 'rookeries,' might be found.

"The soundings during the night were very irregular. A dredge put overboard for a short time in 95 fathoms, at about 5 or 6 miles east of the island, came up quite full of a small white coral, and between 30 and 40 different kinds of marine animals, corallines, flustræ, and sponges. At daylight in the morning we found that we had been carried so far to leeward by a strong tide, or more probably a current, and so heavy a swell prevailed from the westward, the forerunner of the coming gale, that I reluctantly gave up my intention of landing, rather than lose any more time in hopeless endeavours, and bore away for the Crozets.

"There did not seem to be any bay along the north-eastern or south-eastern coast where a ship could find anchorage, unless it be just to the northward of the east cape, where we supposed we saw a small sandy beach between two extensive patches of seaweed; nor did Commander Crozier see any as he passed along the shore the next day in the *Terror*. He mentioned a remarkable detached tower-shaped rock, at some distance off the north cape. This promontory he found by good observation to be in Lat. 46° 53′ S., and Long. 37° 33′ E., agreeing very nearly with Cook in the latitude, but differing considerably in the longitude. In the *Erebus* we were unfortunate in not getting observations near the southern part of the island; nor could we approach the smaller north-eastern island sufficiently near to see any creeks or bays; but I was afterwards told that sealers sometimes anchor at a place

called Cave bay, on its east side, in Lat. 46° 40′ S., with the N.E. point bearing N.E. by E.; the Cave, W.N.W.; and Mary's point S.W. ½ S. in 8 or 10 fathoms of water."

THE CROZET ISLANDS.*

The **CROZETS** are situated between Lat. 46° and 46° 37′ S., Long. 50° 20′ and 52° 20′ E.—on the direct track of vessels bound to the Australian colonies. The westernmost of the group is **Hog island**; the easternmost, **East island**; and the largest has received the name of **Possession island**; besides these, there are the **Twelve Apostles** to the north, and **Penguin islands** to the south. Their relative positions will be seen by reference to the chart. They have not been surveyed, and are supposed to contain but one place of anchorage—viz., **Ship bay,** at the S.E. end of Possession island, where vessels may ride in tolerable security sheltered from all winds except those from the south-eastward, to which quarter the bay is open. The group is named after M. CROZET, commander of the French ship *Ajax*, who discovered the islands in 1773.

The only known sunken danger among the Crozets is a reef upon which the sea usually breaks, situated about midway between Hog island and the island south-eastward from it, named Penguin; this reef is named Heroine breakers, from the French ship commanded by M. CECILLE. On the west and north sides of Possession island there are some detached rocks.

In Ship bay—the small bay at the south-east end of Possession island—the depth decreases from 17 fathoms at the entrance to 6 fathoms close to the shore at its head near the watering-place. The best place to anchor is in the middle of the bay in 9 fathoms, but care is required to keep clear of the rocks jutting out from the south shore; the north shore of the bay is probably clear of sunken rocks.

The Crozet islands were examined in 1838 by M. CECILLE, of the French Navy, in command of the *Heroine*, and from his published report† the following is translated:—

"We began our task in the N.W., with land which we have since found to be part of Hog island; and running southward along the western shore of it, a mile distant, we satisfied ourselves that it was inaccessible. Having reached its southern extreme, the Twelve Apostles (a group of rocky islets) bore N. 25° E.; at the same time, breakers were reported at a considerable distance bearing S. 50° E. We returned along the eastern coast of Hog island, and ascertained correctly that only the western coast of that island and the Twelve Apostles offered no shelter for ships. We then retraced our course to examine the dangerous breakers which had been reported, and which we had lost sight of, and at 11h. they were three miles W. 28° S. of us. At midday we were enabled to obtain tolerably good observations, notwithstanding the horizon was not perfectly clear, and the sea was very high. We thus fixed the relative positions of the three islands, as well as the dangerous reef, which was still in sight.

"We then steered for the eastern group. At 4h. P.M. we perceived an island, not only more elevated but of much larger proportions than those we had visited, and which we concluded to be Possession island. At 6h. P.M. we neared a large perfo-

* See Chart of the Crozets, and Plan of Ship Bay.

† Extrait du rapport, &c., par M. CECILLE, to which reference has already been made, p. 491.

CROZET ISLANDS

30′ 51° 30′ 52°

46° 46°

Mag.

Var.n 32° W. (1865)

Apostle Is.

HOG I.

Heroine Breakers

POSSESSION I.

Ship Bay (see plan)

EAST I.

Penguin Is.

46° 30′ 46° 30′

30′ 51° 30′ 52°

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CROZET ISLANDS
POSSESSION I.
Penguin I.

rated rock to the N.W. of the island, and not far from the shore; from this rock we were enabled to see distinctly the whole of this steep coast entirely exposed to the wind, and against which the sea broke with all its fury."

Captain Cecille was unable to continue his exploration that day, being compelled to stand off; but he made the land again next day, when he says:—"We approached the perforated rock in order to proceed with our survey of the eastern coast.

"We had been for some time keeping a southern course along the land, when, on the 23rd of November, at 3h., we perceived off a point ahead of us two boats coming to meet us; they were soon on board. The crews were Americans, each being commanded by a captain of that nation, who informed us of the loss of their two vessels, the *Atlas* and *Colossus*, on Possession island, on the 4th of October preceding; they also told us that the passage-boat, *Bordelais*, had been lying in Ship bay since the 6th of November. We proceeded thither, intending to anchor at the entrance of the bay, where we found her engaged in the fishery.

"The resources of the *Heroine* offered to Captains Barnum and Randall, as well as twenty-five of their crews, were accepted with gratitude. I took them on board in order to transfer them to any ships of their own country that I might happen to meet at the different fishing-stations, or at any of the English colonies of Australia where there are consuls. My first care on arriving at the anchorage was to cause a correct survey of Ship bay to be made, so as to enable us to fix its position, hitherto so badly known,—a service which was performed by MM. Fournier and D'Ubraye, in the course of the day.

"The Crozet islands, situated between Lat. 46° 9′ and 46° 34′ S., Long. 50° 24′ and 52° 20′ E., are five in number, and are divided into two groups. The largest of the western group is Hog island, which is mountainous and high; the coast in many places steep, without any bay or anchorage for ships. The only parts at all accessible, and that with difficulty, are a few places on the eastern coast. It abounds with wild hogs and seals. At the distance of nine or ten miles E. 40° S. from the southern point of this island is a dangerous reef, which appeared to extend about a cable's length. It blew a gale all night, which made the danger formidable.

"About eight or nine miles to the N.E. of Hog island are the Twelve Apostles, which, strictly speaking, are connected together. Formed by two islets of moderate height, separated by a narrow channel and surrounded by ten or twelve small rocks, they appeared inaccessible on all sides. A danger is reported to lie three miles S.E. of the Apostles, but we could not see it.

"The most southerly of the Crozets is Penguin island, formed by two very elevated islets—close together. It is six miles in circumference, and has the appearance of a sugar-loaf when seen from the N.E. It abounds with seals.

"The eastern group of the Crozet islands is composed of Possession island and East island. On the S.E. of the former island is a small bay, about a quarter of a mile in depth, and about half that in width, called Ship (Navire) bay. It is situated at the termination of a deep valley, from whence a stream of delicious water runs into the sea. Being open to the E. and S.E. winds, which seldom blow with much violence, but sufficiently so as to produce a high sea and considerable surf, it is then very dangerous; but these winds rarely blow between November and the end of February. The N.W. wind, which comes down the valley, is very strong; and when the N.E. and S.W. winds, which blow along the coast, are strong, the

surf breaks violently, and renders communication with the land very difficult. Vessels intending to remain here any time should ride with strong chains secured to the rocks on the shores of the bay, with the strongest chain to starboard, on account of the sea. Ship bay is the best place of shelter, and the most frequented by fishermen; water is easily obtained there. Its Lat. is 46° 26′ 18″ S., Long. 51° 50′ E.

"Two miles to the northward of Ship bay is the bay of Chaloupe, which offers no shelter except for boats. Three miles farther to the northward is America bay, moderately large. A ship anchored in 8 fathoms water at two cables length from a rock on the starboard side of the bay on entering, is tolerably protected from any wind between north and south, by the west; the bottom is sand and rock. It is not advisable to stay long at this anchorage; good water is found in a small river at the bottom of the bay. Three miles farther north is Hebe bay, where a vessel of that name was lost in 1831. It is small, and only fit for boats, which may find shelter under the lee of a rock in the middle of it. The western coast, with the exception of a reef lying three or four miles off the western point of Possession island, is clear of danger; but as the sea there runs extremely high, it should be carefully avoided under a light wind or with uncertain weather.

"East island, the most eastern of all the islands is very high and steep, access to it being only attained by a very small bay, situated on its N.W. part. It is not favourable for fishing, although seals in great numbers find more shelter on its southern side than on any of the other islands. All these islands are plainly visible in clear weather at the distance of twenty to twenty-five leagues; but, like Prince Edward islands, they are totally destitute of trees or bushes. Being nearly always covered with snow, the only vegetation is grass and a very hard sort of hollow-stemmed moss, which grows on a soil everywhere marshy, as well as on the sides of the mountains. This moss is of a reddish colour, and when squeezed emits a juice of the same colour. The islands are an asylum for a prodigious number of birds of several species, and three kinds of penguins—viz., the royal, the tufted, and the common."

The Crozets were subsequently visited in 1840 by Captain Sir James Clark Ross, R.N., when on his Antarctic Voyage of Discovery in the *Erebus* and *Terror*, and from his observations we make the following extract:—

"Land was seen at daylight bearing E. by S. at the distance of 10 miles. It proved to be Penguin or Inaccessible island, and well deserves either of the names it bears, for it was literally covered with penguins on all the ledges of its rugged shores, nor could we anywhere see a point on which it would be possible to land.

"'Pig or Hog island' of the sealers, was soon afterwards seen to the northward. It is the westernmost island of the group, and presented a much more agreeable aspect, but the weather being unfavourable, and its eastern, or lee side, having many dangerous reefs and detached rocks off it, we did not venture nearer than 2 or 3 leagues; but after passing close to Inaccessible island, we shaped a course for the southern extreme of Possession island, which we had been informed extended as far as the 47th deg. of lat. During the night the wind increased to a strong breeze from the westward, with thick weather, and we were obliged to carry a heavy press of sail to clear the land under our lee, which we had scarcely accomplished when a south-westerly gale came on.

"April 27. Although still very foggy at times, we were enabled to bear away at

10 A.M., and having passed over the assigned position of Possession island, we saw the land at 5 P.M. through the haze, 5 or 6 miles distant, but daylight was now almost gone; we nevertheless stood towards it, until darkness closed the scene, when the ship was hauled off for the night.

"April 28. The morning was more clear, when as the day broke between 6 and 7 o'clock, we perceived the lofty mountains of East island 4 or 5 leagues directly to windward of us, so much had we been carried to the eastward during the night. The whole day was spent in beating up against the current and strong westerly breeze, and at sunset we were still several miles from the shore. I could not but regret this serious loss of time, but having appointed Possession island our first rendezvous, until the end of this month, in case of parting from the *Terror*, I wished to communicate with one or other of the sealing parties, to ascertain whether they had seen her off the islands. I was still more anxious to land the provisions which I had on board for the winter stock of those people who might have been in much want of them. We therefore continued beating to windward all night, and at daylight, the fog having cleared away, we had a good view of this perfect mountain mass of volcanic land; its shores, bold and precipitous with many projecting rocks, which seem to have been formed by the unceasing action of the waves cutting away the softer parts, and with the exception of a single beach of some extent, on the north-east part of the island, affording no place where either a habitation could be built, or a boat land.

"This beach appearing to us the only favourable spot for the sealing party, we fired several guns as we stood close in to the shore, and by these means attracted their notice, for we soon afterwards observed by our glasses a large fire on the east side of the bay, which the people had made to point out to us their location. We were still too far to leeward for them to venture off to us, and after beating to windward until 2 P.M., when just as we could have fetched into the bay, the wind suddenly increased to a strong gale, and the violent gusts that rushed along the almost perpendicular coast-line, raising the spoon-drift in clouds over us, reduced us to a close-reefed main topsail and storm staysails, under which, when within half a mile of the shore, we wore and stood off again, seeing the utter hopelessness of communicating with the party until the return of more moderate weather. We were greatly disappointed at being thus defeated; but these frequent repulses only made us more determined to do our utmost to effect the objects we had in view; and although we were driven by the gale and current far away to leeward, yet, towards evening, when it abated, we began to maintain our ground, and, by carrying a heavy press of sail throughout the night, we found ourselves the next morning (April 30) several miles to windward of East island, and had Possession island distinctly in sight on our weather bow. Knowing the greater facility of communicating with this land by reason of the shelter its extent affords from the strong westerly gales that blow almost continually except at this period of the year, and as the larger establishment of sealers was on this island, I preferred beating up to it as the weather was fine, and we were making good way, rather than run down to the leeward party at the risk of being again unable to land at their station. Soon after noon it fell quite calm; and, after firing a few guns, we observed a white flag hoisted on a pole by the party in America bay; we were at this time about 5 miles from the shore, and directly between Possession and East islands; the weather was still too unsettled for a boat to come off to us. While lying becalmed in this passage we obtained soundings in

85 fathoms, on a bank of sand, shells, and corallines. At dusk, on a breeze springing up from the north-west, we stood off to sea for the night.

"May 1. It blew hard from the north-westward with so dense a haze that it was only during a partial clearing, and when within 4 miles of Dark head, we had a glimpse of the high perforated rock that stands out more than a mile from the coast to the westward, and is an unerring mark, by which the cape may always be distinguished. As we bore away close along the shore we got into smooth water, but passing 'Windy bay,' the squalls that came down the valleys compelled us to lower our topsails and keep them down until we had passed the opening.

"The remarkable 'Red Crag,' near which the flag had been displayed yesterday, came in sight, and guided us to America bay, where we saw the party on the beach launching their boat. Their superintendent came on board, and he, as well as his boat's crew, looked more like Esquimaux than civilized beings, but filthier far in their dress and persons than any I had ever before seen. Their clothes were literally soaked with oil, and smelt most offensive; they wore boots of penguins' skins with the feathers turned inwards. They told us that the weather had been so tempestuous that until yesterday they had not been able to launch a boat for five weeks; they had, therefore, been very unsuccessful at the Sea Elephant fishery, and were disappointed, to find they were not to be removed to Pig island for the winter, which they describe as being so overrun with these animals, that, to use their own words, 'you can hardly land for them.' The breed was left there by Captain Distance in 1834, and in less than six years have increased in an almost incredible manner, although great numbers are every year killed by the sealers, not only for present subsistence, but salted down for supplies on their voyages to and from the cape. Some goats had been landed from an American ship some years ago on Possession island, and were also thriving on the long coarse grass with which it abounds, but still maintained their domestic state, under the protection of the sealers. The party consisted in all of 11 men, one of whom had been on the island for three years; they seemed to have no wish to return to the Cape of Good Hope, and were quite contented, having plenty of food. The tongue flippers, and part of the carcase of the sea elephant, are eaten by them, and they get a great abundance of a species of rock fish (probably a *cottus* or *notothenia*,) about the size of a small haddock, with a very large head, which they preserve by drying on the rocks. The eggs of sea-birds, in the breeding season, may be collected by boat-loads, and are said to be excellent food, particularly that of the albatross, which averages above a pound in weight, and the young birds, when first taken from the nest, are described by them as being quite delicious; it is possible, however, they may have acquired the Esquimaux taste as well as their habits. They described the soil as being good, but they have never planted potatoes nor other vegetable, although they have no doubt of their thriving here, as the temperature is never very low. Wild ducks are so numerous in a lake on the top of the Red Crag, that dogs, trained for the purpose, get them any number whenever they are wanted.

"They had no plan of the island, and their information on this subject was vague and unsatisfactory; they stated it to be 20 miles long, and 10 miles broad, having three bays on its east side, in which ships may anchor, but the western coast is quite unapproachable by ships of any size, on account of the heavy swell that constantly rolls in upon its shores: a boat belonging to this party and all the crew were lately lost there, whilst in search of sea elephants. In America bay, Lively bay, and Ship

bay, vessels at anchor are well protected from the prevailing winds, but must leave the two latter immediately on the springing up of an easterly breeze, as America bay is the only one where there is room for a ship to beat out. These winds are said to be of rare occurrence, so much so, that the French frigate *Heroine*, which was sent to examine this group of islands, remained the whole period of her stay, above five weeks, moored in Ship bay; since then, however, two English whalers were wrecked in the same bay, by trying to ride out an easterly gale.

"We were told that there was every indication of an easterly wind, which is more frequent just at this time of the year, and the height of the barometer seemed to confirm his opinion, or I should have anchored for a few hours to have examined the bay; but convinced from the nature of its formation that it could be of no use as a magnetic station, and being anxious to rejoin the *Terror* as soon as possible at our next rendezvous, we bore away with the intention of laying down as much of the coast-line of the island as we could before dark.

"Like the rest of the group, it is evidently of igneous origin; near the tops of some of the hills we could perceive short basaltic columns, and two or three appearances of extinct craters. The coast is high and precipitous at the north end—and *singularly stratified;* along its eastern shore it is more broken into small bays, and we observed several cataracts issuing from the more extensive green patches upon the hill sides, and dashing over the black cliffs into the sea beneath.

"The remarkable Dark head, at the northern extreme of the island, is in Lat. 46° 19′ S., Long. 51° 53′ E.; the southern point is in Lat. 46° 28′ S., and Long. 51° 56′ E.; the variation of the compass, 35° 13′ W. The centre of East island is in Lat. 46° 27′ S., and Long. 52° 14′ E. These results, though sufficient for all the purposes of navigation, were not obtained with exactness, owing to the unfavourable state of the weather for observations.

"**Detached Rocks.**—Leaving the south end of Possession island at 4 P.M., we steered close along the southern coast of East island. Though not more than 3 or 4 miles in diameter, its loftiest pinnacles attain a height of at least 4000 feet, and the precipices of its shores in some places rise several hundred feet perpendicularly from the sea. Nearly every cape has its detached rock extending off it from ½ a mile to 2 miles; one of these near Bull bay lies still farther off, and being considerably inclined, in one point of view, resembles a ship under a press of sail; hence its appellation 'Ship rock.' Another, near the south-eastern extreme, is called 'Church rock,' from another fancied similarity; but the most remarkable of them all is the perforated rock to the westward of the north cape of Possession island, through which we were told a small vessel might sail."

HEARD OR McDONALD ISLANDS.

This is a group of islands situated southward of Kerguelen island, in about Lat. 53° S. and Longitudes 72° to 74° E. Until 1853 their existence was not known, as but few vessels had hitherto sailed in so high a latitude on the route to Australia. They generally bear the name of McDonald, but they should properly be called Heard islands, as it will be seen from the following remarks that CAPTAIN HEARD had priority of discovery over CAPTAIN McDONALD. The following extracts from the *Mercantile Marine Magazine*, 1858 and 1865, contain all that is known of them:—

"These islands are directly in the way of vessels that take the composite track of

53° S. to the Australian colonies, and were discovered almost immediately after the rage for the 'diggings' called up a new class of ships, to take the shortest possible route in the shortest possible time, to that land of gold, where every eager emigrant expected to make his fortune and return in an incredibly short time a veritable Crœsus. Now, if we mistake not, the following will be found to be the true order of discovery:—

"Nov. 1853.—Capt. Heard, of the American ship *Oriental*, saw islands in Lat. 53° 10′ S., Long. 74° 10′ to 74° 40′ E.—*Maury's Sailing Directions.*

"Jan. 1854.—Capt. McDonald, of the *Samarang*, discovered two islands—
1st—in Lat. 53° S., Long. 72° 35′ E.
2nd—in Lat. 53° 3′ S., Long. 73° 31′ E.

"Dec. 1854.—Extract from the log of the *Earl of Eglinton*, Capt. J. S. Hutton—
Nov. 30th—Lat. 51° 21′ S., Long. 70° 1′ E., strong breeze from N.N.W. with snow.
Dec. 1st.—Lat. 53° 1′ S., Long. 75° 30′ E., strong breeze from W.N.W. with snow.

"Steering S.E., southerly, at 2 A.M., on the 1st December, just as daylight was breaking, land was observed right ahead; all hands were immediately called, and the studding sails that were set on both sides hauled in, and we rounded close under the N.W. shore—after passing two rocks off the western point: we hauled in within 3 to 4 miles of the shore, which was covered with snow, and from 50 to 80 feet high. No shrub nor vestige of verdure was to be observed. That we were near the habitation of numerous ocean fowl was evident, since they quite shaded us overhead.

"A large conical mount on the northern end resembled in height and appearance the Peak of Pico (Western isles)—also a table land, in appearance like Table mount, in the Cape Colony, and as seen from Table bay. Although the weather was clear, we lost the extreme end in the distance, and a large quantity of snow lay on it. In calculating the position from excellent sights on the previous noon, as well as the noon of that day, the N.W. end lies in Lat. 52° 53′ S., and Long. 73° 50′ E. The island appeared from 15 to 20 miles in a N.W. and S.E. direction; but as we lost the land in the distance, it may extend beyond that length.

"Dec. 1854.—Capt. J. Attwaye, of the *Herald of the Morning*, reports from his log as follows:—

"Dec. 3.—I discovered an island, and sounded in 73 fathoms, on black sand. A harbour about 10 miles distant, good to view, but exposed to westerly winds. On the next day, the 4th, a small island, distant from the larger one about 10 miles, and a steep rock about a mile from it; the large island about 40 miles, and the small about 9 miles long. I had good observations when close to and sailing along two sides of the island. I give the middle of the large island Lat. 53° 10′ S., Long. 74° 36′ E. Longitudes deduced from chronometers, which leaving the Cape of Good Hope on the 18th November were found to be correct.

"Dec. 1854.—Capt. Rees, of the *Lincluden Castle*, gives the following account:—

"Dec. 4th, at 8 A.M., fine clear morning, to my great astonishment, we discovered something very like an island. At 10 A.M. we passed within 3 miles of a rocky island, apparently about 4 or 5 miles in circumference, and 400 to 500 feet high. Detached from the island, about a mile to the westward, stood a high rock, in the

THE HEARD OR McDONALD ISLANDS.

(*From a sketch by* JAMES S. HUTTON, *of the "Earl of Eglinton," Dec.* 1*st*, 1854.)

shape of a sugar-loaf, higher than the island. I could see it plainly from the poop, 18 miles distant. The position of the island by good observations is Lat. 53° 2′ S., Long. 72° 50′ E. I named it Gray island.

"When abreast of this island, high land was discovered to the S.E., covered with snow, the highest peak capped with clouds. At noon we were within 7 or 8 miles of the N.W. point; from this point the land trended to the S.W. as far as I could see, the land high and bold. We sailed along the north side two hours and a half at the rate of 10 knots. In passing along the north side, I saw an opening between two high hills, very like a fine harbour; there appeared a good bay outside, only open to N.W. winds. We passed two rocky islands, about 6 or 7 miles from the large one, apparently quite barren. The large island presented a magnificent spectacle; the sun shone brilliantly on its snow covering, and its highest peak seemed lost in the clouds. I could see the high land plainly at sundown, 50 miles distant. Lat. of N.W. end 53° 2′ S., Long. 73° 20′ E. Lat. of S.E. end 53° 12′, Long. 73° 50′. I named this Dunn Island.

"These islands would appear to have become, shortly after their discovery, the resort of whalers, as we learn from the *Mauritius Commercial Gazette* that Capt. Rogers, having received intimation concerning them, proceeded from Kerguelen island, as soon as the season would permit, in the ship *Corinthian*, to the neighbourhood, and found land, but whether a continent or island he could not tell; however, he returned to Kerguelen, and having procured tenders, again started for this new land. Arrived there with the *Corinthian*, *Atlas*, and *Mechanic*, in March, 1855, sending Capt. Brown, of the *Atlas*, on shore to look for a harbour. Capt. Rogers, at the same time, sailed under easy canvas along the land, making his observations upon the coast. Finally, they discovered a small creek in Lat. (according to Capt. Rogers, a good observer) 53° 00′ S., Long. 72° 31′ E. Capt. Church says it is in Long. (according to his chronometer) 73° 00′. Capt. Rogers states, on looking from a small promontory, he saw at once elephants and sea leopards enough to fill 100,000 barrels with oil.

"Capt. Rogers sailed along the N.E. side of this island, about 30 miles, and discovered one small harbour, where he anchored the *Atlas* and *Corinthian;* but it seems to be an unsafe harbour. He lay ten days, he says, in great danger with a S.E. gale blowing.

"A reef of rocks W. by N. (true), 40 to 42 miles from the N.E. end of the land.

"The mainland itself seems to be covered with ice and perpetual snow, and can only become a whaling station, as there is not a blade of grass to be seen during the height of summer.

"Capt. Meyer, of the *La Rochelle*, from Hamburg, is the next who reports the discovery of islands hereabout:—

"On the morning of January 10th, 1857, with a fresh breeze from N.E., the *Rochelle* was pursuing her voyage in the Great Southern Ocean near the parallel of 53° S., at the rate of 11 knots an hour. The rain was almost incessant and the atmosphere very foggy, so that there was scarcely a hope of getting a good observation that day. Towards mid-day, however, the fog and mist partially cleared away, when, at no great distance from the ship, a sugar-loaf rock was seen, and almost at the same instant a saddle-shaped island. At 0h. 15m. P.M., they bore N. by

compass, distant from 2 to 2½ miles; shortly afterwards the look-out announced a second island to leeward, the summit of which stood out above the clouds surrounding its base; it bore S. by E., while the first island lay N.N.W. from us, whereupon the course was changed from S.E. to S.

"At 1h. 6m. P.M., we had a clear sky, and an altitude of the sun was taken, for a reduction to the meridian; again, at 2h. 38m. P.M., we had another observation, and at 5h. 30m. a third; from these, combined with our courses and bearings, we determined the following positions:—

	Lat. S.	Long. E.
The Sugar-loaf rock	53° 8′·4	... 72° 23′·7
The North extremity of the larger island . . .	53° 13′	... 72° 44′
The Peak near the north end ditto . . .	53° 17′·5	... 72° 56′
The South extremity ditto . . .	53° 50′	... 73° 6′·6

"The middle of the strait separating the two islands is in about Lat. 53° 10′ S., Long. 72° 36′ E. of Greenwich, and while in it we experienced a strong set (? tidal) to the S.S.W.-ward; there was also a difficulty in keeping clear of the floating ice, of which it was full.

"As already observed, the first island, as seen from a ship to the westward of it at the distance of 2 or 3 miles, appears saddle-shaped; but on steering south the two peaks open out more, leading us to think that a small arm of the sea separates them. The loftiest peak was found by observation to be 286 feet high, and the island about 4½ miles in extent, N. by W. ½ W. and S. by E. ½ E.

"As we sailed along the southern and greater island, we could distinguish at about 4 miles S.E.-ward of its northern extremity a peak higher than that just mentioned. The coast appeared to be steeper and more broken to the south, where it terminates in its loftiest height, 1000 feet. The entire length of the island was 36 miles,* and at about a third of this distance from the northern end was a small bay, near which was a large islet. As evening drew on we were at its S.W. extremity, whence it stretched 20 miles to the eastward, which we had passed by 6 P.M., and at 8 P.M. the whole group had disappeared below the horizon.

"The land wore a winterly and truly antarctic aspect; ice-clad mountains rose high into the clouds; and only here and there was the naked iron-bound coast visible, with isolated patches of green showing through the snow, while in a few places the melting of the latter was productive of a waterfall tumbling from crag to crag. The only signs of life in these frozen regions were immense flocks of birds, among which were recognised the penguin and the albatross.

"February, 1858.—Lastly, we have CAPT. CUBINS, of the *Caribou*, making the north extreme of one of the islands in Lat. 53° 1′ S., Long. 73° 7′ E., and giving the following description:—

"On February 22nd, wind westerly, brisk gale with snow squalls; at 10·33 A.M. in a clear between the squalls, I fancied I saw land to the southward; took in studding-sails, shortened sail, and stood towards it. At 1.30 P.M. hove to abreast an island, with the centre bearing S.S.W., about 12 miles; lowered a lifeboat, and sent

* Another account in the Neue Münchener Zeitung states, that the greater island is 10 German miles from N. to S., and about 12 German miles E. and W. (The German mile is about 4½ miles English.) And the group lies between Lat. 53° 8′ S., Long. 72° 24′ E., and Lat. 53° 47′ S., Long. 73° 40′ E. of Greenwich. These islands were named the King Max by CAPT. MEYER, on the supposition that he was the first to discover them.

her to the land. I afterwards stood in to about nine miles off shore, and got no ground with 120 fathoms of line. The island appeared to be in a S.E. and N.W. direction, about 25 miles, its southern extreme trending to the S.W., forming a deep bight on its western side, which was entirely snow-clad, and gave it the appearance of a great barrier of ice. The greater part of the island was covered with snow; there was a remarkable group of high rocks lying off to the N.E. from the S.E. part of the island, apparently 6 or 7 miles, and on the N.W. extreme an iceberg aground. The island was cloud-capped, but I think that its greatest elevation could not be less than 450 feet above the level of the sea. While hove to, awaiting our boat's return, I was astonished to see vessels at anchor in a bay, we having opened it through drifting to the S.E. One of the vessels got under weigh, when I stood towards it; it proved to be the American schooner *Oxford*, of Fairhaven. They put out a boat, and the master came on board; he told me they called it Kurds island, and that it was discovered by them eighteen months before. He seemed annoyed that my boat had landed, and advised me to go and leave her behind, saying she would never return; but I told him I would never leave her while I had another boat to seek for her. I was very anxious, for it was then sundown, and darkness coming on fast; but while speaking, the look-out at the masthead reported the boat in sight. He then became more communicative, and told me they were after oil; that the shores of the island swarmed with sea elephants, and that they had sent to America from the island since the discovery 25,000 barrels of oil. The island was bold on the N.E. side, and no hidden dangers; and the bay where the vessels lay was a fine bay, or natural harbour, with good anchorage; no sunken dangers, with 12 to 20 fathoms all over, and sheltered from all winds except a north-easterly, with a fine river of fresh water at the head of it. He also told me that there was another island west of Kurds, distance some 30 miles, and another E.S.E. 70 miles, both of which he had seen, but never landed on them. My own officers that went in the boat confirmed his statement of the sea elephants, and of the island being well watered; there were penguins and other birds in myriads, and on an island about a mile apart from the main appeared to be a great mound of guano. Whilst lying-to I went to look at my abstract, and it made me shudder to think that only twelve months before I ran past the island at midnight in a heavy gale of wind, not more than four or five miles distant, ignorant of its existence. My greatest wish on sending my boat to the island was to find out if there were any shipwrecked persons on it whom I might relieve. It was entirely of volcanic origin, my officers having found the surface composed of ashes. I made the northern extreme of the island in Lat. 53·1 S., Long. 73·7 E.—good chronometers.

"From these accounts we come to the following conclusion: that there can be no doubt the observations of Captains Heard, McDonald, Hutton, Attwaye, Rees, Rogers, Meyer, and Cubins, refer to the same group of islands—but the *difference of position* requires a few remarks.

"The positions given by Capt. Attwaye coincide with those of Captain Heard; and are we therefore to conclude that they refer to islands not seen by Captains M'Donald, Hutton, Rees, Meyer, and Rogers? We think we are scarcely warranted in such a conclusion. Something must be allowed for the estimation of distance from the islands; and as all persons are not equally gifted in this respect, we may say the differences in the latitude are not large. But of the longitude, the dif-

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ference of the extremes is 2° 26′, equivalent to 88 miles on the parallel of 53°. Now, from the general description, by all parties, of the characteristic features of the land, we believe we are warranted in saying that there is *one small island near to which is a large pinnacle rock; S.E. of this small island is a much larger one, and separating them there is a navigable channel, when free from ice,* and we therefore draw the inference that the discrepancy in position as regards longitude arises partly from calculation, but more largely from *error of chronometers,* a subject which does not sufficiently receive the attention of captains. Two very important articles, the first—'On the Variation in the Rates of Chronometers,'* and the second—'On the Importance of Testing Chronometers before they are used at Sea,† written by JOHN HARTNUP, Esq., F.R.S.A., Superintendent of the Liverpool Observatory, are recommended for careful perusal, and captains will there see to what errors they are subjected. We may say, then, that the position of these islands is only approximately known, and caution is requisite in sailing near the parallel of 53° S. between Long. 72° and 75° E.; but taking the mean of HUTTON'S, REES', MEYER'S, and CUBINS' reports, we have for the North part of the larger island, Lat. 53° 3′ S., Long. 73° 15′ E.;—and for its south end (mean of REES' and MEYER'S observations) Lat. 53° 31′ S., Long. 73° 28′ E.

"We may here incidentally mention, that it is by no means impossible that shoals and rocks may be met more to the northward and eastward, as the following account will show:—

'CAPTAIN INGLIS, of the *Gauntlet,* of Liverpool, passed Kerguelen island on the 11th November, 1853, in Lat. 53° S. He here encountered continual snow-storms for a fortnight, accompanied by N. and N.E. winds. In Lat. 50° 50′ S., Long. 77° 30′ E., he passed over a bank of shoal water, the water suddenly becoming of a muddy appearance, and he has no doubt but that he passed within a very short distance of some hitherto undiscovered shoal, or island, as the water became perfectly smooth; but, in consequence of the heavy fall of snow, CAPTAIN INGLIS was unable to make such minute observations as he otherwise would have done. This shoal, or island, was observed by the crew and passengers as well as by the captain, who called them to witness the discovery he had made. Observing the blue water ran to the S.E. off the shoal, he steered away direct S. for one hour, going 13 knots, and then dropped suddenly into blue water. CAPTAIN INGLIS strongly recommends all navigators running from England to Australia, to keep a look-out when they arrive in this latitude.'"

KERGUELEN ISLAND.

This large island, situated between Lat. 48° 40′ and 50° 0′ S., and Long. 68° 40′ and 70° 40′ E., was discovered by M. DE KERGUELEN in 1772. It has not been surveyed, and the only part of it of which we have any knowledge is the eastern coast, where the irregularity of the coast line forms several large bays of great depth, affording good and secure anchorage. Christmas harbour, a small inlet under cape Français, the north end of the island, was surveyed by CAPTAIN SIR JAMES CLARK ROSS, R.N., in 1840, and observed to be in Lat. 48° 41′ S. and Long. 69° 3′ E. Some islets lie off the north and west shores of the island at, in some instances, 15 miles from it,—and one, named Solitary island, is even at a greater

* "Mer. Mar. Mag.," vol. i. p. 401-6. † Ibid., vol. iv. p. 33-40.

distance; hence, in foggy weather, more than ordinary care is required when approaching it on this side.

Kerguelen island is seated upon a bank of soundings, the extent of which is uncertain. Captain Ross, R.N., mentions that in his approach to the island from the Cape of Good Hope, he obtained soundings of 145, 120, and 115 fathoms, fine black sand and small stones, at from 25 to 15 miles westward from Bligh's Cap,* and subsequently in the run from that islet to cape Français had 70 to 80 fathoms, rocky bottom. In his attempt to enter Christmas harbour a heavy gale drove him from the land in a north-easterly direction, and afterwards, when regaining the land, a connected series of soundings was obtained on the bank, which was found to extend above 100 miles from the cape; the bottom consisted of black sand and rock. To this bank the name of Erebus was given, from one of the ships of the Expedition.

In the direction of E. by S. (*mag.* ?) from cape Français, distant 15 or 16 miles, there is a dangerous reef, named Terror reef, upon which the sea breaks.

Cape Français, the north-east point of Kerguelen island, is a striking object from sea, being very bold and making in terraces; it is also surmounted by a conical hill 1200 feet high, having a crater-shaped summit. Immediately under cape Français, on its south-east side, is Christmas harbour (previously mentioned), one of the best places of anchorage in the island, and so named by Captain Cook because he anchored there on December 25th, 1776.

Christmas Harbour is safe and commodious, and affords good anchorage in every part. It is about 2 miles in extent, N.W. and S.E., and three-quarters of a mile wide at the entrance, which rapidly decreases towards its head; the depth is 32 to 4 fathoms, on fine black sand. The head of the harbour is separated from the west coast of the island only by a low, narrow isthmus, scarcely a mile across, consisting of low ridges with intervening swampy ground and two lakes. When at anchor just outside the harbour in 45 fathoms, black sand, Captain Cook observed that the flood-tide came from S.E., at the rate of 2 miles an hour at least. Abundance of fresh water can be obtained here, but no wood. Captain Cook says: "The situation alone is sufficient to distinguish this harbour from any of the other inlets; and, to make it more remarkable, its south point terminates in a high rock, which is perforated quite through, so as to appear like the arch of a bridge. We saw none like this upon the whole coast. The harbour has another distinguishing mark within, from a single stone or rock, of a vast size, which lies on the top of a hill on the south side, near its bottom; and opposite this, on the north side, there is another hill, much like it, but smaller. There is a small beach at its bottom, where we commonly landed, and behind it some gently rising ground, on the top of which there is a large pool of fresh water. The land on both sides of it is high. The shores are steep, and the bottom is everywhere a fine dark sand, except in some places close to the shore, where there are beds of seaweed, which always grows on rocky ground. The head of the harbour lies open only to two points of the compass, and even these are covered by islands in the offing, so that no sea can fall in to hurt a ship. The appearances on shore confirmed this, for we found grass growing close to high water mark, which is a sure sign of a pacific harbour."†

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* Observed by Captain Cook to be in Lat. 48° 29′ S., and Long. 68° 40′ E. It is probably the northernmost of the islets off the N.-W. shore of the island.

† The arched rock mentioned by Captain Cook is 150 feet high, and the base of the arch is 100 feet across; it is wholly composed of basalt. The Table Mountain, on the north side of the

Cumberland Bay.—From Christmas harbour, cape Cumberland, the north point of Cumberland bay, is distant about 3 miles in a southerly direction; between, the irregularity of the coast line forms two bays, named Foul Haven and Mussel,* and the headland which divides the bays is a wall of basalt almost perpendicular, having deep water at a short distance from its base, as CAPTAIN COOK, when coasting along, seldom struck ground with a line of 50 or 60 fathoms. Cape Cumberland is a bold headland, with a small but moderately high basaltic islet off it, known as the Sentry Box, in consequence of a rock on its summit bearing a striking resemblance to a sentry box; eastward of this islet, about 2 miles, and separated by a channel more than 40 fathoms deep, there is a cluster of small islets and rocks with broken ground about them.

The south point of the bay, named point Pringle, is distant from cape Cumberland about two miles in a southerly direction. It is composed of basalt.

Cumberland bay is a narrow inlet, trending in a general direction of W. by S. for about 12 miles. Its head is separated from the western coast of the island only by a narrow isthmus of moderate height; at this end of the bay there is a creek having a depth of 10 to 3 fathoms, beyond which is a swampy valley; at two miles from the head of the creek is a lake $1\frac{1}{2}$ miles long and nearly half a mile broad, filling up a pass in the mountains which rise above it to the height of about 2500 feet. On this isthmus several loose pieces of coal have been found.†

When proceeding up Cumberland bay two inlets will be perceived at about 7 miles from the entrance, situated nearly opposite each other; that on the south shore runs into the land $1\frac{1}{2}$ miles, is a mile broad in its widest part, but only one-third of a mile broad at its entrance; its soundings are unknown. The northern inlet is not so large as the southern, and is said to have a depth of about 6 fathoms.

Cumberland bay has not been sounded, nor have its shores been examined with that care and attention which would enable us to say if there are any sunken rocks off them. It is believed to be very deep in mid-channel, an impression conveyed by the bold cliffs on each side of it. The anchorages are probably superior to those of Christmas harbour, as they are not exposed to such violent winds; but they are not so ready of access, and can only be reached during clear and moderate weather.

White Bay.—In a S. by W. direction from point Pringle (about 4 miles) is White Bay point, the extreme eastern end of the south shore of an extensive bay, named by

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harbour, is 1351 feet high; its top has the form of a crater. Beds of coal exist on the south shore of the harbour, and several fossil trees have been dug up, which prove that ages ago the island must have been well wooded; now, it is quite bare of even shrubs, almost the only vegetation consisting of grass. DR. HOOKER, the botanist to the expedition under CAPTAIN SIR JAMES CLARK ROSS, R.N., mentions a valuable kind of cabbage which grows on the island. "To a crew long confined to salt provisions, or, indeed, to human beings under any circumstances, this is a most important vegetable, for it possesses all the essentially good qualities of its English namesake, whilst from its containing a great abundance of essential oil, it never produces heartburn nor any of those disagreeable sensations which our pot-herbs are apt to do. It abounds near the sea, and ascends the hills to their summits. The leaves form heads of the size of a good cabbage-lettuce, generally terminating an ascending or prostrate stalk, and the spike of flowers, borne on a leafy stem, rises from below the head, and is often two feet high. The root tastes like horse-radish, and the young leaves or hearts resemble in flavour coarse mustard-and-cress. For one hundred and thirty days our crews required no fresh vegetable but this, which was for nine weeks regularly served out with the salt beef or pork, during which time there was no sickness on board."

* CAPTAIN COOK considered that these bays might possibly afford good shelter to shipping.

† Beds of coal evidently exist in Kerguelen island, but whether in sufficient quantity to be useful to steamers has yet to be proved. Some of that discovered was very light and friable, with a beautiful black glossy fracture, and, like cannel coal, did not soil the fingers.

Captain Cook White bay, because of some white spots of land or rock he saw at the bottom of it. Off this point there are several rocks above and under water.

White bay contains many small bays and coves, which doubtless afford good anchorage, and may be run for, if proper care be exercised. Loom and Teal bays, two small inlets on the north shore just within the entrance, are said to have a depth of about 7 fathoms.

Howes Foreland, &c.—From Pringle point to Howes foreland the distance is about 11 miles in a S.E. ½ E. direction. This is a projecting point of land joined to the shore by a low isthmus; the bay between White bay and this point, or that immediately westward of this point, is called Repulse bay,—Captain Cook having at first supposed the point to be an island, and attempted to pass southward of it. Some rocks and breakers lie near this point on its north-west side, and two islands, separated from it by a navigable channel, are situated 4½ miles south-eastward from it.

Howes foreland is of moderate height, and hilly. The coast is low, with rocky points projecting from it, between which are little coves with sandy beaches.

Rhode Bay.—The entrance to this bay is 7 to 10 miles southward from the extremity of Howes foreland, and is fronted by rocks and extensive beds of weed. The bay has two branches that run in W.S.W. and W.N.W. from 15 to 18 miles, and its head is separated from Whale bay only by an isthmus not more than three-quarters of a mile broad, across which a boat may be hauled, and so save a détour of 50 miles, if wishing to go into Hillsborough bay, of which Whale bay is the north-western branch.

Rhode bay is almost unknown, but is believed to contain several good harbours. The depth at its head is reported to be 25 to 18 fathoms.

The beds of weed just mentioned appear from the following remarks of Captain Cook to be in deep water. He says—"As soon as we were clear of the rocks and islands off Howes foreland I gave orders to steer S.E. by S. (*true*) along the coast. But before these orders could be carried into execution, we discovered the whole sea before us to be chequered with large beds of rock-weed, which we knew to be fast to the bottom, and to grow on rocky shoals. I had often found a great depth of water on such shoals; and I had as often found rocks that have raised their heads nearly to the surface of the water. It is always dangerous, therefore, to sail over them before they are well examined; but more especially when there is no surge of the sea to discover the danger. This was the case at present, for the sea was as smooth as a mill-pond. Consequently, we endeavoured to avoid them, by steering through the winding channels by which they were separated; we kept the lead continually going, but never struck ground with a line of 60 fathoms. This circumstance increased the danger, as we could not anchor, whatever necessity there might be for it. After running in this manner above an hour, we discovered a lurking rock just even with the surface of the sea; it bore N.E. ½ E. (*true*) distant 3 or 4 miles, and lay in the middle of one of these large beds of weeds. This was a sufficient warning to make us use every precaution to prevent our coming upon them.

"We were now across the mouth of a large bay (Rhode bay) that lies about 8 miles to the southward of Howes foreland. In and before the entrance of this bay are several low islands, rocks, and those beds of sea-weed; but there seemed to be winding channels between them. After continuing our course half an hour longer, we were so much embarrassed by these shoals that I resolved to haul off to the

eastward, as the likeliest means of extricating ourselves from the danger that threatened us. But so far was this from answering the intended purpose, that it brought us into more. I therefore found it absolutely necessary to secure the ships, if possible, in some place before night, especially as the weather had now become hazy, and a fog was apprehended. Seeing some inlets to the S.W. of us, I ordered Captain Clerke, as the *Discovery* drew less water than the *Resolution*, to lead in for the shore; which was accordingly done.

"In standing in, it was not possible to avoid running over the edges of some of the shoals, on which we found from 10 to 20 fathoms water; and the moment we were over had no ground at the depth of 50 fathoms. After making a few boards to weather a spit that ran out from an island on our lee, Captain Clerke made the signal for having discovered a harbour, which was afterwards named Port Palliser."

Port Palliser.—This harbour is situated in Lat. 49° 3′ S., and about Long. 69° 37′ E. It has a general direction of W.S.W. (*true*) for about 5 miles, and is not more than a mile broad at the entrance, whence it gradually narrows towards its head. The soundings are very irregular, from 37 to 10 fathoms, on fine sand, except under the beds of sea-weed, which in many places extend from the shore nearly half channel over. The shores on each side are rocky and barren. In and outside the entrance there are several islands, rocks, and sunken dangers, between which and the north head of the harbour is the navigable channel, through which Captain Cook sailed when he was here in 1776. His anchorage was in 15 fathoms, fine dark sand, at about three-quarters of a mile from the shore, with the north point of the harbour bearing N. by E. ½ E. distant 1 mile, and the small islands in the entrance from East to S.E. (*true bearings*). A little cove in the north point of the harbour is named Penguin cove. This port appears to be well sheltered from the prevailing southerly and westerly winds.

Captain Rhodes, 1799, says—"If bound to port Palliser from Christmas harbour, leave the islands off that harbour on the port hand, and steer S.E. by S. along the land at a distance of about 3 or 4 leagues. This course will carry you between the beds of kelp and sea-weed that lie off the coast; and when you have run the distance of 17 miles from cape Français, Howes foreland will bear S.W. distant 7 or 8 miles; at the same time, a ledge of rocks may be seen from the deck bearing N.E., distant 5 or 6 miles. You may then steer South to S. by W., until you have run about 15 miles, leaving several small islands on your port hand, when you will open the bay in which port Palliser is situated, which may be known by a small round island off Penguin cove, which forms the harbour. Leave this island on the port hand, and the course in is W. by N., where there is a good anchorage in from 7 to 9 fathoms water. (*All compass bearings.*)"*

Captain Cook observes—"In getting out to sea from port Palliser we had to steer through the winding channels amongst the shoals. However, we ventured to run over some of them, on which we never found less than 18 fathoms, and often did not strike ground with 24; so that, had it not been for the sea-weed growing upon all of them, they would not have been discovered."

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* The variation in 1776 was observed by Captain Cook to be 27° 45′ W. It is now about 32° W. Captain Rhodes visited many of the harbours in Hillsborough bay, and gave names to them. He is said to have explored not fewer than fifty inlets or coves, where ships of any tonnage might ride in perfect safety in the most tempestuous seasons.

Hillsborough Bay.—Between Howes foreland and mount Campbell, a distance of about 40 miles, the coast bends inwards and forms a large bay, named by Captain Rhodes Hillsborough bay, after his vessel the *Hillsborough*. It contains many harbours and anchoring places, the situations of which can be best seen by a reference to the chart. A prodigious quantity of weed (*fucus giganteus*) grows all over it, some of which is of enormous length, though the stem is not much thicker than a man's thumb. The only description of this bay is the following by Captain Rhodes, dated 1799; the *bearings are magnetic*, and have reference to the variation of that year, which was about 27° 45′ W.:—

"From port Palliser to cape Henry, the north head of Hillsborough bay, the course is S. by W., and the distance 12 or 13 miles. On leaving port Palliser steer E.S.E. until you are beyond all the beds of kelp, and then the above course will carry you clear of all dangers until you arrive off cape Henry. This cape is on an island, and forms a high bluff headland, and there are several smaller islands and rocks both north and south of the cape. Between port Palliser and cape Henry there are seven different bays, of considerable extent, with coves that form good harbours, all trending in from W. to W.N.W.

"From Howes foreland, or any of the projecting points or headlands that form the several bays and inlets between it and cape Henry, mount Campbell may be seen, as also the low land of cape Digby. The mountain has a round top, is of a moderate elevation, and may be seen, in clear weather, at 15 or 16 leagues' distance. In running down the coast, mount Campbell will be discovered some time before you raise the low land of the cape, which forms its termination at $1\frac{1}{2}$ miles from it; it is distant from any other mountain 7 or 8 miles, and bears from Howes foreland S.E.; mount Campbell and cape Digby are the best guides into Hillsborough bay.*

"When arrived off cape Henry, you will open Whale bay, so named from the great numbers of whales that frequent the place at a certain season of the year. In the mouth of this bay is a small reef, which always shows itself, and lies about 6 miles S. by W. from cape Henry. You may go on either side of the reef; but if intending to enter Hillsborough bay, steer for the group of islands which lies to the S.S.W. of the reef, and about 3 miles from it. You may anchor within those islands, in any depth from 20 to 7 fathoms on good holding ground. There are here several inlets and coves, which afford good harbours. Keep those islands on the starboard hand, and you will soon shut in mount Campbell,—and Seal island will be on with cape Daniel and the south head of Hillsborough bay: then steer S.W. until you raise a small reef which lies in the middle of the bay, near the entrance of Hunter's sound. Here you will have from 36 to 42 fathoms on a soft muddy bottom.

"Leave this reef on the port hand and steer W. by N.; this course will carry you to Winter harbour, which is distant from the group of islands 14 miles. You will here find a safe and good harbour, where you may anchor in from 7 to 9 fathoms.

"When the western extreme of the island bears north, you will then be shut in and entirely landlocked; here you will have from 15 to 25 fathoms on a soft muddy

* "The land here is low and level: the mountains ending about five leagues from the low point, a great extent of low land is left, on which mount Campbell is situated, about four miles from the foot of the mountains, and one from the sea coast. These mountains have considerable elevation, as also have most of the inland ones. They seemed to be composed of naked rocks, whose summits were capped with snow. Nor did the valleys appear to greater advantage. To whatever quarter we directed our glasses, nothing but sterility was to be seen."—Captain Cook.

bottom; but when you advance 4 or 5 miles farther up the sound, you will find from 70 to 100 fathoms near Raven and Duck islands.

"**Whale Bay,** to the northward of Hunter sound, affords several good harbours.

"**Irish Bay** lies to the southward of Winter harbour, and likewise affords some very good harbours.

"**Foundry Branch,** so named from the great quantity of iron ore and limestone found there, contains many inlets and coves, in which ships may anchor protected from all winds or weather. This branch lies S.E., about 13 miles from Winter harbour.

"**Elizabeth Harbour** bears E. by S. from Winter harbour; there is good anchorage in it, in from 4 to 9 fathoms water. There is a reef in the mouth of it, which you may pass on either side in perfect safety, and will not find less than 9 or 10 fathoms until well within the reef.

"**Betsy Cove,** which lies in the head of Accessible bay, is an excellent harbour, and has from 5 to 7 fathoms water over a tough blue clay. It is the southernmost harbour in the coast north of cape Digby, and is about 8 miles from it.

"When passing cape Digby, it will be necessary to give it a berth of 3 miles, to clear the spit that runs out from it to nearly that distance."

When approaching cape Digby (cape Sandwich of the Admiralty chart, No. 2398) from the north-westward, Captain Cook first struck the bottom in 18 fathoms, fine sand, and after a run along the land for about 3 miles, sounded again and had 13 fathoms, when seeing the shoal water jutting out from the cape he hauled off about 3 miles, and increased the depth to 25 fathoms. This depth was continued and the bottom of fine sand prevailed, till the cape bore West (*true*) distant 6 miles, when the water increased to 26 fathoms, and soundings were immediately afterwards lost.

Cape Digby is in Lat. 49° 23′ S., and Long. 70° 34′ E. From this point the land trends W. by S. ½ S. 12 or 15 miles to a low point named point Charlotte, which is the southernmost of the low coast. At 18 miles from cape Digby, in the direction of S.W. by W. ¼ W., there is a moderately high projecting point, named Prince of Wales's foreland; and 18 miles beyond that in the same direction is cape George, in Lat. 49° 54′ S., and Long. 70° 13′ E., which was considered by Captain Cook to be the southernmost point of the island.

Captain Cook, in his concluding remarks on Kerguelen island, says—

"Between point Charlotte and Prince of Wales's foreland, where the country to the south-west began again to be hilly, is a deep inlet, which was called **Royal Sound.** It runs in West (*true*), quite to the foot of the mountains which bound it on the south-west, as the low land before mentioned does on the north. There are islands lying in the entrance, and others higher up, so far as we could distinguish. As we advanced to the southward, we observed, on the south-west side of Prince of Wales's foreland, another inlet into Royal Sound; and it then appeared that the foreland was the east point of a large island lying in the mouth of it. There are several small islands in this inlet, and one about a league to the southward of Prince of Wales's foreland.

"All the land on the south-west side of Royal Sound, quite to cape George, is composed of elevated hills, that rise directly from the sea, one behind another, to a considerable height. Most of the summits were capped with snow, and they appeared as naked and barren as any we had seen. The smallest vestige of a tree or shrub was not discoverable, either inland or on the coast; and I think I may venture to

pronounce that the country produces none. The low land about cape Digby, when examined through our glasses, resembled the rest of the low land we had before met with; that is, it appeared to be partly naked and partly covered with a green turf. The shore is composed of sandy beaches, on which were many penguins and other oceanic birds; and an immense number of shags kept perpetually flying about the ships as we sailed along.

"Being desirous of getting the length of cape George, to be assured whether it was the most southerly point of the whole land, I continued to stretch to the south, under all the sail we could carry, till half-past seven o'clock; when, seeing no likelihood of accomplishing my design, as the wind had, by this time, shifted to W.S.W., the very direction in which we wanted to go, I took advantage of the shifting of the wind, and stood away from the coast.

"At this time cape George bore S. 53° W. (*true*), distant about seven leagues. A small island that lies off the pitch of the cape, was the only land we could see to the south of it; and we were further confirmed that there was no more in that quarter by a south-west swell, which we met as soon as we brought the cape to bear in this direction.

"But we have still a stronger proof that no part of this land can extend much, if at all, to the southward of cape George,—and that is, CAPTAIN FURNEAUX'S track in February, 1773, after his separation from me during my late voyage. His log-book is now lying before me; and I find from it that he crossed the meridian of this land only about 17 leagues to the southward of cape George, a distance at which it may very well be seen in clear weather. This seems to have been the case when CAPTAIN FURNEAUX passed it, for his log-book makes no mention of fogs or hazy weather; on the contrary, it expressly tells us that, when in this situation, they had it in their power to make observations, both for latitude and longitude, on board his ship; so that, if this land extends farther south than cape George, it would have been scarcely possible that he should have passed without seeing it."

AMSTERDAM ISLAND.

AMSTERDAM ISLAND, discovered by ANTHONIO VAN DIEMEN, June 18, 1633,* is only about 4 miles across, and 2891 feet high; it is situate in Lat. 37° 58′ 30″ S., and Long. 77° 34′ 44″ E.† It has not been surveyed. Anchorage may probably be obtained off its south side, as VLAMMING, the Dutch navigator, is reported to have anchored there in 1696 in 16 fathoms, black sand, at about a cannon-shot from the shore, and to have subsequently landed and made an unsuccessful search for water. The only descriptions we have of the island are the following:—

MR. JOHN WANE, midshipman of the *Morse* in 1770, writes: "This island, at the distance of 3 or 4 miles, appears to be small, and of a moderate height, but, on a nearer approach, the fog clearing away, we observed it to be very high land, of a

* See a very interesting article upon the discovery of this island in the "Nautical Magazine," 1854, contributed by M. L. C. D. VAN DYK, of Amsterdam, who maintains that the island should properly be named New Amsterdam.

† This is according to the observations of the Austrian frigate *Novara* in 1857; the point of observation was not stated, but we suppose it to be on its S.E. side. The highest summit of the island was found to be 2891 feet, the second highest 2651 feet; the length of the south coast 32,359 feet, and of the western shore 5507 feet. In the "Australia Directory," vol. i., published by the Admiralty, the position of the island is stated to be Lat. 37° 52′ S., Long. 77° 35′ E.; D'ENTRECASTEUX determined the west point of the island to be in Lat. 37° 47′ 46″ S., Long. 77° 25′ 5″ E., which is evidently incorrect.

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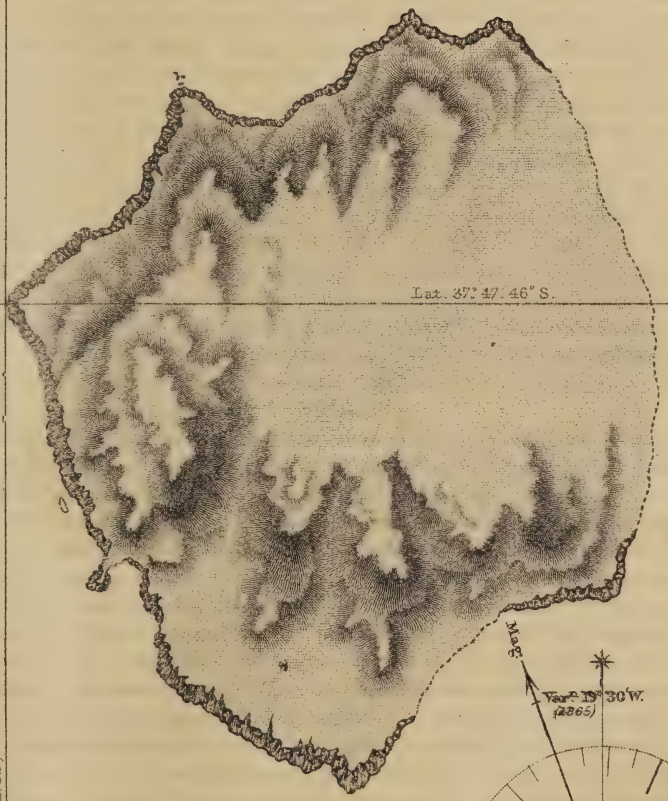

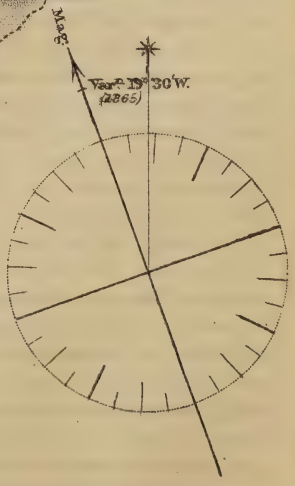

The Austrian frigate "Novara" in 1857 made the island (point of observation not stated, but we suppose on the south shore) in Lat.- 37° 58' 30" S. Long.- 77° 34' 44" E.

Long. 77° 25' 5" E. (D'Entrecasteaux, 1792.)

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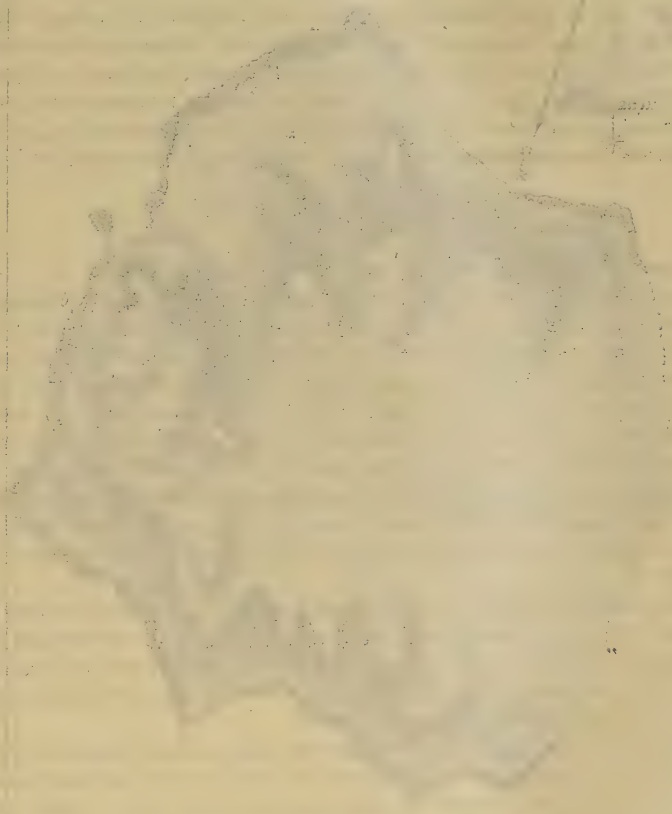


pyramidal shape, and about 12 miles in circumference. Ships that go the outward passage to India mostly make Amsterdam, but seldom see the height of it, on account of the weather being generally hazy. The *Morse* sent her boat on shore, in which I went, and, to the best of my remembrance, the particulars are as follows: We sailed round the island, but found no place to land, on account of the rocks, which are almost perpendicular, and rather inclining over the sea, and at a great height above the surface of the water. There are a great number of these extending round it, for the space of $\frac{1}{4}$ of a mile, having about 2 feet water on them. You have soundings off the island, but very uneven, except on the north part, where they are more regular and free from rocks. Ships may anchor there in 7 fathoms, sandy ground, distant off the rocks 1 mile,—but not with safety, as there is a high swell, and it generally blows hard. We came to a grapnel, to leeward of the island, with a determination to land if possible, and, after several attempts, we succeeded, but with great difficulty and danger. The method of our landing was thus: One of the crew swam ashore, and after many efforts, being beaten off several times by seas, he ascended the rocks; this man carried the end of a deep-sea line with him, the other end being made fast to a rope, which he hauled ashore; this secured our landing, which we could not otherwise have effected. We took a general view of the place, and found it to be a light sandy soil, which produces high grass and shrubs, with which the whole island is covered. About $\frac{1}{2}$ a mile inland there is a small drain of water issuing out of a rock, which, by estimation, might fill a butt in twelve hours, and this was the only spring of water we found; we saw a small quadruped, of the size and shape of a goat, spotted, and without horns."

Admiral D'Entrecasteux made the island on the 29th of March, 1792, and the writer of his voyage gives the following account of it:—"The island appeared in the distance covered with thick clouds, above which rose the summits of the mountains. We were sufficiently near it, about four o'clock, to distinguish perfectly that these clouds were formed on the island, whence issued a smoke that almost entirely covered it, especially towards the north; flames were seen in different points, and it was soon discovered that the forests were in a blaze: the traces of the fire and the smoke, which appeared successively in different places, exhibited the progress of the conflagration. We shaped our course so as to pass as near as possible to windward of the island; the same species of birds that we had seen a few hours before we got sight of it were flying in great numbers around the rocks, which served them as a retreat. A great many seals were swimming in the midst of the large heaps of sea-weeds detached from the coast, the south side of which we ranged along, at the distance of above $\frac{1}{2}$ a mile. This steep coast is very safe. The sea followed its direction, and would have apprised us of the danger of approaching it, had it been skirted by shoals. Rocks inclined about 50° from north to south (and which I took to be composed of strata of free-stone) formed the mountains to the S.W., and exhibited great declivities as far as the sea-shore. Farther on to the south were seen horizontal strata of the same species of stone: thence issued a small rivulet, the waters of which fell into the sea, forming a cascade. Perpendicular surfaces of rock exhibited, on a large scale, those strange forms known under the denomination of *Lusi*. We observed a thin smoke issue in puffs from a small subterraneous aperture, at a little distance from the shore. The mountains slope towards the S.E., so that, in favourable weather, it would be easy to land on that side. We here saw some little rivulets, which, after a meandering course, mix their waters with those of the sea."

Dr. Karl Scherzer, in the narrative of the *Novara's* voyage, says :—"The first view of Amsterdam island greatly resembles that of St. Paul. Our course was directed to its south-east side, along the acclivities of which pyramids of loose stones were visible, resembling those on St. Paul, but more numerous and of larger dimensions, the entire island seeming altogether on a much larger scale and more lofty. On the west side we observed rocky precipices of from 1000 to 2000 feet in height, fissured with deep clefts and rents, whereas on the south and south-east sides these presented a more gradual slope. For above an hour we steered along the shore, which rose sheer out of the water, without being able to detect a single point at which it was possible to disembark so as to scramble up to the high ground. The entire eastern side is hemmed around with steep abrupt precipices of 150 to 200 feet high, not unlike skilfully constructed bastions, and clothed with long thick grass. As we drew near, we could plainly discern in the watercourses that descend upon the upper slope —radiating, as it were, from all sides of the highest peak, which was enveloped in clouds—numerous streams of water, each pouring through a rift like a thread of silver; after which, precipitating itself over the steep precipices on the shore, it washed like a small torrent over terraces and banks of lava, till it was lost in the sea. If these streams are swollen by heavy rains in winter they may form waterfalls, as mentioned by early navigators, which must impart a far less pleasing character to the landscape. Two small patches of dazzling white, like fresh-fallen snow, which were visible high above the slope, we could not make out with the utmost power of our glasses. The green colour which enveloped the entire island seemed to indicate the existence of grass vegetation resembling that of St. Paul. A nearer approach showed the south-eastern point, which at a distance presented the appearance of a low headland jutting out into the sea, to be a small detached rock; while the shore (so far as the eye could reach) rose like a wall to a height of from 150 to 200 feet. After rowing some distance we found a smooth spot between two reefs, which projected above the level of the sea like a breakwater, and at once let go the boat's anchor. At this spot we succeeded in effecting a landing, and afterwards with great difficulty climbed to the summit of the island."

ST. PAUL ISLAND.

ST. PAUL.—At about 40 miles almost due South (*true*) from Amsterdam island is the island of St. Paul, which is 820 feet high, and visible from a distance of 50 to 60 miles. It was surveyed in 1853 by Captain Denham, R.N., who determined the position of the north side of the entrance to the crater to be Lat. 38° 42′ 45″ S., and Long. 77° 35′ 4″ E.*

Some care is required when approaching Amsterdam and St. Paul islands in winter, because of the strong gales and thick weather that then prevail. The colour of the water affords no certain indications of their vicinity, and the sea-weed they produce is drifted to leeward in small patches by the prevailing north-easterly current.

* Depending upon the accuracy of the meridian distance from the Cape Observatory, which is assumed to be in Long. 18° 28′ 45″ E., the meridian distance was 59° 6′ 59″ E. This differs slightly from a previous determination of Captain Blackwood, R.N., in 1842, who ascertained the position of the Nine Pin Rock, on the north side of the entrance to the crater, to be Lat. 38° 44′ 40″ S., and Long. 77° 37′ 40″ E. The *Novara*, in 1857, determined the position of a small pyramid of stones on a little eminence north of the huts of the colonists to be Lat. 38° 42′ 55″ S., Long. 77° 31′ 18″ E. This longitude was obtained by meridian distances from the Cape and Madras, the observatory at the former place being estimated to be in Long. 18° 28′ 45″, and that at the latter 80° 14′ 19″ E.

LONDON. James Imray & Son.

St. Paul is only $2\frac{3}{4}$ miles in extent from N.W. to S.E., and $1\frac{1}{4}$ miles across. Like Amsterdam island it is volcanic. When viewed from the eastward, it appears to be only a ruined crater, with the sides (north and south) sloping gradually to the sea. It is on this side of the island that the entrance to the Crater lake is found, which, if the bar fronting it were deep enough to permit vessels to cross, would be a very valuable harbour, well protected from all but easterly winds; it is in shape nearly circular, has very steep sides, and a depth varying from 16 to 29 fathoms. There is a peculiar shaped rock, 80 or 90 feet high, at the north side of the entrance to the Crater lake, which from its form has obtained the name of Ninepin rock. Along the north-east shore of the island there are some detached rocks above and under water, none of which are probably more than $\frac{1}{4}$ of a mile from the cliffs; and there is a rock (12 feet under the surface) named Roure ledge, three cables' length from shore, at about three-quarters of a mile N.N.E. from Hutchison point, the south-east point of the island; upon the latter rock the sea occasionally breaks.

The south and west sides of St. Paul island have not been closely examined, but are believed to be free from outlying rocks. It was noticed by the surveyors that the sea broke heavily in places at from a quarter to half a mile from the south shore, which they suspected might be upon ledges projecting from the coast. A ledge of rocks projects three cables' length northward from Smith point (the north point of the island), and has a depth of 20 fathoms almost close to it.

The anchorage at St. Paul's is off the eastern coast, fronting the entrance to the Crater lake, in soundings of from 14 to 30 fathoms, on a bottom of fine black sand, resembling gunpowder. When Captain Denham, R.N., was here in 1853, he anchored in 31 fathoms, at about $1\frac{1}{4}$ miles N.E. $\frac{1}{2}$ E. from the south point of the island, and considered it a well-sheltered position, with the wind from S.W. to N.W. (west about), and sufficiently convenient to permit of slipping in case of an easterly gale; but it was subject to the disquietude of swell which comes round the northern and southern points, and across which the prevailing westerly wind will cause the ship to ride. Captain Denham subsequently anchored nearer the island in 14 fathoms, fine black, compact sand, with the Ninepin rock bearing N.W. a quarter of a mile,—at which position the two rocky islets on the northern trend of the island were in one with each other, and the causeway gap leading into the Crater lake West half a mile nearly.

Captain Denham says:—"When at St. Paul's, we had reason to ascribe the excess of variation found on shore as compared with that resulting from azimuths observed on board, to some magnetic disturbance in the heterogeneous structure of this volcanic island. Indeed, when a fragment of the surrounding rocky heaps, such as from the causeway between the sea and the crater, was held within six inches of the needle, an attraction was discernible. The magnetic variation on shore $23\frac{1}{2}°$ W. that afloat came out $19\frac{1}{4}°$ W.

"The tide gauge series up to, and three tides over, the full-moon phase, shows that it is high-water on full and change of the moon at 11h. 30m., and that the tidal range is four feet.*

"The island is of a triangular form, with its base trending N.N.W. $\frac{1}{2}$ W. (*true*).

* The hour of high water, both at full and new moon, was found by the *Novara* in 1857 to be 1h. 10m. P.M. According to Lord Macartney, the tide rises at full and new moon, between 8 and 9 feet perpendicular. A northerly wind always causes the highest tide, the current of which is from S.E. by S. to N.W. by N., and has a velocity of about three miles an hour.

$2\frac{3}{4}$ miles, from the middle of which base the apex of the triangle is $1\frac{1}{2}$ miles at right angles, and constituting the western projection; the whole range of its seaboard extending over little more of linear measurement than 6 nautical miles,—with a table top, and sides of steep acclivity, the summits of which are severally elevated from 740 to 860 feet above the sea.

"It is very well known that a remarkable volcanic phenomenon is displayed at this island. A circular crater, which, when originally formed, must have occupied a space bordering upon the eastern margin of the island, forms an extensive basin of ocean, the ridge of it gradually declining down to the sea towards the S.E. quarter. In Vlamming's time, who visited the island in 1696, this ridge was still a few feet above the sea, as represented in a view by him preserved by Valentyn. By whatever means it may have been effected (perhaps by the washing of the sea), there is now a breach 600 yards across, through which a boat may pass into the basin. The deepest water in the channel is 8 feet at high water.

"The passage is rendered sometimes for a day or two dangerous by the breaking of the bay swell upon it; such may be looked for at the full and change of the moon. When once across this bar (a distance of but half a cable from deep water to deep water), a magnificent floating dock of lake-like surface is entered as deep as 29 fathoms, with steep margin all round. The diameter of this nearly circular sheet of water is about two-thirds of a mile, and is encompassed by the steep sides of the crater, the ridge of which, in its highest part, is from 700 to 800 feet above the level of the water. A rank grass flourishes on the sides of the crater, much interspersed with rocky fragments; but the absence of any natural production at this island for the use of man, excepting fish, and the conviction that there should be no reliance on the periodical visits of a single vessel from Réunion, has induced the few residents on the island employed there to terrace up every lodgment of soil on the slopes of the crater. In the midst of the rocky crags of the island, their little terrace gardens are refreshing to the eye, and gratifying proofs of the ingenuity of man in turning to the best account he can even the most niggardly of nature's gifts. The produce more than compensates the toil, affording even a surplus to exchange with passing ships for groceries, &c. Each of these garden plots consists of about fifty square yards; they are terraced up by ponderous blocks of lava, each of which may become loose and fall, like another avalanche, when disturbed; and they require a flight of steps to be formed, perhaps winding abruptly among the rocks for hundreds of feet, to admit of communication round their almost vertical sides, or from a boat beneath them in the basin. I found evidence of the genial soil and climate regarding our European vegetables; and this period (January) being its summer season, the peas, cabbages, carrots, turnips, potatoes, and artichokes, were in perfection, and the wheat was in full ear; but there is no indigenous vegetable except wild celery and the rank grass, such as we observed at Tristan da Cunha. Nor are there any animals on the island except those imported, which run wild, and are shot or snared at pleasure. These consist of sheep, goats, pigs, cats, and mice. The oxen, together with pigs, fowls, and rabbits, are kept at the little settlement.

"The island for several years has ceased to be the resort of seals and sea-elephants, excepting a dozen or so in the course of a season; a whale or two would also pass within gun-shot of the cliffs. The only systematic fishery carried on is along the eastern margin of the island, by hook and line, for the take of a species of cod and mullet to salt down, and which are much esteemed and in large demand at Réunion.

The presence of man has scared off the seals, &c. of which Vlamming the discoverer, and succeeding voyagers, among whom was Sir John Barrow, witnessed the existence.

"At several places along the high-water mark round the northern side of the basin of ocean water, vapour was seen by our party curling out, and the heated stones hissing as the tiny wave lost itself against them. And no wonder, for they, as well as their clayey bedding, were too hot to be handled. Here boiling heat prevailed, but on moving off a boat's length the temperature of the surface water was the same as the air, 67°; and the water at the bottom, 38 fathoms deep, stood at 52° temperature. We waited for the fall of tide below the mean level, and then we found the pools of water which had been two or three hours covered with salt water, with vapour floating, now full of boiling chalybeate water. Here we were enabled over and over to realize the singular operation of tossing the fish from the water in which it was hooked to that which forthwith boiled it. Indeed, this can be done at any time, excepting at high-tide intervals. Thus may be boiled eggs and potatoes without the trouble of making a fire or using a kettle! The island is evidently charged with subterraneous fire and volcanic gases, and yet no eruption or convulsion has been experienced by the residents, and the two minor craters on the back slope of the island are perfectly inactive. November to March forms the summer season; June to September are the coldest, and in every respect the winter months; and it is in the winter season only that thunder and lightning occur, and then so rarely as to happen but once in the season.

"The climate has proved remarkably healthy to Europeans; the two great drawbacks to more than a few settling on the island is the total absence of fuel and fresh water.

"While the ground and features favourable for anchoring and access lie upon the east side of this island, it is happily, too, the aspect upon which the wind seldom blows; a gale from the east has only occurred three times during the last six years. The prevailing wind is from north, veering every three or four days west about to south and back again. But what renders an inshore anchorage unsafe is the setting in of rollers from S.E. At the full and change of the moon days such will occur at all seasons, and as a calm attends these rollers, a sailing vessel would be in imminent peril. When the sunken rock, lying about one and a half cables off the S.E. point, with not more than 12 feet of water on it, breaks, which it did (and regularly does) a few hours before the off-shore or long-shore breeze dies away, a vessel should trip and take an offing.

"The island is well fixed as to geographical position, and, to or fro, it depends upon latitude, and look-out for making it, being situated about midway of the east and west track, which for 6300 miles separates the Cape of Good Hope and Tasmania. The navigation round this island merely requires a quarter of a mile berth to be given to the actual heads. The anchorage is at once beaconed by the remarkable Ninepin islet, close to the north side of the crater,—and 21 fathoms will indicate a sufficient distance off shore, say three-quarters of a mile. The upper half of the island is so frequently shrouded by fog, that an angle of elevation for distance must not be looked to.

"The tide sets round St. Paul island, turning and returning according to the rise and fall on the shore. An occasional confluence of streams will take place off each point, producing, as the wind and outer sea may happen to be with or against each

other, an ebullition like breakers. The actual definable and important course of tidal stream, worth the mariner's attention at this island, is in regular operation along its roadstead; here he may expect a one knot set of flood to the N.W. for six hours, beginning at two hours flood; and three-quarter knot set of ebb to the S.E. for six hours, beginning at two hours ebb. The knowledge of this tidal action may be the means of saving a ship in the always possible exigency of having to slip with the wind on shore. In moderate weather, a ship as regularly and sensibly indicates the set of tide at this anchorage as if she were at Spithead; but under a strong breeze from seaward she would be wind-rode. Then the tidal establishment—*i.e.*, time of high water on full and change of the moon—must be resorted to, and which being XI, the high water hour for the day or night in question is attained; and according as it is herein stated, that the flood and ebb stream at the anchorage sympathises with the actual flow or ebb upon the shore, so will the master of a ship be able to answer his first and most natural question—'How shall I cast my ship so as to take the tide upon my lee-bow, to aid my clawing off this lee shore?' It will be obvious that on the choice of tack, with reference to tidal set, the rescue of his ship will depend; and surely it will be worth while to turn so palpable a tidal advantage to account."

An officer of the *Hindostan*, in 1774, says—"The Crater lake forms a regular ellipse. The circumference round the water's edge is 2980 yards, or nearly 1¾ miles. By taking the perpendicular height of the surrounding sides at 700 feet, and the angle of their inclination at 65°, the circumference of this crater will be 2 miles 160 yards. The average height of the sides being taken at 700 feet, the depth of water at 29 fathoms, or 174 feet, the whole depth of the crater is 874 feet. The entrance into the lake, about 25 yards wide, is formed by two narrow causeways or ridges of rocks that run out from two peaks which terminate the sides of the crater, one on each side; that on the right is 743 feet high. At its foot, on the causeway, there is a hot spring, where the thermometer stood at 212°, at which were boiled some fish; and this is the general standard of heat at all the springs round the water's edge."

Captain Vlamming, the Dutch navigator, landed here in 1696, and described the north-east point of the island as a low slip of land which gradually decreased in height to the water's edge, in appearance not unlike the Bill of Portland. "On the north side there is no ground, it is all rocky, with a heavy swell rolling in from the sea; on that side you see a fall of water." The island was at that time so covered with wood, rushes, and thick canes, entangled together, that one could not in a day go any great distance, being obliged to creep under the shrubs and clamber over the trees, which stood close together, some of them being so thick as a man's waist. The soil was noticed also to be a fenny land, about 3 feet thick, and under it were stones like burnt pumice; it was also very loose, and the trees not getting sufficient root in the ground, could not grow high. Neither man nor beast were visible, the only evidence of life being a few small birds, like sparrows, a quadruped like a weasel, and another like a fox. The sea was so full of seals and sea-lions, some of them at least 18 feet long, that he says he was obliged to kill some of them to get a passage through when he steered for the shore; the fish, also, were wonderfully abundant.

Mr. John Henry Cox anchored here in 20 fathoms, black sand like wet gunpowder, in 1789. The following is extracted from his journal:—

"On May 31st we hoisted out our boats, and rowed towards the shore (abreast the ship), which here forms a sort of causeway of large clean pebbles, that has the appearance of being raised by art; in the middle of this causeway we saw an opening (in which a great many seals were playing) about a pistol-shot wide, into a basin or lake; we rowed for this entrance and found a strong tide, at least 2½ knots, running out; and with some difficulty, it being nearly ¾ ebb, got the cutter over the bar, which is formed of loose pebbles; we were then in deep water, and smooth as a mill-pond, though the sea ran very high without. We landed on the north side of the entrance, where we found seals innumerable; after killing a great number we went in search of fresh water, and for that purpose began to ascend the only accessible part of the hill; up a considerable way the seals had formed a good path, but beyond this we found the ascent obstructed by large tufts of coarse grass, which, in VLAMMING's time, were 8 or 9 feet asunder, but were now close together, so that we were obliged to return, though it must have been on these heights that he found water; indeed, had we reached the top, and found water, though it might have supplied present expenditure, and in that light would be valuable to a vessel that made any stay here, it would be endless work to attempt watering a ship from hence.

"Sent the cutter ashore sealing; rowed round the basin, which is between 2 and 3 miles in circuit; found 29 fathoms in the middle, and 27 and 28 within 150 yards of the shore, close to 7 and 8 fathoms. The land round the basin is table land, rising in some places almost perpendicularly from the border of the basin, and covered with grass, which gives it a pleasant appearance. As we rowed round, we saw smoke rising amongst the stones, in several places close to the basin; we landed and found the water so hot that we could not bear our hands in it. I had a pocket thermometer with me, which, in the open air, stood at 62°, but when put into the water, at 190°, and then, in about a minute, fell to 185°. Our people, who were ashore sealing, constantly boiled their dinner of fish in some of those springs, which are in all parts close to the basin.

"June the 5th, in the afternoon, blowing hard from N.E., with a great sea, determined to put to sea, and run down under the lee of the island; at 5h. got a spring on our cable to cast, cut the cable close to the splice, and went to sea. We lay in a very good berth to clear the island on either side, but it would be safer for a large ship to lie about two cables' length farther to the eastward, and upon appearance of blowing weather from the eastward, to go to sea immediately, and run to leeward of the island, where she would find smooth water; and as the easterly wind is never of long continuance, she would be sure of soon regaining the anchorage."

REUNION.

General Remarks.—The island of Reunion is situate between Latitudes 20° 51½ and 21° 22′ S., and Longitudes 55° 16½′ and 55° 53½′ E., and is of an oval form. It is geologically formed by two systems of volcanic mountains of great elevation, one at either extremity of the island. The central point of the most northerly system, the Piton des Neiges, is estimated to be 10,069 feet, and that of the southern system, an active volcano named Piton de Fournaise, or emphatically the volcano, 8613 feet above the sea. These two volcanic centres are connected by a chain of mountains running north and south, which divides the island into two parts, that on

the east side being called the windward (*partie du vent*), and that on the west side, the leeward division (*sous le vent*), in consequence of the prevailing winds in Bourbon being from east to south. There are no plains of any size, and the island is watered by many small rivers, none of which are navigable. There are several lakes, but all of small size with the exception of one, which is said to cover an extent of 40 acres. The island is reported to be deficient in good roads. The soil is very fertile, particularly in the vicinity of the shores, where there are extensive alluvial deposits, which, like the soils in other parts of the island, consist largely of volcanic matter. The cultivated lands form a girdle round the island, and in some parts ascend the mountain slopes to considerably more than 3000 feet above the level of the sea. In 1836 the population was 106,099.

The exports of Reunion are principally sugar, coffee, cloves, dye-woods, and saltpetre; and the imports mainly consist of rice, wheat, oil, wines, cattle, timber, glass, porcelain, &c., with cottons and other manufactured goods.

The coasts of the island are in general but moderately elevated; about them there is an abundance of fish and turtles; they also furnish coral and ambergris. So great is the quantity of fish, that a large portion of the population bordering the shore got their living by fishing, selling the produce, after providing for the consumption of their families, for about 12,000*l.* a-year. The great drawback to the prosperity of the island is the want of good harbours, all the roadsteads being open, so that there is nothing to prevent a vessel being driven on shore by a violent gale from seaward. The principal ports are St. Denis, St. Paul, St. Benoit, and St. Pierre; of these, the first is on the north coast, and the last on the south coast of the island.

The climate of Reunion is healthy and agreeable, especially that of the eastern part of the island. The air is pure and the sky clear, though this tranquillity is sometimes broken by violent hurricanes. The hot and rainy season continues from December to May, when the mean temperature is 80° Fahr.; during the remaining or temperate months, the mean is 76° Fahr. Being on nearly the latitude of Mauritius, the seasons are similar, and have like peculiarities. The island is also exposed to the same winds.—See p. 73.

Reunion was discovered in 1545 by Mascarenhas, a Portuguese navigator, whose name it bore till the French took possession of it in the next century. The English took it in 1810, but it was restored to France in 1815. For many years it was called Bourbon, but on the expulsion of the Bourbons from France its name was changed to Reunion. When first occupied by the French the sides of the mountains were covered with forests which reached even to the shores. The whole of the lower lands have been cleared, but the centre of the island is still covered with its primitive vegetation, which affords forty-one different species of woods serviceable for arts and manufactures.

Lights.—On Point Bel-air, near Saint Suzanne, on the north-west side of the island, there is a lighthouse 66 feet high, which shows a *fixed white* light at 151 feet above the sea, visible 18 miles.

At St. Denis two small *fixed white* lights are shown from the flagstaff on the *Barachois*, at 85 feet above the sea, visible 8 miles. Beyond the distance of 5 miles these lights blend and appear as one.

A small *fixed white* light is also shown from a mast at the landing-place in St. Paul's Bay.

ST. DENIS.—St. Denis is situated at the north extremity of Reunion, and is the capital of the island. In 1836 it had about 12,000 inhabitants. It is seated on a plateau at the mouth of a river of the same name. Most of the houses are of wood, the *Hôtel du Gouvernement* being the only public building of importance.* Here is the residence of the governor of the island. The church is in almost the centre of the town.

The soundings immediately off the rocks surrounding Pointe des Jardins, upon which point the town of St. Denis stands, are $2\frac{3}{4}$ and $3\frac{3}{4}$ fathoms, which rapidly deepen to 20 fathoms, the latter being at not more than half a mile due north from the point. The usual anchorage is north-westward of St. Denis, and during winter in a depth of from 8 to 15 fathoms, but during summer nearer to the shore in about 4 fathoms water. The roadstead is quite open, and cannot be considered safe with violent winds blowing on shore.

Sainte Suzanne.—From Saint Denis to Sainte Suzanne the distance is about 9 miles in an E.S.E. direction. At 6 miles from St. Denis is the small town of Sainte Marie, off which there is an exposed anchorage in 7 to 9 fathoms; thence at about midway to Sainte Suzanne, there is a dangerous rock 6 feet under water, named *Le Cousin*, which is situate 886 feet from the coast, at a little westward of the ravine des Chèvres. This rock is not more than 23 feet in extent, but its situation makes it an important danger to be guarded against, especially as there is a depth of 7 to 13 fathoms immediately outside it,—to keep outside it do not approach the coast nearer than Cape Bernard in one with the church of St. Denis, or keep in deeper soundings than 20 fathoms.

The usual anchorage of Sainte Suzanne is eastward of the town in about 10 fathoms. It is exposed to all winds except those from the shore, and is consequently safe only during fine weather.

St. Benoit.—From Sainte Suzanne the coast trends south-eastward and southward 11 miles to St. Benoit. The anchorage here is in 12 to $16\frac{1}{2}$ fathoms, sand and mud, at $\frac{8}{10}$ of a mile northward of the River Marsouins, and at about the same distance eastward from Point Bourbier. In fine weather or during summer, vessels usually anchor in $12\frac{1}{2}$ fathoms with the buildings on Point Bourbier bearing west, but in winter the greater depth should be selected. It is necessary to be careful in anchoring, because the current may otherwise carry you upon Pointe du Mat, where there is no anchorage.

There is also anchorage in 18 to 20 fathoms at a little south of the River Marsouins, but it is no longer frequented, the ground being very indifferent. In consequence of the difficulty and risk of landing, the jetties have been allowed to fall into decay, and are now entirely destroyed.

St. Rose.—From St. Benoit to the little bay of St. Rose, the distance is nearly 6 miles. The anchorage at this place is in 14 to 18 fathoms, at $\frac{1}{6}$ of a mile from the shore, with the church bearing S.E. $\frac{3}{4}$ S., and is exposed to all winds except those that blow from the land. When leaving it some care is required to avoid the rocks close to the eastern side of the bay.

St. Pierre.—From St. Rose to St. Pierre, along the whole of the south and south-eastern side of the island, there is no anchorage. At St. Pierre the surf is usually

* The position of this building has been observed by the French surveyors to be Lat. 20° 51′ 48″ S., and Long. 55° 30′ 1″ E. (1864.) CAPTAIN OWEN, R.N., made the town in 1824, in Lat. 20° 52′ 30″ S., and Long. 55° 31′ 39″ E.

very heavy, and the hardness of the bottom under the thin covering of sand frequently causes the breaking of anchors or chains.

During winter, vessels anchor in 27 to 30 fathoms water at nearly a mile from the shore, in nearly the line of direction of the ravine, with the steeple of the church bearing N.N.E. ½ E.; but during summer in a position nearer the shore, in 23 fathoms, with the church on the same bearing.

The anchorage at St. Pierre is only safe when the wind blows from the land, and it is recommended to be ready to get away immediately the wind veers to the south-westward, for should it then prevail with any strength, nothing could save the vessel from destruction.

Etang Salé.—At nearly 10 miles westward from St. Pierre is the bay of Etang Salé, where is anchorage in about 20 fathoms at ¾ of a mile from the shore, with the village bearing E.S.E., and Point Avirons N.E. ¾ N. This anchorage is only safe with the wind from the land, consequently all must be ready on board that the ship may be got away immediately the wind begins to blow from the southward, for winds from seaward always send in a very heavy sea. With strong southerly winds a landing at the village is impossible, and at such times is forbidden to be attempted by a flag hoisted on a staff at the shore side. As a rule it is only in very fine weather that a landing can be safely effected.

St. Leu and St. Gillies.—Following the coast northward from Etang Salé, at about 6 miles distance, is the village of St. Leu, off which there is anchorage in about 20 fathoms water; thence to St. Gillies the distance is 7½ miles. At St. Gillies vessels anchor in about 18 fathoms, with the village bearing East ¾ of a mile, but it is safe only with winds from the shore.

ST. PAUL.—The bay of St. Paul is 3 miles northward of St. Gillies. The town is considered to be second in importance in the island, as it has a population numbered at 10,000, and boasts of a fine church, a hospital, &c. During the S.E. Monsoon the breeze is generally S.W. in the bay, and vessels anchor in 13 to 19 fathoms at about ½ a mile from the shore, with the flagstaff bearing E.S.E. During winter the winds are generally N.E., and it is then customary to anchor in 16 to 22 fathoms, with the flagstaff bearing S.S.E. The holding-ground throughout is good, especially in the winter anchorage.

The currents are very strong at Points Houssaye and Galets, the south-west and north-east points of the bay of St. Paul, and in general are sufficiently powerful even in a calm to carry a vessel round the latter point. Point Galets is very low, and has not upon it anything sufficiently remarkable to be recognised at a distance; when approaching the bay from the eastward, shipmasters may be certain that they have passed it when they can see the peak of Cimandet in the ravine of the river Galets. The mountains can generally be seen at night, and greatly facilitate the navigation of the bay.

Point Galets, although very low, is steep at its extremity, and has deep water so close to it that a large vessel may pass it at less than a cable's length; thence to St. Denis the distance is 10 miles.

For a general description of the winds, see p. 73.

The following remarks on the anchorages at Réunion, by Captain Bilton, of the *Rowena*, are extracted from the "Mercantile Marine Magazine," 1865:—

"I shall commence first with the printed form of charter-parties, which runs thus —'The ship having been despatched from Callao, shall proceed to St. Denis,

Réunion, where the agents of the charterer are to have the right of receiving the whole or part of the cargo, and also of sending on the ship with such quantity of guano as they require to any *two* of the nine following points, viz.—

"'St. Paul, St. Pierre, St. Leu, St. Rose, St. Benoit, Le Champ Borne, Le Bois Rouge, St. Suzanne, and St. Marie.'

"'At the three ports the cargo is to be discharged and weighed on shore, at the ship's expense; the charterers engage to receive it at the average rate of not less than 25 tons per working day.'

"I will now endeavour to describe the accommodations for discharging cargo at the above-named ports, and as St. Denis is the principal, I shall commence with it.

"At St. Denis there are four marine establishments, or what would be perhaps termed in England four cargo-boat companies; each company is supposed to have three good boats, that will carry on an average about 13 tons each. The charges for taking the cargo from alongside the ship and landing it, are 7½ francs per ton of 1000 kilogrammes, and 2½ francs per ton for weighing it; ballast is 7½ francs per ton put alongside the ship. Here you can anchor in from 7 to 17 fathoms, according to the season, and as the anchorage is quite exposed to all winds from S.E. round by north to N.W., more or less swell always rolls in, even in the fine season, which often prevents cargo from being landed.

"At St. Paul there are three boat companies; charges for landing cargo 7½ francs per ton, for weighing 2½ francs per ton; ballast 5½ francs per ton put alongside. This is the only good roadstead in the island, and that only during the fine season, from the middle of April to the middle of November.

"At St. Leu there is only one boat company; charges for landing cargo 7½ francs per ton, and for weighing 2½ francs; ballast 7½ francs per ton put alongside.

"At St. Pierre there are six boat companies; charges for landing cargo 7½ francs per ton, and for weighing 2½; ballast 7½ francs per ton put alongside. This is considered to be the worst roadstead about the island; you must anchor in 28 or 30 fathoms, bad ground, close to the shore, and quite exposed to the southerly winds. It is seldom that a ship leaves here without the loss of an anchor and cable or two; and it is a place that a ship is very likely to be sent to, as it is the second town of importance in the island.

"At St. Rose there is only one boat company; charges for landing cargo 7½ francs per ton, and 2½ francs per ton for weighing. Here you must anchor very near the shore in 12 fathoms, and should a vessel part her cable with an on-shore wind, her destruction is certain. Ballast is very difficult to get; indeed, if a vessel were ordered there to discharge, she would in all probability have to touch at one of the other places for ballast.

At St. Benoit there is one boat company, and two landing places—one at St. Benoit, and the other at port Bourbier—distant 1¼ miles from each other. This place, with the exception of St. Pierre, is the very worst part about the island that a ship could be sent to either for loading or discharging a cargo. It is quite open to the drift of the S.E. Trade. We anchored in 14 fathoms, St. Benoit church bearing S.W. by S., port Bourbier W. by N., and port Champ Borne North. We remained there from the 24th May until the 4th July, during which time we only managed to discharge 318 tons of guano; and twice had to slip and put to sea; once from 90 fathoms cable, and were seven days out; the second time from 105 fathoms, and were four days out; but each time we were fortunate enough to re-

cover the anchor and cable. At this delightful *port* the charges for landing cargo are 10½ francs per ton, and 2½ for weighing; ballast 10½ francs per ton put alongside. As St. Benoit is situated in the principal sugar district, the chances are much in favour of a ship being sent there, and during the months of May, June, July, August, and September, you may consider yourself fortunate if you can land cargo twelve days during each month. I was informed at St. Benoit that the cargo boats have been lying bottom up at their anchors for fifteen days, and no communication could be had with the shore during the time. This happened in July; when we arrived there in the month of May, there had not been any communication with the shore for the previous eleven days.

"At Le Champ Borne there is one boat company; charges for landing cargo 7½ francs per ton, and for weighing 2½ francs per ton; ballast 7½ francs per ton put alongside. Here you anchor in about 9 fathoms, quite exposed to the S.E. wind, ground bad."

"At Le Bois Rouge there is one boat company; charges for landing cargo 7½ francs per ton, and for weighing 2½ francs per ton; ballast 5½ to 7½ francs per ton, put alongside. Here you anchor in 8 fathoms, about half a mile from the landing-stage, ground pretty good.

"At St. Suzanne there is one boat company; charges for landing cargo 7½ francs per ton, and for weighing 2½ francs per ton; ballast 5½ to 7½ francs per ton, put alongside. Here you anchor in 8 fathoms, from ¼ to ½ mile from the landing stage, good ground, and a little sheltered from the S.E. wind. We discharged 750 tons of guano at this place, and took in 350 tons of ballast in 36 days, during which time there were only three days that we could not work.

"At St. Marie there is one boat company; charges for landing and weighing cargo, and for ballast, the same as at St. Suzanne. Anchorage good, in from 7 to 9 fathoms, half a mile from the shore, well sheltered from the S.E. wind.

"N.B.—It must be understood that each ship must wait her turn for discharging or loading; for example, suppose a ship arriving at St. Suzanne with a full cargo finds other two ships in the roads, one discharging and the other waiting her turn; both these ships must be discharged and ballasted before the new comer commences. This is the regulation at all the ports round the island; port charges are 2 francs per ton on all foreign shipping, but on French shipping only 30 centimes. When those exorbitant charges were made, I complained about it to Captain Hill, H.B.M.'s Consul, and he personally waited on the Collector of Customs and the Captain of the Port, and was informed by them, 'that whatever reciprocal arrangements had taken place between England and France, nothing of the sort had yet been extended to the French colonies;' and it is yet a question undecided whether a ship would or would not have to pay port charges at each of the three ports—namely, St. Denis, St. Paul, and St. Pierre, if ordered there to discharge; these are the only places that you can enter, and clear at.

"Having described the facilities for discharging cargo at the various places, I will now give a few hints which may be useful to a stranger bound to St. Denis. Having made the land anywhere on the south-east part of the island, continue your course along its northern shore, which is free from outlying dangers at least within a few cables lengths, and you will see the lighthouse on Point Bel-air, which stands on a high point, and is painted *white;* having passed it, you will next see the flagstaff at St. Denis, which is high, with yards and gaff on it; continue your course and you

will soon see the shipping anchored to the N.W. of it; run down abreast of them, heave-to, and a pilot will be sent off to bring the ship into the roads; but should it be night time, keep to windward of the port until daylight, and then should a pilot not come off, stand in to leeward of the shipping, and anchor in from 7 to 11 fathoms. Provisions of all sorts are very dear. Labourers' wages for working amongst guano 5 francs per day, and found in provisions. At St. Denis you can procure good coasting pilots, who will remain on board during the time you are shifting ports and discharging cargo; their pay is 10 francs per day.

"In conclusion, I consider that a ship going to Réunion to discharge a cargo of guano ought to have at least 20s. per ton more than what is given for Mauritius; and no guano-laden vessel ought to go there during the bad weather season—say from the end of November to the middle of April, and then they ought to be well found in ground tackle and in sails."

MAURITIUS.

General Remarks.—Mauritius is an island of an irregular oval form, having an area estimated at 500,000 acres. It is situate about 470 miles eastward of Madagascar, and 90 miles eastward of Reunion. The position of the observatory at Port Louis, the principal port of the island, is estimated to be Lat. 20° 9′ 56″ S., and Long. 57° 29′ 30″ E.; the latter being the determination of Colonel Lloyd, the late Surveyor-General.

From whatever direction the island is approached, its appearance is singularly abrupt and picturesque. The land rises rapidly from the coast to the interior, where it forms three chains of mountains from 1800 to 2000* feet in height, intersecting the country in different directions. Except towards the summit these are generally covered with wood, and in many parts cleft into deep ravines, through which numerous rivulets find their way to the low grounds, and terminate in about twenty small rivers, by which the whole line of coast is well watered from the foot of the mountains to the sea. Though, from its mountainous and rugged character, a great part of the interior is not available for any useful purpose, yet extensive plains, several leagues in circumference, are to be found in the high lands; and in the valleys, as well as along the coast, most of the ground is well adapted either for the ordinary purposes of agriculture, or for raising any description of tropical produce. Extensive forests still cover a considerable portion of the districts of Mahébourg, the Savanna, and Flacq, and in the centre of the island are several small lakes.

The soil in many parts is extremely rich, consisting either of a black vegetable mould, or a bed of stiff clay of considerable depth; occasionally the clay is found mixed with iron ore and the débris of volcanic rock. In the neighbourhood of Port Louis, and generally in the immediate vicinity of the sea, there is but a scanty covering of light friable soil over a rocky surface of coralline formation. The whole

* Peter Botte Mountain, over Port Louis, is probably 2600 feet high. This mountain is situated at the junction of the Long Mountain with the range of Les Calebases, and is easily recognised from all directions. When viewed from certain positions, it appears very curiously shaped towards the summit, having the outline of a figure in a very full flowing robe, and representing in the eyes of the colonists a Dutch Doctor of Laws in full costume. It has been rendered famous by the interesting account given by Lieutenant Taylor, of the Royal Engineers, in the "Transactions of the Royal Geographical Society," of its first ascent by a party of British officers, on September 7th, 1832, when the flag of England was planted on its extreme summit.

coast is surrounded by reefs of coral, with the exception of a few openings, through which vessels can approach the shore; and at these points the various military posts for the defence of the island have been established.

The principal produce of Mauritius is sugar, which is cultivated to the almost total exclusion of coffee, cotton, and indigo, that were previously produced in considerable quantities, the coffee especially being of excellent quality. Wheat and maize are raised in small quantities, with yams, manioc (introduced by the French), potatoes, bananas, and other vegetables. But the island is almost wholly indebted for its supplies of provisions to the ports of India, the Cape of Good Hope, Madagascar, and Reunion. Next to sugar, blackwood or ebony, of which there is an immense supply, is the principal article of export.

The history of the island is briefly as follows. It was discovered in 1505 by the Portuguese. The Dutch took possession of it in 1598, and named it Mauritius in honour of Prince Maurice. In 1644 they made a settlement on it, which was abandoned early in the following century. The French having in 1657 occupied Reunion, sent occasional settlers to Mauritius, and on its evacuation by the Dutch, they established a regular colony in the island in 1715, of which, however, they did not take formal possession till 1721; but the real founder of this important settlement was the justly celebrated M. DE LA BOURDONNAYE, who was appointed governor in 1734. Mauritius had hitherto been neglected for Reunion, and was, at the arrival of the new governor, in the most impoverished and disordered state imaginable. M. DE LA BOURDONNAYE immediately perceived the importance of the island, which its two excellent harbours rendered of the greatest consequence to any European power having, or wishing to have, possessions in India, and he set about its improvement with a zeal, sagacity, and success that have rarely been equalled and never surpassed. Besides extending the culture of the sugar-cane, coffee, cotton, and indigo, he introduced the manioc from South America, and cinnamon, cloves, pepper, &c., from the Dutch islands; though the latter, with the exception of cloves, have not answered expectations.

He fixed the seat of government at Port Louis, which he may be said to have created as well as fortified, and constructed numerous roads, aqueducts, and other useful public works. His administration continued only for eleven years, and in that short space of time he contrived to change the whole aspect of the country and render it a most prosperous and valuable colony. This highly-gifted man, who may justly be considered the founder of Mauritius as a colony, met with a most ungrateful return for his services, for on his return to France, in 1748, he was thrown into the Bastile and imprisoned for more than three years, without, as it turned out, there being the smallest foundation for any one of the charges made against him; he died, the victim of this disgraceful treatment, in 1755. Even after the possessions of France in India had fallen into our hands, Mauritius continued to be of importance to her, and proved how justly M. DE LA BOURDONNAYE had appreciated its capabilities as a naval station. It was estimated that during the first ten years of the great war between England and France, the value of the British vessels captured by privateers and other cruisers from Mauritius amounted to 2,500,000*l.* At length, a formidable armament being sent against it in 1810, it surrendered to our arms, and was definitely ceded to us in 1815.

Mauritius has numerous small dependencies between latitudes 3° and 20° S., and longitudes 50° and 70° E. The chief are the Seychelles,

For a general description of the winds, see p. 74.

It is possible in clear weather to see Mauritius from a great distance, but this is unusual, as the mountains are generally covered with mist. When approached from the north-eastward, shipmasters not unfrequently believe themselves further from the island than they really are, and thus unexpectedly find themselves close to Serpent island or to Round island; some care is therefore requisite in estimating the vessel's position with respect to the land.

When making the island from the eastward on the parallel of 20°, a group of mountains will be seen to the southward, called the Bamboo range, which in clear weather are visible from the distance of 40 or even 50 miles. These mountains, of which the highest is 2042 feet above the level of the sea, surround Grand Port.

The S.W. point of Mauritius, named *cape Brabant*, is a high bluff headland which is probably surrounded by shallow ground to some distance out. On its southern side there is a small island called Fourneau, and another, known as the Ile de Tamarin, lies close to its north side. At the outer extremity of the channel, separating Tamarin island from the cape, the land begins to rise into a high peak called La Morne. The sea rolls against this headland with great force, and after a stormy and tempestuous day breaks against it with immense violence.*

At about a mile northward from cape Brabant there is an islet of triangular shape, named Morne or Hill island, which is seated on the shallow flat extending from cape Brabant along the coast. At low water it may be gained from the shore on foot, as may most of the smaller islets which surround the coast.

Following the coast from cape Brabant, about 4½ miles, we come to two streams named *Great and Little Black rivers*, which have at their entrances a depth of probably 2 to 15 fathoms, rapidly deepening seaward. On the north side of Great Black river there is a military post, where, says the Rev. Francis P. Flemyng, "is the most beautiful spot on the island. Encircled by the highest mountains on it, and the scenery interspersed with pretty winding rivulets and picturesquely wooded uplands, the landscape is almost perfect; the seaboard is varied on its surface by the long lines of coral reefs and rollers breaking over them in surf. The atmospheric rarity and the tropical vegetation, the cocoa-nut and other palm trees, and the graceful banana, plantain, and bamboo, which wave their foliage on every side—all lend their charms to the picture."

From Great Black river the distance is 2 miles to *Tamarin bay* along a steep coast covered with brushwood. The strand consists of a fine shingle. Tamarin bay receives the waters of Tamarin and Rempart rivers, and is said to have a depth of 6 to 30 fathoms, the latter being at only a short distance from the shore.

From Tamarin bay to the small rivers *Les Galets* and *Le Dragon* the distance is 4 miles. These streams are insignificant, but form the land lying between them into a narrow point, which separates the adjoining lowlands surrounding Tamarin bay from the steeper slopes of the plains above. The scenery which here opens to the interior is extremely grand; the long rugged spurs of the mountains of La Pierre Rouge rise at this point, and branch out into many irregular features of country, which, like all the high lands of this district, are covered near their bases

* Our description of the shores of Mauritius is far from satisfactory. The island has not been surveyed, and in the absence of a survey it is impossible to give so complete and reliable an account of it as we could desire. The only parts of it that have been examined are Port Louis and Grand Port.

with forest, whilst the summits are bare, uneven, and almost perpendicular peaks of grey and blue basalt rock.

At a mile north of Dragon river is the *river de Belle Isle*, which is fordable even at the mouth. The surrounding district, called the Plains of St. Pierre, is a pretty wooded and picturesque tract of country. All the coast along this part is steep and rugged; the soil is stony, the ground dry and arid, and although more productive in the moister localities, it is still far from being so rich as that in other parts of the island.

From the river de Belle Isle to the bay of *La Petite rivière* (Little river) the distance is $2\frac{1}{2}$ miles. Here a small battery commands and defends the mouth of the river. This stream has at its entrance a depth of possibly 4 to 10 feet.

Point aux Sables is a projection of the coast 3 miles north-eastward of the bay of La Petite Rivière, the shore between consisting of steep and perpendicular precipices which gradually decrease in height towards the point, which is low and surmounted by a small battery; there is also another battery in its immediate vicinity, called Pauline. The land above these precipices is covered with loose stones strewn over the surface, and there are but few trees, if we except some maples and velvet-trees and some tamarinds. Hence to Great River bay the distance is not more than 2 miles.

Great River bay has probably a depth sufficient for vessels of a moderate size. Immediately eastward of it is Port Louis, the capital of the island. On the west point of the bay there is a martello tower, where a small *fixed* light of red colour is shown on a mast as a guide to vessels bound to the port; this light bears S.W. by W. $1\frac{1}{2}$ mile from Fort George at Port Louis.

PORT LOUIS.—The harbour of Port Louis has water sufficient for vessels of the largest size; the soundings in the channel-way, according to the survey of Commander Evans, R.N., 1819, decreasing from 80 to 16 and 20 feet, the latter being immediately off the town: it is, however, stated that of late years the depth has considerably lessened.* On the north side of the harbour there is an island named Tonnelier, which is surmounted by batteries, and there is also a battery on the south side of the harbour, so that the approach to the town is well defended.

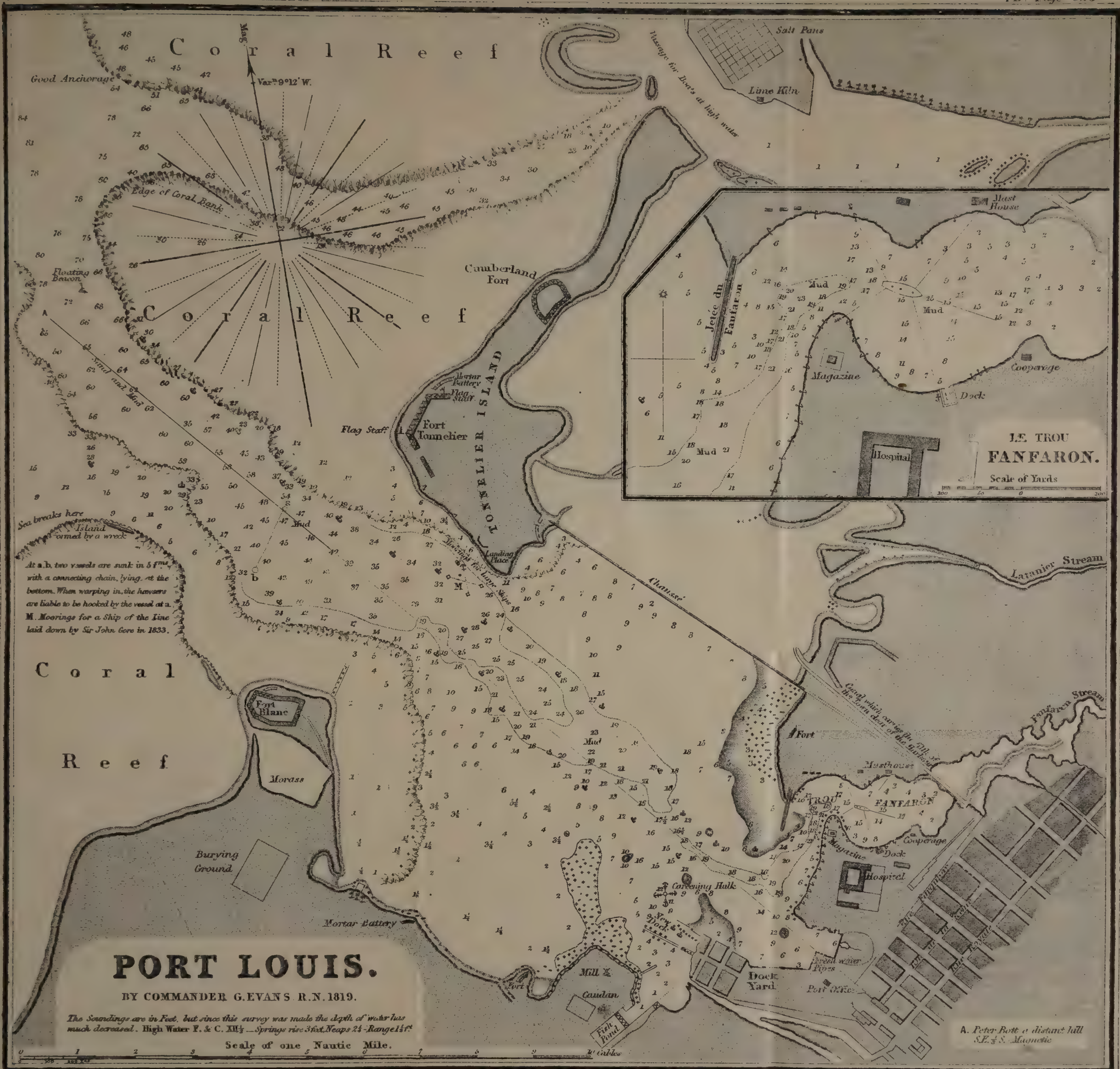
As a guide to vessels making Port Louis, a small *green* light is shown on a mast at the outer angle of Fort George on the western side of Tonnelier island.

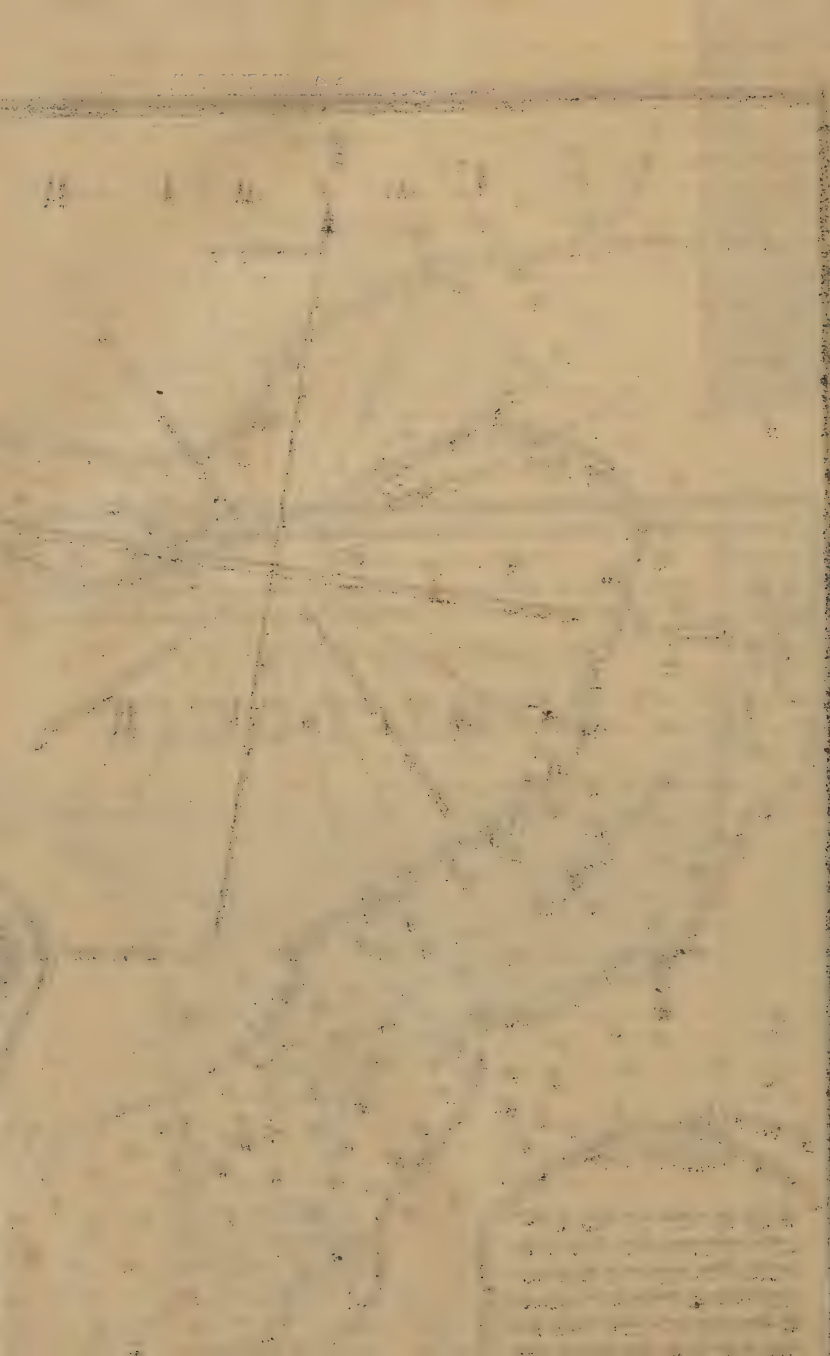
It is high water at Port Louis, on the days of full and change of the moon, at $12\frac{1}{2}$h. Springs rise 3 feet; neaps, $2\frac{1}{4}$ feet; neaps range $1\frac{1}{2}$ foot.

The Rev. Francis P. Flemyng thus writes of Port Louis:—"By natural position and surrounding scenery, few sea-port towns can be found more favoured—save those of Rio Janeiro, in South America; Sydney, in Australia, and Natal, in Africa; there is hardly a harbour in the world which is more picturesque.

The houses rest on a gentle declivity, at the foot of the rugged and grand mountains, which rise from their rear as a striking background to the picture. The bases of these mountains are covered with brushwood and trees, and from the numerous fissures in their rocky faces several rivulets issue forth and trickle down the surface of the blue basalt stone, falling in diminutive cascades where obstacles arise to

* A fresh survey of Port Louis is much needed, and would be a great advantage to the commerce of the island.


Coral Reef
Mag.
Varn 9°12' W.
Good Anchorage
Edge of Coral Bank
Floating Beacon
Coral Reef
Sand and Mud
Sea breaks here
Island formed by a wreck
At a.b. two vessels are sunk in 5 fms with a connecting chain lying at the bottom. When warping in, the hawsers are liable to be hooked by the vessel at a.
M. Moorings for a Ship of the Line laid down by Sir John Gore in 1833.
Coral
Reef
Fort Blanc
Morass
Burying Ground
Mortar Battery
Passage for Boats at high water
Salt Pans
Lime Kiln
Cumberland Fort
Mortar Battery
Flag Staff
Flag Staff
Fort Tonnelier
TONNELIER ISLAND
Landing Place
Moorings for Large Ships
Chaussé
Mud
Mud
Careening Hulk
New Dock
Mill
Caudan
Fish Pond
Fort
Dock Yard
Fresh water Pipes
Post Office
Hospital
Dock
Cooperage
Magazine
TROU FANFARON
Masthouse
Fort
Canal which carries the Hill ... the town clear of the Harbour
Fanfaron Stream
Latanier Stream
Mast House
Jetée du Fanfaron
Magazine
Cooperage
Dock
Hospital
LE TROU FANFARON.
Scale of Yards
A. Peter Bott a distant hill S.E. ¾ S. Magnetic
PORT LOUIS.
BY COMMANDER G. EVANS R.N. 1819.
The Soundings are in Feet, but since this survey was made the depth of water has much decreased. High Water F. & C. XIIh ½ _ Springs rise 3 feet, Neaps 2¼ - Range 1¼ ft.
Scale of one Nautic Mile.
Cables



retard their downward progress or to restrain them until they have gathered volume and impetus enough to break over the precipice. The purity of the atmosphere, the intense blue of the cloudless sky, together with the gorgeous tints of tropical verdure, render these mountains, both at their summits and their base, objects of peculiar beauty; the colouring on them, particularly at sunrise and sunset, being perfectly charming; whilst the white buildings of the town, with their green verandahed and trellised windows, harmonise by contrast with the other parts of the picture.

The harbour is wide and expansive, and is well defended by a large battery at its mouth, and by another nearer the town, while the guns of the citadel command and enfilade the whole space around them. On the opposite side from the citadel, and to the right hand on entering the harbour, is seen a long regularly planted avenue of trees, which marks the approach to the cemetery of Père la Chaise, a prettily arranged and carefully tended inclosure dedicated as a sanctuary of the Christian dead.

The public buildings of port Louis are quite without pretension, if we except the Roman Catholic cathedral. The government house, the official residence, which is the most conspicuous edifice on first landing, is a large, square-looking building, useful, commodious, but conspicuously ugly. The barracks are large and commodious, and occupy a commanding site at the extremity of the town. The streets, though wide, are not well drained; the houses are close and badly ventilated, many inclosed in gardens surrounded by high stone walls, and, although they may be thus rendered more private and comfortable to the immediate inmates, they are nevertheless injurious to the place, and completely spoil the uniformity and appearance of the streets. The aspect of the town is, however, pleasing, if viewed from the sea, although a closer acquaintance is not altogether gratifying.

Of the scenery immediately surrounding port Louis, the most striking object is the Pouce mountain, taking its name from the singular resemblance of the finial piece of rock at its summit to the human thumb, and which stands 2847 feet above the level of the sea. The lower ascent of this mountain is by no means difficult; it rises by an easy and gradual elevation from the site of the town. At the immediate top, and for some distance below it, it is, however, very precipitous and steep. On reaching this the view is very grand; the whole island lies stretched out below you—ocean-girt on all sides save one, and this is where the yet steeper peaks of the mountains of the Rivière Noire district rise and impede the view of that part of the shore which stands behind them. Directly beneath lies the speckled plateau of white and green dwellings of port Louis, and further on the ships in the harbour. The summit of the mountain is a piece of rock not more than 8 feet square.

On the opposite side of the town from the bazaar, and immediately above the barracks, rises a steep and conical hill called the Long mountain, 996 feet high, on the summit of which stands a signal-staff. This communicates with another on Port Louis mount, also a very commanding position. From these points, by means of a code of Marryat signals, the approach of all vessels to the island is telegraphed; whilst timely notice is likewise given to the inhabitants on the approach of hurricanes or bad weather."

Time Ball.—On April 19th, 1833, the following public notice was issued respecting the Time Ball recently established at the Observatory: "From the 25th of

April, 1833, a signal will be made from the Tower Observatory on Tuesdays and Fridays, denoting the exact moment of 1h. mean time at Port Louis. Facing the harbour will be seen on the white ground of the Observatory, and about $\frac{1}{3}$ from the top, a large black sphere, which, by a communication from the inside, will disappear exactly at 1h. It will be necessary, therefore, for regulating chronometers, to observe, either with or without a telescope, the exact moment when the black sphere disappears. To give the better notice, a white and blue flag will be hoisted on the tower one hour before the time on the above-mentioned days, and will be lowered at about 12h. 55m. It being almost impossible invariably to avoid error, a white flag will be hoisted on the tower after the observation, provided by any chance an error has been committed."

Directions.—The following official instructions for vessels making port Louis were issued September 22nd, 1855, and bear the signatures of E. C. Frome, R.E., Surveyor-General, and Edward Kelly, Harbour Master, Port Louis:—

"A vessel making the island from the eastward (or on the windward side) should give a berth of $2\frac{1}{2}$ miles to the reefs off Ambre island, and should be careful not to approach the revolving light on Flat island on a course northward of N.N.W. $\frac{1}{3}$ W. until Gunner's quoin bears west, when a course may be shaped mid-channel to pass between Gunner's quoin and Flat island.

"Having passed westward of the Quoin, the fixed light on Canonnier point will become visible, and having brought the light on Flat island to bear E.N.E. $\frac{1}{2}$ N., the course may be changed to W.S.W. $\frac{1}{2}$ S., to pass Canonnier point at the distance of about two miles.

"So soon as the fixed light on Canonnier point bears S.E. by S. the vessel may haul up S.W. by S. (with Tamarind mountain in sight a-head, if the night be clear), for the anchorage off port Louis, distant about 10 miles. But, having sailed $6\frac{3}{4}$ miles on this course to abreast of Tombeau bay, the light on Canonnier point will become *red*, at which time the lights on Canonnier point and Flat island will be in line.

"The *red* light at the mouth of Grand river (Great River bay) will now be seen bearing S.S.W., and if the night be clear the Corps de Garde mountain over it, which course of S.S.W. the vessel may now steer for about 3 miles, and when the *green* light of Fort George on Tonnelier island bears S.E. $\frac{1}{2}$ S., the anchor may be dropped on the best anchoring ground outside of the harbour. By standing further towards the Grand River light to the southward the vessel will approach too near the reefs.

"It is, however, generally advisable for the vessel passing Canonnier point to lie to, but making sail occasionally for the purpose of preserving her position, so as to gain the anchorage at daylight, in preference to attempting it at night, by which, in but few cases, has time been saved. Considerable risk, as well as the necessity for anchoring outside, will thus be avoided. After passing Canonnier point, too much caution cannot be taken to prevent the vessel being set within the *red* range of that light before she has run the distance of $6\frac{3}{4}$ miles."

The following further directions for approaching port Louis are by Mr. D. Wales, Harbour Master, and were published September 23rd, 1858:—

"It is by no means generally known that the tides along the edge of the reef and between the islands northward of Mauritius run at times with a velocity of from 5 to 6 miles on the springs. They are equally strong off the Morne and along the

southern coast; their direction is from S.E. to N.W., the flood running to the S.E., and the ebb to the N.W., varying a point or two according to the wind.

"Wherever the reefs extend to a distance from the land, the lead, if carefully attended to, will be a tolerably safe guide in the night; but should the lead be overhove when standing towards the shore, haul off immediately whilst preparing for a fresh cast, or you may run your ship aground. From 14 to 20 fathoms is generally a safe distance from the reef, but the soundings vary considerably. Of all the vessels that have been run on shore or lost on the coast of Mauritius during the last few years, it is not too much to say that the neglect of the lead was without exception the principal cause. The strength of the currents had also something to do with these accidents, but the neglect of the lead was the most important fact elicited in each inquiry.

"Where there is no coast reef marked on the chart, the shore is generally bold, having deep water to within a cable's length of it.

"Vessels arriving from the eastward and south-eastward, should be careful not to bring the light on Flat island to the northward of N.N.W. $\frac{1}{2}$ W. until Gunner's quoin bears west, when they may pass midway between it and Flat island. This course will lead about $2\frac{1}{4}$ miles clear of the reefs that extend from the north-east end of Mauritius.

"On passing Gabriel island, be careful to give a good berth to a reef that extends about half a mile to the S.S.E. of it; this warning applies more particularly to Cooly ships, which having to be visited by the Surgeon Superintendent at the Lazaret at Flat island, frequently pass much too close to this reef without being aware of its existence, as in very fine weather the sea does not always break on its extreme point.

"When westward of the Quoin, Canonnier point light will be seen. Steer with Flat island light astern bearing N.E. by E. $\frac{1}{2}$ E. until the Canonnier point light bears S.E. by S. (which will carry you clear of the dangerous reef that extends from the point); you may then haul up S.W. by S. till the red light at Grand river is seen, bring it to bear S.S.W., and steer for it on that course until the green light on Tonnelier island bears S.E., when, being over the best ground, you may anchor in from 12 to 16 fathoms. A nearer approach to the red light at Grand river would bring a vessel too near the reefs to the south-westward of the entrance of the harbour.

"Should the night be clear when running down the coast, the western shoulder of the Corps de Garde mountain will be seen in line with the Grand river red light when the latter bears S.S.W.

"Remember especially that after passing Canonnier point on your way to the Bell buoy, the Canonnier point light changes from *white* to *red* if it be brought to bear more northerly than N.E. $\frac{1}{2}$ E. This change will warn you that the vessel is too near the reefs that skirt the coast between Canonnier point and point Piment.

"But this change from white to red is only intended as a guide as far as point Piment, after passing which the red light at Grand river will be the mark to the anchorage. It is not well, however, for a large vessel ever to approach so near the reef as to change the Canonnier point light from white to red. The great object in view in thus arranging the light was the convenience of the numerous coasting vessels belonging to the colony, to whom (knowing the ground as they do) it is most useful. The best mark for keeping clear of the reefs between Canonnier point

and point Piment, by night, is to keep the Flat island light open westward of Canonnier point light, until the red light at Grand river is seen.

"Should you be approaching the Canonnier point light from the westward when it shows white, and steering directly for it, there can be no change of colour; but by attending to the bearing of Flat Island light it will be impossible for you to run on the reef. The barque *Cornwall*, of 947 tons, steering E.N.E. for Canonnier point light, was wrecked on the reef within three-quarters of a mile of the lighthouse, because it was erroneously supposed that the light changed colour on approaching it whenever a vessel was southward of it; whereas it is only when it is brought to bear N.E. ½ E., and northward of that, that the light changes colour.

"When running for the anchorage by day, after passing Canonnier point with Flat island lighthouse bearing N.E. by E. ½ E., bring Tamarind mountain (a conical hill westward of all the other high land) to bear S.W. by S., and steer for it until the Martello tower on the south side of the mouth of Grand river is seen in a line with the western shoulder of the Corps de Garde mountain, bearing S.S.W. This will lead clear of all danger to the anchorage, which is indicated by a floating beacon painted red and white, generally called the Bell buoy, which lies in 12 fathoms on the north side of the mouth of the harbour. Anchor northward of this beacon in from 12 to 20 fathoms.

"When approaching by night from the south-westward, Flat island light bearing N.E. by E. will lead between two and three miles to the westward of the reefs southward of the port, and when the green light on Tonnelier island bears E.S.E., steer for it if the wind be favourable under easy sail. If the night be clear the shipping at the Bell buoy will be seen and afford a good mark. Keep the lead going, and bring the two harbour lights to bear as already described, and anchor.

"During the day, the Gunner's quoin bearing N.E. ¾ E. is the best mark.

"It is most unadvisable to attempt anchoring at the Bell buoy after dark, unless well acquainted with the localities; it is far better, with the admirable advantages afforded by the lights for ascertaining a vessel's exact position, to keep under way till daylight; considerable risk will thus be avoided, and as no communication with the shore is permitted till vessels have received pratique, no time is gained by anchoring in the night."

It has been remarked by a shipmaster, that the reefs in the vicinity of the harbour of Port Louis generally show themselves by discoloured water, and that a good look-out should at all times be kept for them. A stranger should not attempt to enter the harbour without a pilot, especially as one can usually be obtained at from two to four miles from the entrance. The wind most frequently blows out of the harbour, and renders it necessary for vessels to warp in. From October to February (when the winds are inclined to vary, and sometimes blow from North and N.W.) the current is liable to run eastward along the north side of the island; at such times vessels may approach Port Louis with facility by coming round the west side of the island. This is the best season for ships crossing from Madagascar to Reunion and Mauritius.

Port Regulations and Signals.—The following official notice was issued from the Harbour Master's Office at port Louis, November 30, 1850:—

"1. All vessels above 100 tons burthen shall take a pilot, and receive the assistance that may be sent them from the port office.

"2. All British vessels under 100 tons may be allowed to warp in by their

own means, but they must be moored in the berth pointed out by the harbour-master.

"3. Vessels of every description are to be moored with two bower anchors forward, and from 1st December to 30th April two also astern, with buoys and good buoy-ropes on them; during the other months, one bower anchor astern will be deemed sufficient. Captains and owners shall be obliged at all times to take any additional precautions for the safety of their vessels that the harbour-master may think proper. Pilots, when mooring vessels, must be careful not to overlay other ships' anchors; if possible, to avoid it.

"4. Pilots are not to bring any vessel above the forts until the powder has been taken out; and if time will not permit of its being landed, it must be put into a boat and moored outside the harbour; the powder to be well covered with tarpaulins or sails, and a man left in the boat to guard it; this man is not to be permitted to smoke, or have any fire in the boat. During the time he has the powder in charge, a red flag is to be hoisted on a staff, and kept flying in the bow of the boat.

"5. As soon as a vessel is moored and secured in the berth (or before if necessary), the flying and standing jib-booms, and also the studding-sail booms on the yards, are to be run in, and no spars serving as guess-warp-booms can be allowed while in the harbour. Captains and officers not complying with this regulation must be answerable for any accident which may happen by other vessels hauling in or out, sailing in or out, or towing in or out by the steamer, changing their berths, or by small craft boarding them, or by any other means whatever.

"6. From the 1st day of December to the 30th day of April, all ships and vessels moored in the harbour are to keep their topgallant-yards and masts struck and on deck, that they may be in constant readiness to strike their yards and topmasts on the first order from the harbour-master.

"7. It is expressly forbidden to throw dirt or ballast from vessels in the harbour. A boat will be sent round once a week, or oftener if necessary, to receive the dirt from vessels and carry it away.

"8. When vessels are laid up, the owners are to provide a competent person to take care of them, in default of which one will be provided by the harbour-master at the expense of the said owners.

"9. Coasting vessels cannot be allowed to remain in harbour during the night, without two men at least, as a guard, on board of them.

"10. All captains and officers of vessels moored in the harbour shall be obliged to receive the tow-ropes from any vessel which may be warping in or out, as ordered by the pilot in charge.

"11. Vessels at anchor, or moored in the harbour, are not to scale their guns or fire salutes without leave from the harbour-master.

"12. No vessel is to be smoked for the destruction of rats without having first acquainted the harbour-master, and obtained permission for that purpose.

"13. In the event of an alarm of fire in the harbour or on shore, each vessel shall be obliged to send her buckets, axes, maules, and whatever she may have on board which may be useful in such cases, and also as many men to assist as can be spared.

"14. Vessels requiring hay for the purposes of their voyage cannot be allowed to remain the night at anchor, or on the warps in the harbour, after the hay is on board;

and should they not be ready to proceed immediately to sea, they must run out and anchor at the Bell buoy, to wait until they are.

"15. Neither hay nor cotton can be allowed to remain on the wharf during the day, unless under a special guard; nor can such be suffered, under any circumstances, to remain on the wharf during the night.

"16. Vessels embarking gunpowder must in like manner proceed to sea immediately, or wait outside the harbour until they are ready.

"17. Boats are not allowed to be hauled up or landed on the government wharfs or ways without leave from the harbour-master.

"18. No vessel can be swung preparatory to going to sea until the clearance from the Custom House is produced at the Port Office.

"19. Notice of the departure of vessels shall be given in writing by their respective commanders at the Custom House and Port Office, 48 hours previous to sailing, and a flag shall be hoisted at the maintop-gallant-masthead from the time such notice is given until their departure. English ships to hoist the Jack, and foreigners the small flag of their country.

"20. Vessels that are swung will be allowed to remain 24 hours on the warps belonging to the port, but no longer; if they do not proceed to sea at the expiration of that time, they will have to pay for the use of each of the four warps by which the vessel is secured, the daily charges fixed by the Port Tariff until her final departure. Vessels under 100 tons which are allowed to make use of their own means in swinging, will be charged 20 shillings per day for the time they remain swung above the 24 hours, as allowed to other vessels.

"21. Captains and officers of merchant vessels of all nations are strictly prohibited from hoisting at either mast-head of their respective ships any pendant or anything that can be construed into a pendant, while they remain in this harbour.

"22. From the 1st of December till the 30th of April of each year, all vessels, whether English or foreign, arriving in the harbour of port Louis, shall be authorised to enter and anchor in the harbour, as far up as the line which, during this season is destined to form the north-east boundary of the roadstead of port Louis; ships and vessels thus arriving and anchoring thus high, shall not be liable to any entries, fees, or formalities exigible by the Custom House or Port Office, other than they were formerly subject to, when they could only anchor at the Flag or Bell buoy.

"23. The boundary referred to by the foregoing article, shall be marked out by two flagstaffs erected upon the beach, one on either side of the harbour, indicating a line from the inner point of Isle Tonnelier to the inner point of Fort Blanc, and each of them bearing a yellow flag blazoned with the Royal initials, surmounted by a Crown.

"24. With reference to Art. 9 of Ordinance No. 38 of 1844, a red flag with a swallow tail, will be used to indicate that a vessel arriving has been permitted to communicate with the shore.

"25. In case any ship or other vessel be sunk, stranded, or run on shore in any part of the harbour, port, or roadstead, the owner or owners, or some other person having or pretending to have any property therein, or the commander thereof, shall clear the said port, harbour, or roadstead of such ship or vessel and of all wrecks and parts of the same within the time appointed, in a notice under the hand of the harbour-master requiring them so to do, and in default by such owner or owners, or other persons aforesaid, to obey such orders, such ship or vessel, wrecks and part

of the same, shall be removed in such manner as the harbour-master shall order and direct, and the expenses of removing such ship or vessel, wrecks and part of the same, shall be chargeable to and against the owner or owners of such ship or vessel, or other person aforesaid, independently of the fine and penalties prescribed by the Art. 42 of Ord. No. 38 of the present year.

"BAD-WEATHER SIGNALS:—

"The following Signals will be made from the Flag-staff at the Port Office, and repeated at the Flag-staff of Fort George, on the approach of bad weather.

"*Signals to Ships and Vessels in the Harbour.*

"A White Flag, with Horizontal Blue Stripes:—Send down top-gallant yards and masts, and prepare for bad weather.

"The Masters of all Ships and Vessels in this Port are required immediately to repair on board their respective Vessels.

"A White Flag with a Blue Cross:—Strike lower yards and topmasts.

"N.B.—This Signal shall be confirmed by a gun at Fort George.

"*Signals to Vessels at anchor at the Bell-buoy, and repeated at the Flag-staff of Fort George.*

"Red Pendant over a White Flag with Horizontal Blue Stripes:—To indicate the appearance of bad weather or of a hurricane.

"Red Pendant over a White Flag with a Blue Cross:—To indicate that the gale or hurricane has begun.

"Ball over a White Flag with a Blue Cross:—Shall announce to all vessels outside the harbour that the danger of remaining at anchor has become great, and that their safety requires them to put to sea.

"N.B.—This signal shall be confirmed by a gun at Fort George.

"The several ships and vessels are required to answer the above signals by hoisting the Jack of their nation at the main.

"Ships at the Bell buoy can communicate with the Port Office by MARRYAT'S signals; the same to be kept flying till answered by the pendant at the Port Flag-staff.

"N.B.—The Captain of the Port desires to impress upon the minds of the masters of vessels arriving at this port during the hurricane season, the necessity of prompt obedience to the above signals.

"All infractions against the Regulations of the Port shall be punished by fine, which shall not be less than 5*l.*, nor more than 50*l.* sterling, and by an imprisonment of from eight days to three months, accumulatively or separately."

Canonnier Point, &c.—At about 9½ miles northward from port Louis is Canonnier point, to which such frequent reference has been made in the instructions for making the port. At 2¾ miles from the harbour is Tombeau bay, in which there is probably a depth shoaling from 18 fathoms at the entrance to 2 fathoms close to the shore; and at 1¼ mile northward from this is Turtle bay, which receives the waters of the river Pomplemousses, a stream running about 8 miles into the interior. Hence to Canonnier point the coast trends north-eastward, and at about midway there is a projecting point, named Rocky point.

Canonnier point is low and sandy, and has a battery upon it. The point will be easily recognised by its lighthouse, which stands at the extremity of the headland, in Lat. 20° 0′ 35″ S., and Long. 57° 35′ 24″ E., and shows a *fixed* light at 38 feet above the sea, visible 10 miles. This building bears S.W. ½ W., nearly 9 miles from the lighthouse on Flat island, and one of the objects of its erection is to indicate the position of a dangerous reef which extends off shore 1¾ miles from the point, and to warn vessels from approaching too near the coral reefs north-eastward and south-westward of the point. When seen from the southward *on any bearing northward of N.E. ½ E. the light will appear red*, and thereby give warning to seamen (when within 6 miles of the light) that they are too near the shore.*

On the east side of Canonnier point there is a shallow bay named Great bay, and at nearly 3 miles further eastward is Cape Malheureux, the north point of Mauritius. At 2¾ miles N. by E. ½ E. from Cape Malheureux is the islet Gunner's quoin.

Gunner's Quoin.—The Gunner's quoin is an island about a mile long in a W. by N. and E. by S. direction, the highest part of which, the north-western point, is steep and 515 feet above the sea; thence it slopes gradually towards the south-east, where it is terminated by three dangerous rocks named the Carpenters. There are also several dangerous rocks on its north and north-east sides, distant from it about ¼ of a mile.

Between the Gunner's quoin and Mauritius there is a good channel of 16 to 37 fathoms water, through which vessels may pass with care. It is necessary to give the mainland a good berth, as there are several shoals off it. The deepest water is at about half a mile from the Quoin, where will be found from 20 to 30 fathoms. It is said that good anchorage may be obtained at about a mile from the shore of Mauritius.

Flat Island.—At 4 miles north-eastward from Gunner's quoin is Flat island, an island of about a mile in extent, the shores of which are rocky, and, with the exception of the south-west side, bordered by sunken rocks. Its south-western extremity is steep and rugged; the remainder of its surface is flat and comparatively smooth. At its south-east end there is a small islet, named Gabriel island, which is separated from it by a narrow channel, too shallow to be navigable.

At ¼ of a mile N.N.E. from Flat island there is an isolated rock 172 feet high, named Pigeon house. The channel between probably has a depth of 2 to 3½ fathoms; but it is very unsafe, and never used by vessels.

The lighthouse on Flat island stands on the south-west angle, the highest land of the island, in Lat. 19° 53′ 26″, and Long. 57° 41′ 12″, and shows a light revolving in one minute, during which period it appears bright for 20 seconds. It is 365 feet above the sea, and visible from the deck of an ordinary vessel at the distance of 25 miles. In addition to the lighthouse there is a telegraph station on the island, and also a flagstaff.

In Palisade bay, at the western side of Flat island, small vessels occasionally anchor in about 10 fathoms, and obtain shelter from easterly winds. And vessels may also anchor on the south-west side of Gabriel island in a similar depth, but great care is necessary to avoid a dangerous sunken reef extending from the south end of the island to a distance probably of half a mile.

* Colonel Lloyd, Surveyor-General of the island, says, "The breakers on the north-west coast of Mauritius can generally be heard from the distance of 3 miles, and should not be approached nearer than the depth of 15 fathoms."

The channel between Flat island and Gunner's quoin is the channel generally used by vessels bound to port Louis from the north-eastward. It is quite safe, but it is necessary to guard against the sunken reef off the south end of Gabriel island and the rocks off the north-east side of Gunner's quoin.

Round Island.—This island is situate $11\frac{1}{2}$ miles E.N.E. $\frac{1}{4}$ E. from the Gunner's quoin; $13\frac{3}{4}$ miles E.N.E. $\frac{1}{2}$ E. from cape Malheureux; and 7 miles E. $\frac{1}{2}$ N. from Flat island. Its position is estimated to be Lat. 19° 50′ 34″, and Long. 57° 47′ 56″. It is about three-quarters of a mile in extent, 1049 feet high, and has soundings on its western side of from 4 to 25 fathoms, the latter being at about a mile off. It may be passed on the east side, and also on the south side at the distance of a mile. In the event of a calm, anchorage may be obtained in 15 fathoms at half a mile from the shore, with the island bearing S.W., and the reef of Serpent island North distant three-quarters of a mile.* In clear weather the island may be seen from a distance of 20 to 30 miles.

Vessels sometimes pass between Round island and Flat island, but should not approach the latter nor the Pigeon House rock within the distance of a mile.

Serpent Island.—Serpent island is a large rock of whitish colour, situate north-eastward from Round island $1\frac{1}{2}$ miles. A reef extends from its east side about $\frac{1}{4}$ of a mile, rendering a near approach unadvisable; indeed, it is said that vessels should give the north and east sides of the island a berth of at least one mile.

In the channel separating Serpent island from Round island there is probably a depth of 23 fathoms, but it is not advisable to attempt this passage at the risk of being becalmed, and also on account of two dangerous reefs, one of which is $1\frac{3}{4}$ miles westward of Serpent island, and the other half a mile N.W. of Round island; the latter breaks only when the sea runs high. If obliged to run through this channel, pass midway between the reefs, or at about $\frac{3}{4}$ of a mile southward from that of Serpent island, which is always visible by its breakers.

Currents, &c.—The flood runs between the islands just described (Gunner's quoin, Serpent island, &c.) N.E. and the ebb S.W. The stream is very rapid, averaging from 3 to 4 miles an hour, which must be allowed for; during the S.E. Monsoon in June, July, and August, the stream sometimes runs 6 miles with the flood, and the ebb occasions an equally heavy race between the Gunner's quoin and the north end of Mauritius.

It may be remarked here that, as a rule, a vessel making Mauritius in the evening, and in hazy weather, should not run between the islands in the night; but in clear weather, as they are visible at a great distance, she may pass in safety between Flat island and Gunner's quoin.

M. D'Après de Mannevillette says, "Great care is requisite when approaching the north-east end of Mauritius, because dangerous reefs project from several places nearly a league into the sea. Round island appears like a haycock, and can be seen from a distance of about 30 miles in clear weather, and is visible, when viewed from the north-eastward, sooner than Mauritius, especially in cloudy weather, or when the horizon is hazy. If a ship pass outside all the islands, with the wind far to the southward, she will have to work in afterwards; it is therefore proper to work in southward of Round island, keeping at

* It has been stated that the channel between Round island and Serpent island is unsafe, there being numerous reefs about, although in other respects it is sufficiently deep for large vessels.

more than half a league from it, to give a berth to the reef projecting from its west side.

"If a ship, in passing through the channel among the islands, experience a calm, she ought to anchor with a stream or kedge, in 15 or 20 fathoms gravel or coral, which is the common ground here; this will prevent her being driven by currents on the reefs joining Flat island, or being carried between it and Round island, where are several shoals, particularly a ledge extending nearly 3 miles to the north-westward from Round island. This ledge, which has no breakers on it but when the sea runs high, renders this channel narrow and dangerous; a ship may, notwithstanding, pass through it without accident, but if she fall to leeward of Round island, it is safest to pass outside of Flat island also, keeping about 1½ miles from it, then steer for the west end of Gunner's quoin and Canonnier point."

Flacq Bay.—From cape Malheureux, the north point of Mauritius, the coast trends to the south-eastward, and for about 12 miles is fronted by extensive and dangerous banks, upon which are seated some irregularly-shaped coral islands, named Ambre; it then trends round to the southward 7 miles to Flacq bay, where is one of the oldest settlements on the island, and the district is one of the best cultivated; it was originally settled by the Dutch. Here is a military station. The sugar from Flacq is conveyed to port Louis by *chasse-marées* or *gaulettes*, large lugger-boats decked over, and able to hold a great number of bags stowed below. A passage which exists between the reefs and the shore at the mouth of the river enables them to run in close to the coast, and take their cargoes on board with very little trouble.

At 8½ miles southward from Flacq bay is the outlet of Great river, or Rivière Sud-Est, where is also a military station.* Adjacent to this river lie the Deer islands, and another rocky islet called Roche island; these are small coral islands formed as the surrounding reefs, but separated and detached from them. On the south side of the river rise the first abutments of the Bamboo range of mountains, the highest peak of which is estimated to be 2042 feet above the sea.

GRAND PORT.—Succeeding the outlet of Great river or, as it is termed by the colonists, Rivière Sud-Est, is the large bay forming Grand port, which is the only harbour on the east side of the island. It is at Grand port that the town of Mahebourg is situate, which is a small town of but little commercial importance. All this part of the coast is fronted by reefs, and the approach to Mahebourg is rendered difficult to strangers by the windings of the three channels by which it is approached; the assistance of a pilot is therefore essential at all times.

Grand port is but little frequented, as it is on the windward side of the island, and the trade-wind generally blows into it, which increases the difficulty of leaving it. On the days of full and change of the moon there are breezes at times from the land, which permit a vessel to get out of the harbour. The reefs forming the channels generally show themselves by the colour of the water; when within, there is usually a smooth sea, the reefs forming an excellent natural breakwater.

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* The shore in the vicinity of Great river is covered with large stones, the surfaces of which are pierced with numerous circular holes about a foot or fifteen inches in diameter, and nearly to the same depth; these are also found on the land in the interior of the island, and appear as though the boiling matter of which they were first formed had suddenly cooled and left large bubbles of air burst on its surface.—FLEMYNG'S *Mauritius*.

Light.—A lighthouse has recently been erected on Isle aux Fouquets, on the edge of the reef, at half a mile north of the southern entrance of Grand port. The tower from base to vane is 84 feet high, and as well as the buildings adjacent to it, is coloured white; it marks the southern entrance to Grand port, and stands at about 4½ cables' length E.N.E. from Isle Passe, and 3 miles from the coast of Mauritius; its position is Lat. 20° 24′ 10″ S.; Long. 57° 45′ 9″ E. The light, *fixed*, is 108 feet above the sea, and visible from a distance of 16 miles.

Directions.—In reference to the light on Isle aux Fouquets, the following instructions were officially issued in 1863. The magnetic variation allowed was 9° 25′ W.

"A Government pilot in a few months will be stationed at the newly erected lighthouse, and will board vessels bound to Grand port on their making the usual signals. Vessels bound to Grand port may approach the light, when bearing from N. by E. round by north to W. by S.; and when about 2 miles from it should heave-to for the pilot, with the vessel's head off-shore.

"Should it be desired to get shelter, approach the light under easy sail till at about three-quarters of a mile from it, avoiding the shoal patch of 6 fathoms water off Laverdie point, the extreme of the coral reef bounding the south side of entrance to Grand port; then steer so as to round Isle Passe at the distance of half a mile, as a spit runs out from its south side for about a cable's length; when haul to the northward and anchor in 18 to 20 fathoms. It is not recommended to attempt to enter without a pilot, except in cases of extreme necessity.

"A vessel from the southward bound to port Louis, round the north end of the island of Mauritius (the usual track), should, after sighting Grand port light, steer so as to pass it at a distance of 4 miles; when at that distance, with the light bearing W. by S., a N.N.E. ½ E. course for 9 miles, if the weather be clear, will bring a vessel in sight of Flat island *revolving* light, bearing about N. by W. ½ W.; the course can then be shaped as required.

"A vessel from the northward having Flat island light on a N.N.W. bearing, should be careful after sighting Grand port light, not to bring it, when at a distance of less than 8 miles, on a more southerly bearing than S.W. by W. ½ W., or she will be too near the coast reef northward of the light.

"The coast reef bounding Grand port is bordered by a bank of irregular soundings extending some distance seaward; the lead, if carefully attended to, will prove a tolerable guide in thick weather.

"Vessels bound into Grand port should not approach it at night, but should heave-to well southward of the light, as the drift is to the northward, and much time will be lost in working back. Isle Passe, on the north side of the entrance, is easily known by the battery and other buildings on it. At times the rollers block the channel, although the depth is from 14 to 22 fathoms; and generally the reefs on either side are perfectly visible from aloft. The rise of tide is 3 feet."

The following additional instructions by the late Colonel Lloyd, C.E., Surveyor-General of the island, dated 1849, may still be of service:—

"*North Entrance.*—A vessel intending to enter Grand port, or Mahebourg, by the northern entrance, must keep Bamboo peak bearing West by compass until Rocky island is made, which is surmounted by a beacon visible at 5 miles' distance. This rock is situate at the extremity of the reef, and forms the northern arm of this entrance to Grand port; it should be passed ⅓ of a mile to the southward. A

S.W. ¼ W. course must then be steered about 2 miles, when on the port bow a remarkable isolated breaker, named the Diamond, will be visible opposite another entrance to Grand Port, called Danish Channel. Having brought this breaker to bear S.S.W. ⅓ of a mile, steer W. ½ S. about one mile, when a bluff hill will be seen on the port bow, stretching to seaward, surmounted by a curious black rock, and at the foot of its leeward extremity there is a battery. This is called the Devil's point, and so soon as the black rock bears W.S.W. distant one mile, steer S.W. by S. ½ S. for about 1½ miles, passing the Devil's point ⅔ of a mile from the battery, and bring up in 9 or 10 fathoms, sand and gravel, the Devil's point bearing N.W. ¼ W., and Bamboo peak N.W. ¾ N.

"When passing the Devil's point take care to keep closer to the reef on the port-hand than to the land, as there are two large banks ⅓ of a mile from the shore, with only 2 or 3 fathoms water over them.

"By following the above directions, and not approaching the reefs on either side of the channel within less than ¼ of a mile, a vessel may be taken to the above safe anchorage without risk.

"It would not be advisable to attempt going any further towards Mahebourg without being well acquainted with the intricate channels and shoals, or without having a colonial pilot on board.

"*Eastern, or Isle Passe Entrance.*—The eastern entrance to port Royal is less intricate than the above, in preference to which it is recommended. It is situate about 9 miles S.W. by S. of the northern entrance, and can be easily made out by the Isle Passe rock, which forms the northern arm of its entrance, as well as by a remarkable bluff mountain, 1583 feet high, inshore immediately opposite, named the Lion's Head, which, in making the pass, must be kept on a N.N.E. ¾ E. bearing.

"The Isle Passe will be easily recognised; it is the southernmost of several small rocks or islands bordering the reef, and is covered with houses, fortifications, &c.,—there is also a flagstaff near its centre.

"When entering the channel keep the Lion's Head bearing N.N.E. ¾ E. as above, until the centre of the Isle Passe bears E. by N. distant ¼ mile; then steer for the rock of the Devil's point, which will bear E.N.E., and after running ¾ of a mile bring up in about 13 fathoms, sand and gravel, the Isle Passe bearing south, and the Lion's Head S.W. ¼ W. It is not advisable to go further without a pilot.

"*Danish Passage.*—The Danish passage, already mentioned, bearing W.N.W. ¼ W. from Bamboo peak, cannot be recommended on account of the small depth of water at its mouth (3 fathoms), which occasions a heavy cross sea, sometimes breaking from point to point. If, however, this entrance be attempted, when off the mouth of the channel keep as close as possible to the northern point, in order to avoid a large coral bank in the centre of the pass, on which there are only 2½ fathoms; steer ⅔ of a point to the southward of Bamboo peak for about a mile, when the Diamond rock will be right ahead; pass it on either side at a cable's length, and as Bamboo peak is brought to bear W.N.W. ¼ W., steer W. ½ S. to make the Devil's point, and follow the directions given above for the northern entrance to pass that point to the anchorage."

South Shore of Mauritius.—From Grand port the coast trends W. by S., and forms the south shore of Mauritius, in which there are no harbours, it being rendered almost inaccessible by the coral reef which borders almost the whole of it, the only exceptions being the immediate channels of the rivers. This

bars all approach to the shore save for vessels of small tonnage and a shallow draught of water; but many of these, called chasse-marées, trade round the coast of this district for the transport of sugar to port Louis—at one part between cape Brabant and Le Cap the reef rises to an elevation of fifteen feet above the water. At 6½ miles eastward of point Brabant is the river Citron, where vessels of 200 tons have been built, the wood being here plentiful, whilst the rivers on the south coast of the island being generally navigable at their mouths, render this particular district a favourite resort for those engaged in this occupation. Between the river Citron and cape Brabant the charts represent a little inlet, named Cape bay, which is merely the outlet of a stream known as the Cape river; the depth at the entrance to this bay is probably 8 fathoms. Port Savanna, a similar bay, is in Long. 57° 30′, and nearly midway between Grand port and cape Brabant.

RODRIGUES.

General Remarks.—This is an irregularly-shaped island of considerable altitude, which can probably be seen from a distance of 30 to 40 miles in clear weather. It is about 18 miles long from east to west, and 6½ miles across in its broadest part. It possesses two harbours of sufficient depth to admit vessels, of which that on its north-eastern side bears the name of Mathurin bay, and that on the south side, Sea Turtle Pen; the latter is seldom frequented, being considered too intricate for strangers. Reefs extend around the island, and have their outer edge at least 5 miles from it, in some places probably as much as 7 miles, excepting at its north-eastern part, where it is believed that they do not run off more than half a mile, a statement having been made that there is a depth of 25 to 17 fathoms at that distance from this side of the island. The position of the centre of the island is estimated to be Lat. 19° 41′ S., and Long. 63° 25′ E.

Rodrigues has not been surveyed, and we are chiefly indebted to the old chart of M. D'Après for the foregoing details. Statements have been made that the reefs surrounding the island extend many miles from it, but it is generally believed that 7 miles is their utmost limit.* When approaching the north-east side of the island no bottom can be obtained at the distance of 3 miles from it; thence it decreases in

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* Mr. D. Wales, Harbour-master at port Louis, Mauritius, in some remarks addressed to the Editor of the "Nautical Magazine," which were published at Mauritius in 1860, is of opinion that the reef extends southward of Rodrigues about 12 miles, an opinion he arrived at during the evidence given by the master, officers, and crew of the *Nusser Sultan*, before the Marine Court of Inquiry into the cause of the loss of that vessel; and also from a bird's-eye view of the dangers on the north, west, and south sides of the island, which he obtained from one of the highest of its mountain peaks. He says: "Although I don't pretend to state with *accuracy* the distance of the extreme broken water southward from the nearest shore, yet I can safely assert that it appeared to me to be nearly double the distance from the land, as compared with the reef to the northward off Palm Tree point. Now, the reef off Palm Tree point is laid down in M. D'Apres' chart as extending 6¼ miles from the nearest shore, which is known to be nearly correct, from which I infer that if the reef to the northward is 6 miles from the land, that on the south side is nearly double that distance." And this opinion he retains, notwithstanding the triangulation of Sir J. Marshall, of H.M.S. *Isis*, which would tend to prove that the distance is not more than 6 miles.

The Marine Court of Inquiry, alluded to in the preceding paragraph, advised ship-masters to give Rodrigues a wide berth at night, as they could not regard it otherwise than very dangerous land to approach at any time, and especially when there is cause for doubting the accuracy of the vessel's position. They considered it quite unnecessary to follow the usual custom of sighting it when bound to Mauritius for the purpose of verifying chronometers, believing it to be far better to get into the parallel of Round island, and thence steer directly for it, particularly as the coast of Mauritius is now so well lighted that it is difficult to mention any land that can be made by night or day with more safety and less risk by vessels coming from the eastward.

depth from 45 to 17 fathoms, the latter being, as already mentioned, at half a mile from the shore—further westward the soundings are more gradual. But few vessels frequent the island, there being no inducement beyond getting a supply of fresh water.

Mathurin Bay.—The following instructions for Mathurin bay, by LIEUTENANT GRUBB, of the Bombay Marine, were written many years since (in 1810), and are still the only information we possess of the harbour. It is, perhaps, scarcely necessary to add that as they are not modern, they should be followed with the care which a shipmaster should always exercise when guided by uncertain information.

"The road or harbour is called Mathurin bay, and near the middle of the island and south from the roadstead, there is a remarkable peak which answers as a guide. Vessels may stand in shore to 18 or 16 fathoms, but the bottom in general consists of coral rocks, though in some spots of sand and mud. There is a small level spot of land between two hills, with some houses, where a resident and some soldiers were usually stationed. An extensive shoal, known as the Middle ground, fronts the harbour, on some parts of which there are 3, 2, and $1\frac{1}{2}$ fathoms, with gaps of 6, 7, or 8 fathoms between the shoal patches. The harbour is in general good holding ground, the bottom being a mixture of sand and mud. The tide rises about six feet, and it is high water on the days of full and change of the moon at 1h. 45m.; the flood runs to the eastward and the ebb to the westward at the rate of about 2 miles per hour.

"There are two channels for entering or leaving the harbour; the eastern one being only about 250 yards in breadth, renders it very intricate for large ships. The western or leeward channel is free from danger, being about $\frac{1}{4}$ of a mile in breadth, and is formed by a small shoal of $2\frac{3}{4}$ fathoms on the edge of the Middle ground, and a rocky patch of $3\frac{1}{2}$ fathoms to the westward; this channel, being far to leeward, should only be used by vessels going out of the harbour. There is another channel over the Middle ground, of the same breadth, which was used for bringing in ships previous to the survey of the harbour; but this was often attended with danger from violent gusts of wind from the valleys, rendering a ship liable to miss stays when near the reef, where she might be on the rocks before the anchor could bring her up. Ships, therefore, should always go in by the eastern and out by the western channel.

"*Eastern Channel.*—If a ship have occasion to touch here she must go in by the Eastern channel, and after having made the east or north-east part of the island, may stand in within $1\frac{1}{2}$ miles of the reef, and coast along it at this distance until Booby island is seen, which bring to bear W. $\frac{3}{4}$ S.,* and steer towards it with this bearing, keeping a good look-out for the peak, which will bear about S.S.W. $\frac{1}{4}$ W. when first seen. Steer for Booby island till the peak bears S. by W. $\frac{3}{4}$ W., or about two ships' length open eastward of the White rock (a rock close to the shore, whitened to make it conspicuous), then Diamond island will be just touching Diamond point, and the vessel will be at the entrance of the channel with the peak S. by W. $\frac{3}{4}$ W.; Booby island W. $\frac{3}{4}$ S.; and Diamond island touching, or a little on with Diamond point,—steer in W. by S. $\frac{1}{2}$ S. until the peak and White rock are in one (observing not to open Diamond island with the point); then haul up S.W. $\frac{1}{4}$ W. or

* Variation 10° W. in 1810. It is now 7° 35′ W.

S.W., keeping a good look-out on the port bow for a $2\frac{1}{4}$ fathom shoal, which is generally visible. When Diamond island is open with Diamond point you are within the shoals, and may run down to the westward, and anchor in 12 or $12\frac{1}{2}$ fathoms sand and mud, with the peak bearing from S. $\frac{1}{4}$ W. to S. $\frac{1}{4}$ E., and Diamond island between two knobs or hummocks near the point, which is the most convenient berth for watering.

"*Western Channel.*—The wind is too scant to sail out by the Eastern Channel, a ship leaving the anchorage, should, therefore, use the Western Channel, and so soon as the anchor is weighed for that purpose, get her head round to W.N.W. and run down till the peak bears S. by E. nearly, then haul up N. by W. or N. $\frac{1}{2}$ W. (observing how the tide sets you, so as to keep the peak bearing S. 10° E.), and when the north-east point of the island is open with the east point of the bay, you are clear of all the shoals, and will have 16 or 17 fathoms water. A rocky patch of $3\frac{1}{2}$ fathoms has been discovered nearly in the middle of the Western Channel, and was marked in 1810 by a blue buoy. The peak just opened westward of the large house leads a ship between the rocky patch and the western extremity of the middle ground.

"When sailing into or out of this harbour, a good look-out from the fore or fore-topsail yard is advisable, for the shoal coral reefs may often be easily seen when the water is clear; a boat ahead is also a necessary precaution for those who are unacquainted.

"The soundings decrease regularly from 30 fathoms, 2 or 3 miles off, to 8 or 9 fathoms, within a cable's length of the reef."

For a general description of the winds, see p. 74.

To the foregoing remarks on Rodrigues may be added the following extracts from a description of the island by Edward Higgin, Esq., read at a meeting of the Royal Geographical Society, London, June 26, 1848:—

"The island is one of the dependencies of Great Britain, and at present within the jurisdiction of the government of the Mauritius. It is situated in Lat. 19° 30′ S., Long. 63° 50′ E., within the tropics, and under the influence of the S.E. Trade-winds.

"The land extends in a nearly due east and west direction for about 12 miles, with coral reefs running out about 3 miles more at the western end. The width varies from 3 to 6 miles, the narrowest part being towards the east, where the cliffs rise abruptly from the shore, with deep water immediately outside a barrier reef. The appearance of the island is striking from the ocean. A central peak of granite rises from amidst a group of hills, divided from each other by valleys running north and south.

"The chief substance of the land is granite, with beds of overlying sandstone and limestone. Masses of red and grey granite are met with, which appear to have been subject to igneous action, and are much disintegrated. The subsoil appeared generally to be clay, a stiff gravelly earth, with a fine loam on the surface; but the rapid growth of vegetation in such a climate prevents a cursory examination, such as mine, from being worth much.

"The mildness of the climate equals or exceeds that of the Mauritius. The island is of too small an extent to feel the influence of 'land and sea breezes,' but the steady trade-wind keeps the temperature cool and equable. The same cause produces great humidity, the quantity of rain that falls being very great.

"There are springs of excellent water in the interior, but on the coast the natives

are dependent on the water coming down the rivulets, which, after rain, is charged with calcareous matter, or tinged with iron, and in summer not unfrequently fails altogether. Several small cascades are found on the northern side. The chief stream falls over a rock about 60 feet high, and shortly after enters the sea at the port of Mathurin.

"From the hilly nature of the land, the rain which falls is soon restored to the ocean: an hour after a shower has fallen the thundering of the cascades may be heard some distance, but the disturbance soon ceases, and a tiny streamlet alone remains.

"The 'port of Mathurin,' as the harbour is called, is merely a sheltered roadstead to leeward of the island, with the anchoring ground some ¾ of a mile from the shore. There is a deep and tolerably large basin, with 13 to 15 fathoms water (the sides of which are formed by precipitous coral reefs, over which the breakers roll incessantly,) where small vessels anchor; but it would hardly be safe for large vessels; and Captain Kelly, of H.M.S. *Conway*, when on an exploring expedition in 1844, preferred anchoring his ship outside the reefs in 35 fathoms. An opening in the reef enables boats to go backwards and forwards without much danger from the surf.

"There is but a small tidal rise, the variation being from 5 to 6 feet between high and low water. After a hurricane, storm-waves break on the shore, but I found without the damaging effects which result from them in the Mauritius."

EAST COAST OF MADAGASCAR.

On the east coast of Madagascar, from cape St. Mary, its south point, to cape Amber, its north extremity, an extent comprised between Latitudes 25° 36′ and 12° S., there are but few ports frequented by foreign shipping. The shore has in general only a moderate elevation, and is usually well-wooded; towards the northern end of the island it becomes bolder. The edge of the bank of soundings seldom lies at a further distance from the land than 4 to 8 miles, and is immediately succeeded by deep water.

The most healthy part of this coast appears to be the neighbourhood of Fort Dauphin, whence it gradually becomes less healthy as you proceed northward.

The east coast of Madagascar has been only imperfectly surveyed, and some parts of it still remain unexplored. Admiral Owen, R.N., was employed in surveying this coast from 1823 to 1826, and much of the information we possess of it is derived from his examination. Since 1826 some of the ports have been surveyed by French officers, and we believe a thorough survey of the coast is at present (1865) being carried on by M. Germain, of the French Navy.

Cape St. Mary, the south extremity of Madagascar, is in Lat. 25° 39′ S. and Long. 45° 7′ E. From this cape eastward to fort Dauphin along the south shore of Madagascar (which is in general mountainous and with a bold coast), the depths are 40 to 50 fathoms at four to five miles from the land, on a bank of regular soundings, the outer edge of which has not been traced.

Fort Dauphin.—At 110 miles eastward from cape St. Mary, following the coast,

is the small bay of fort Dauphin, in the western part of which there is anchorage in 6 to 3 fathoms, under protection of the reef extending from the point. Here was formerly a French settlement, abandoned in consequence of the hostility of the natives, and unhealthiness of the climate in the rainy season. The anchorage is now seldom visited by foreign shipping, and the fort is, we believe, in ruins.

The bay of fort Dauphin, or Tolonghare, is about 8 miles in extent from point to point; the coast-line falls in about 4 miles from a straight line joining the two points. The eastern point, named Itapere, is surrounded by a reef, and has a rock off it at the distance of about three-quarters of a mile; in the channel between, the old chart of M. Mengaud de la Hage, represents a depth of $4\frac{1}{2}$ to 15 fathoms. This rock is said to be a very good mark for the point, as the sea always breaks upon it. The village of Itapere is in a little rocky cove at $1\frac{1}{3}$ miles from the extremity of the point.

The west point of the bay of fort Dauphin is even land, and the country behind is mountainous; it is surrounded by a reef, which juts out in a north-easterly direction a considerable distance; eastward of this point the bottom, in a depth of 10 to 16 fathoms, is rocky, consisting principally of coral. On the south-west side of the point is Gallions bay, which is fronted by a reef.

When bound to fort Dauphin it is recommended to make the land northward of it, in about Lat. 24° S., because of the strong southerly currents which *are said* to flow at the rate of 40 to 50 miles per day. To avoid their effect during the night in approaching the bay, if the weather permit, and you meet with a sandy bottom, it is advisable to anchor, unless the breeze is sufficiently strong to enable you to withstand their force. These violent currents are occasioned by the winds, which the French have called *fort Dauphin winds;* they prevail the whole year from the N.E., and extend about 30 miles from the coast; they are first met with between the 22nd and 23rd parallels, where they have scarcely any force, but grow stronger on the 24th parallel. A ship once to leeward of fort Dauphin cannot possibly enter the harbour: the mountains, which are extremely lofty in this part of Madagascar, are probably the cause of these local winds. M. Mengaud de la Hage observed that these winds experience a revolution about the full and change of the moon, when they are from the West,—or it is calm for two or three days; at this time he recommends shipmasters to leave fort Dauphin, taking advantage of this change, as at other times it is difficult to get away. This officer likewise mentions a reef in Lat. 24° 22′ S., extending 4 miles from the shore, which is so steep that at less than half a mile from its edge is a depth of 40 fathoms; and he is of opinion that there may be other dangers thereabout which are not inserted in charts.

When the land in Lat. 24° S. is first seen a chain of very lofty mountains comes into view, supposed to be not less than 10,800 feet high; and in Lat. 24° 15′ to 24° 18′ S. a hummock, in the form of a sugar loaf, is distinguished amidst some sand-hills on the sea-shore. Then ranging along the shore at $2\frac{1}{2}$ leagues distance, a reef may be perceived in Lat. 24° 22′ S., which projects to a considerable distance from the land (*see* the preceding paragraph); and a little further southward you discover, through St. Lucia islands, some small rocky shoals under water, at a considerable distance from the coast, between Latitudes 24° 35′ S. and 24° 45′ S. Continuing to sail along at the same distance a point will come into sight, S.W. by W. appearing at first to stand by itself, with two hummocks more flat than round, and after this another, with hummocks of the same shape; these two points

have been often taken for point Itapere, which is the next, or third in order, having sharp-pointed hummocks upon it. When you come near the second point, ranging along the coast at $1\frac{1}{2}$ league's distance, there are shoals, some of which extend about two miles from the shore; it is therefore advisable to give the shore an offing of 5 or 6 miles, or even more. Arrived at point Itapere you will be in front of the bay of fort Dauphin.*

If obliged to anchor in the bay of fort Dauphin in consequence of daylight failing before the roadstead is reached, some care is required to choose the ground as it is not all of the same quality. Water may be obtained at the landing-place by digging in the sand, but there are plentiful springs of good water at a small distance inland.

Ranoufoutsi Bay.—At a short distance from fort Dauphin bay is the little bay of Ranoufoutsi, which is open to winds from S. to S.E. The holding ground is not good, and the anchorage is very bad; hence it is never frequented by foreign vessels, although such necessaries as ships require may be obtained there with facility.

Loucan, or St. Claire Bay.—This little place is about midway between fort Dauphin bay and that of St. Lucia. It offers excellent anchorage, has good shelter, and the water is as smooth in it as in a basin, but, unfortunately, its depth is only sufficient for vessels of 50 or 60 tons. Some sunken rocks render the entrance dangerous.

St. Lucia, or Mangafiafa.—At about 15 miles northward from fort Dauphin following the coast, is the bay of St. Lucia, or Mangafiafa, which is protected from eastward by a chain of islets and reefs, under shelter of which vessels anchor in 8 to 4 fathoms, sand and mud. Of this place it is useless to attempt a description, for no shipmaster should attempt to run into it without having a chart of it at hand for reference.

Menintingue, or Ambatoube.†—This river is 32 miles northward from St. Lucia, and in approaching it from southward some care is required to avoid a sunken rock at a mile from the shore; distant 7 miles from St. Lucia. The Menintingue is

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* "The province of Anossi extends along the south-east coast of Madagascar from the river Manambatou, in Lat. 24° 34′ S., to that of Mandrerci, in about Lat. 25° 30′ S. Its mean breadth is 6 to 7 leagues, and its superficial extent about 160 square leagues. It is bounded on the north and north-east sides by the valley of Amboule; on the north-west and west by the mountains of Antandroui, a barren and waterless country; on the south-west by the river Mandrerci; and on the south and south-east by the sea. This country presents an imposing aspect to the navigator coasting along it. Its high and fantastically shaped mountains rise abruptly at a league from the shore; thick forests cover their sides and approach the sea, from which they are separated by a strip of sand—this, when viewed from a distance, shows the line of coast by its whiteness. The interior consists of a vast plain, which surrounds on all sides a mountainous chain. Along the coast, an extent of 20 to 25 leagues, there are numerous creeks, but no harbour sufficiently capacious and of good anchorage enough to accommodate large vessels. The three principal anchorages are St. Lucia, Fort Dauphin, and Ranoufoutsi.

"Fort Dauphin is very much exposed to winds from E.S.E. This anchorage is formed by a chain of reefs which extends out from the extremity of the peninsula on the south side of the bay of Tolonghare, and protects the anchorage in great measure from the swell of the sea, but not entirely, as the sea is sometimes very heavy there during the prevalence of E.S.E. winds, but smooth with other winds, even with those from N.E., which blow nearly all the year with great violence. The bottom is of sand, with coral ridges, which greatly damage the ground tackle; another inconvenience is the difficulty of its approaches, sea and land breezes being unknown, and rendering towage necessary during the morning calms. Schooners alone can get under way with N.E. winds; the anchorage is very near the land, and landing is easier than at St. Lucia. The bay is easily recognised by a rock at its east part, upon which the sea breaks even in the calmest weather, and throws up the surf from it in the form of a column of water spouted by a whale; this rock is distant from point Itapere about half a mile, and the channel between is navigated by the natives, who never sail seaward of it, being deterred by superstitious feelings; it is named by them, Maroulefou."—M. Albrand, 1820.

† Probably the Manambatoo South, of the Admiralty chart, No. 677.

barred by rocks, and is consequently not navigable by sea-going vessels. At a little southward of it there is a small sandy bay in the rocks, where a landing may be effected in fine weather. The village is 5 miles inland.

Chandervina.—This large river is 30 miles northward of the Menintingue, and, like that river, is so barred by rocks that no vessel can enter it. At a quarter of a mile from it, and commencing at the entrance, there is a chain of reefs which runs northward, parallel to the coast, for about a mile; and leaves between it and the shore an anchorage approachable either round the north or south end of the reefs. The landing-place is near the river, in the northern part of a little bay sheltered by rocks. At nearly 3 miles from the land, south-eastward from the river, are three rocks above water, which are a useful mark for the anchorage: between them and the shore is a safe passage. The anchorage is in $14\frac{1}{2}$ fathoms, sand, with these rocks bearing S. 25° W., and a mountain in the interior having a summit like a bale (*ballot*) W.N.W.

Manamboul—25 miles northward of the river Chandervina, is one of the best landing-places on the coast, and the anchorage is excellent. The usual riding is in $15\frac{3}{4}$ fathoms, with an inland mountain, shaped like a saddle, bearing about W. by N. The landing is a little south of this, in a little bay formed by the trending of the coast and some rocks which jut outward from it.

Massianaka.—This river is 9 miles northward from Manamboul, and is so barred with rocks and breakers at the entrance that it cannot be entered. The landing-place is at Ecouen, 2 miles south of the river, where are some rocks jutting out from the shore. The anchorage off Ecouen is in $15\frac{3}{4}$ fathoms, sand and coral; good holding ground.

Vengendrane.—Nine miles northward from Massianaka river following the coast, is another barred stream, named Vengendrane, which will be recognised by a small but conspicuous hill on its south shore, having upon it a walled village. This village is an outpost of the Hovas, who have succeeded in maintaining themselves there, although surrounded by their enemies the Malagese. A white flag is usually hoisted at the fort.

Emanahiva, or Mananghara.—This large river is 7 miles northward from the Vengendrane, and in about Lat. 22° 57′ S. It is barred, and can only be entered in fine weather during a smooth sea: usually the breakers are so very heavy that communication with the shore is impossible. The bar is a changeable one, and it is customary for the natives to signal vessels the direction of the channel. The anchorage is in 15 to 16 fathoms sand, at about 2 miles outside the entrance, on good holding ground. At 6 miles northward from the Emanahiva there is an excellent landing-place under shelter of a chain of reefs which projects a quarter of a mile from the coast, and runs parallel to the shore. This chain of reefs is intersected by numerous channels, through which boats can pass. It is probable that a small vessel might find shelter behind these reefs.

Farafangane.—From the Emanahiva to the river Farafangane the distance is about 14 miles along a well-wooded coast; at about midway there is or was a large isolated tree shaped like a mushroom, and, being on a hill, very conspicuous;—and southward of this tree is a remarkable mountain, the summit of which is a plateau having a peaked hill at each end. The river is very large, and during the rainy season brings down so much soil that the sea for three miles outside it is dyed yellow. The anchorage is in 15 to 18 fathoms, sand, in a direction due East from it; it is

often difficult to enter this river, the bar being a changeable one, and the breakers almost always extremely heavy. The river can be easily recognised by vessels approaching from seaward, the country immediately north of it being thinly strewn with trees as if planted, among which may be seen several that are very lofty; while south of it the shore is well wooded and the trees are higher.

Mahitzi.—At a few miles northward of the river Farafangane is the river Mahitzi, of which we possess no description. Its position is indicated by a cluster of trees, and the anchorage off it is at 5 miles from the land in 14¾ fathoms, sand and coral, with these trees bearing due West.

It may be here repeated (*see* description of Fort Dauphin), that shipmasters bound to the south-east coast of Madagascar should always make the land north of their destination, because the prevailing north-easterly winds occasion a strong southerly current, having a flow sometimes of not less than 40 miles per day. If bound to Farafangane river, unacquainted with it, and desirous not to make it at night, it will be prudent to endeavour to sight the land in Lat. 22° 6′ S., where will be perceived two hummocks which are nearer the sea than any other parts of the high land bordering the coast; these, if left a little to the southward as you approach them, will carry you into view of the establishment of Matatane on the sea-shore, opposite which is anchorage in 13 to 14 fathoms, bottom interspersed with coral. Four miles southward from Matatane is a sandy shore covered with trees, and 10 miles further southward is the river Mahitzi.

Manooroo.—From the river Mahitzi northward to Manooroo, a distance of about 160 miles, the coast is almost unknown, as it is never visited by foreign vessels. This town is in Lat. 19° 55′ S., and it is said that there is anchorage off it under protection of some reefs. It is probable that refreshments of various kinds may be procured here.

From Manooroo to Tamatave, a distance of 110 miles, there is no town resorted to by foreign ships. The coast immediately south of Tamatave is low and well wooded; it has a general direction of N.N.E. and S.S.W. The first range of remarkable hills is situated at about 15 miles from the sea, and consists of elevated land which runs S.W. and N.E., and apparently terminates in about 18° 15′ S., after which the hills become lower, and scattered more irregularly.

Nossy Domballa.—At about 16 miles southward from Tamatave there is a small islet named Nossy Domballa, or Fong, the position of which is Lat. 18° 26′ 40″ S., and Long. 49° 29′ 19″ E.; it is 3½ miles from the shore, consists of sand and coral, is very low, and covered irregularly with vegetation. In size it is not more than 1000 feet across, and its southern part is much higher than its northern, by which it may readily be distinguished from Nossy Alana (Plum island,) 23 miles northward of it, immediately it comes into view, which will be from a distance of about 10 miles. A reef surrounding the island extends seaward about a cable's length. Landing can be made on the north-west part of the island in fine weather.

At about half a mile southward from Nossy Domballa there is a reef, or rather an islet, of sand surrounded by coral, having an extent of nearly three-quarters of a mile North and South. The passage between it and Nossy Domballa is very confined and dangerous, and should never be attempted even in the finest weather.

Nossy Domballa, and the reef south of it, are very steep on their eastern side. The only known sunken danger in their vicinity is a coral reef of 4¾ fathoms, situated about a mile northward from the island. Between the island and the coast

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the depth is 15, 16, and 18 fathoms, and at a mile seaward from it there is no bottom at 20 fathoms.

Nossy Faho.—At 7½ miles, in a N. by E. direction from Nossy Domballa, and opposite a gentle projection of the coast named point Vatte, is a reef called Nossy Faho, lying N.N.E. and S.S.W. 1½ miles, the edges of which are probably steep. Its centre is in Lat. 18° 19′ S., and Long. 49° 31′ 9″ E. At 3 cables' length from its north end the depth is 8 fathoms; and at a mile from it, in the same direction, about 30 fathoms. It consists of coral, sand, and broken shells, and in time will probably become covered with vegetation.

From Nossy Faho to Tamatave the coast is believed to be clear of danger, but is of such a character that no landing can be effected upon it. At a little northward from Nossy Faho, on the shore side, there is a large village, named Yvondroo, standing on the left bank of a river, the entrance to which is obstructed by a bar of sand to the distance of a cable's length from the coast.

Along the coast from Nossy Domballa to Tamatave there is no creek nor any place of shelter into which a vessel may run in case of need. The currents off it are often very strong. In July, 1862, the French ship *Perle*, anchored on the north-west side of Nossy Domballa, was driven from her anchor by the sole force of the current, and carried in half an hour more than a mile to the northward; and in September, 1863, the current was observed to run southward at a rate of 2 miles an hour before a strong breeze from the N.N.E.

TAMATAVE, or TAOMASINA.—This is a large town of probably 10,000 inhabitants, built upon a low sandy point, named Hastie, situated in Lat. 18° 10′ 50″ S., and Long. 49° 32′ 19″ E.* It is protected by a fort north of the city, and on point Tanio, one mile further northward, are the ruins of another fort. The principal trade is in cattle. Water is scarce, and difficult to get. It is said that poultry and fruits are the only supplies that can be obtained.

Point Hastie is surrounded by a reef which has an extent of about a mile North and South, and runs out seaward from the land nearly half a mile. The northern part of this reef consists of a bank of sand and coral, having a depth over it of 16 feet at a cable's length from its rocky part. The sea does not always break upon this reef, but as, during the ebb, the current flows southward with some strength, it frequently causes vessels to ground upon the bank, and these afterwards become wrecked upon the coral part of the reef.

The landing at Tamatave is north-westward of the reef surrounding point Hastie, in a little creek under the reef. A head of coral, situated a short distance westward from the edge of the reef, must be cautiously avoided.

At half a mile south-westward from point Hastie is the centre of the south reef of Tamatave, upon which (the centre) is a depth of not more than 10 feet at low tide. During the North East Monsoon the sea is much smoother here than northward of point Hastie.

Great Reef.—At half a mile north-eastward from the reef surrounding point Hastie is the south end of the Great reef, which has an extent of about 1½ miles S.S.W. and N.N.E. It is through the channel between these reefs that vessels approach the anchorage of Tamatave, where is a depth of 6 to 13 fathoms, mud.

* Dependent upon the accuracy of the Longitude of the *Hôtel du Gouvernement* at St. Denis, Reunion, determined to be 55° 30′ 1″ E. *See* the article on "Reunion."

The direction of the channel is N.W. and S.E. (*true*), occasioned by a coral bank of about 4 fathoms, detached from the south-east side of the Great reef. In this channel the depth is 8 to 15 fathoms, mud and coral—the mark to sail through it is point Tanio, situated $1\frac{1}{4}$ miles northward of the town, and having a cluster of trees upon it, bearing N.W. by N.

The **anchorage** at Tamatave is within the Great reef in $6\frac{3}{4}$ to $10\frac{1}{2}$ fathoms, mud, with the flagstaff of the fort bearing W. by S. $\frac{1}{4}$ S.; the ship should be moored W. by S. and E. by N. There is also anchorage in $9\frac{1}{2}$ to 13 fathoms, soft mud, between point Tanio and the Great reef, but it is more exposed than that nearer the town;—the bearings are point Tanio W. by S.; and the flagstaff of the fort, S.W. $\frac{1}{4}$ S.

Little Reef.—At about half a mile north-eastward from the north end of the Great reef, is the south end of the Little reef, which thence extends north-eastward nearly three-quarters of a mile. Upon this reef there is a head of coral awash, or nearly so, at low water, but in other respects the soundings are 13 to 27 feet. Its edge is steep, there being 8 to 14 fathoms almost close to it. In the channel between the reefs the soundings are $7\frac{1}{2}$ to 10 fathoms, but it is not a safe passage owing to the absence of a leading mark, and the strong current and heavy sea which generally prevail.

North-East Reef.—At $1\frac{1}{2}$ mile in a N.N.E. direction from the Little reef is the south end of the North-East reef,—a reef half a mile in extent N.N.E. $\frac{1}{2}$ E., and S.S.W. $\frac{1}{2}$ W. It has a depth over it at low tide of 18 to 20 feet, and its edges are steep, especially that to seaward, where from 11 fathoms the lead soon drops into 18 fathoms.

The channel between the Little and North-East reefs is named the Great Passage, to distinguish it from that between the Great reef and point Hastie, which is known to the natives as the Little Passage. The depth is 18 to 9 fathoms, the latter being in the middle of the channel. The only available mark appears to be point Tanio kept between the bearings of S.W. $\frac{1}{8}$ S. and S.W. $\frac{7}{8}$ W. (S. 33° W. and S. 43° W. *true*), until point Hastie, remarkable by its edging of trees, bears S. by W. $\frac{1}{2}$ W., when the northern anchorage of Tamatave, between point Tanio and the Great reef, may be run for.

Nossy Alana, or Plum Island.—This small island is distant $6\frac{1}{2}$ miles from point Hastie in a N.N.E. $\frac{3}{4}$ E. direction, and about $2\frac{1}{2}$ miles from the shore. It is rather more than $\frac{1}{3}$ of a mile long North and South, and about $\frac{1}{5}$ of a mile in breadth East and West, and is rendered remarkable by the lofty and regular vegetation which covers it. The island and the trees are sufficiently lofty to be visible from a distance of 15 miles; hence they form a very useful mark for vessels bound to Tamatave or Foule point from the south-eastward, or during the season of southerly winds. Around the island is a coral reef which extends outward about a cable's length on all sides but the N.W., in which part boats may land in fair weather. The soundings between the island and the coast are 11 to 18 fathoms.*

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* M. D'APRES DE MANNEVILLETTE, 1757, says: "Three leagues to the N.N.E. of Nossy Alana there is a rocky bank with breakers; at $1\frac{1}{2}$ league further on the same bearing there is a shoal with 3 fathoms water upon it; and one league to the N.N.E. of this there is another with 4 fathoms upon it; these dangers are only one league distant from the shore." These shoals were *unsuccessfully* sought for in 1863, by M. GERMAIN of the French Imperial Navy, and in addition none of the local traders of whom he inquired knew of their existence. In March, 1857, CAPTAIN ESTIENNE, of the *Marie Eugenie*, stated that he had met with a shoal of about 15 feet water in

North Reef.—At about a mile N.E. $\frac{2}{3}$ E. from Nossy Alana is the south end of the North reef, which thence extends in the same direction $1\frac{1}{2}$ miles. The soundings upon it are $4\frac{3}{4}$ fathoms to 7 feet, the latter being at two miles from the island. In the channel between the south end of the reef and the island there are two shoal spots of 16 and 27 feet.

From point Tanio the coast of the main land runs nearly North and South (*true*); it is low and wooded towards the shore. Some marshes and lakes commence at two or three miles from Tamatave, and ultimately join the river Ivolohyny, the entrance to which is so changeable that it cannot be navigated. The shore throughout is safe, and with a depth of not less than $7\frac{1}{2}$ fathoms at a $\frac{1}{4}$ of a mile from it.

Currents.—The currents along the coast follow the direction of the wind, but in the roadstead they are influenced by the tides. During the season of southerly winds their flow is almost constantly northward between the shore and Great reef.

Tamatave to Foule Point.—From Nossy Alana to Foule point the coast increases in height as you recede from Tamatave, and is well wooded. The country in the interior rises gradually into four distinct chains of mountains, of which the last one can be seen from a great distance. There are many small streams flowing easterly to the sea, which are a great impediment to the land communication between Tamatave and Foule point, and as they have but a slight fall they render the country very unhealthy during the rainy season.

When sailing along the coast northward from Tamatave, the Mamelles de Natte (in Lat. 17° 47′ S., and Long. 49° 34′ E., and distant from Nossy Alana about 17 miles) are a very valuable landmark. They consist of a mountain of no very great elevation, at about three miles from the shore, the summit of which forms in two small hills; the name Natte is from a village at its base. Between these and the shore are two similar hills of less elevation. The Mamelles de Natte are serviceable as a guide for Foule point, 3 leagues northward from them, because when East (*true*) from them Nossy Alana is not visible; if then, directly this island disappears under the horizon, on a bearing of S.W. $\frac{1}{4}$ S., the Mamelles at the time bearing W.N.W., a course of N. $\frac{1}{4}$ W. may be steered for Foule point.* The coast in the vicinity of Foule point is foul to the distance of one or two cables' length.

FOULE POINT, or Maroufolotra.—This is a large village on point Rafalah, in Lat. 17° 39′ 45″ S., and Long. 49° 37′ 29″ E., where a considerable trade is carried on in cattle, rice, and timber. At a little westward from the village is a fort of no great strength. Good water may be procured from a stream south of the village, if drawn at some distance from the mouth, where it is made brackish by the sea.

Point Rafalah ends at $1\frac{1}{2}$ mile south from Maroufolotra, in white sandhills covered with wood, which are sufficiently high to be visible from a distance of 15 miles. A reef extends from it in a N.N.E. direction rather more than 2 miles, and terminates $1\frac{1}{4}$ miles N.E. by E. from the village; its seaward edge is at about half a mile from the shore, and is believed to be not very steep, hence this part of the coast should have a

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Lat. 17° 58′ S., Long. 49° 40′ E., which is near the position of the southernmost of the three rocks mentioned by M. D'APRES. As, notwithstanding the unsuccessful search for these rocks by M. GERMAIN, some of them may exist (small reefs of coral are always very difficult to find), it will be prudent for shipmasters sailing between Tamatave and Foule point to keep a good look-out for them.

* These instructions should be followed only during the season of S.E. winds, for in the season of N.E. winds the land should not be made southward of the port to which you may be bound.

berth of not less than a mile. The western edge of the reef forms with the shore a creek in which small vessels may anchor in $4\frac{3}{4}$ to $5\frac{1}{2}$ fathoms; but the bottom there is so bad, so irregular, and so rocky, that it is not recommended to vessels having only hempen cables.

The anchorage at Foule point is good only during the fine season (from April to October), at which time winds from S. to S.E. prevail. It is completely exposed to winds from northward, and the bottom is not good for holding. When running for this anchorage, the extremity of the reef extending from point Rafalah should have a berth given to it of at least a quarter of a mile, on account of an isolated patch of 20 feet water; having cleared which, the course may be altered to south-westward, and the vessel brought up in 8 to $6\frac{3}{4}$ fathoms, sand and mud, at rather more than three-quarters of a mile from the village, with the extremity of the reef bearing E. $\frac{1}{3}$ S.; the custom-house at the east end of the village S.S.W. $\frac{1}{3}$ W.; the sandhills at the south end of point Rafalah S. by W. $\frac{1}{3}$ W.; and the mast on the battery S.W. $\frac{3}{4}$ W. The vessel should be moored E. by N. and W. by S., and if it is intended to remain some time, a third anchor should be carried out to the N.W.

At about 4 miles N.N.E. $\frac{1}{2}$ E. from point Rafalah, and 3 miles eastward from point Andrafet, there is a small bank of $6\frac{3}{4}$ fathoms, having at a quarter of a mile seaward from it a depth of 11 to 16 fathoms.

From **Foule Point to Fenoarivo,** a distance of 18 miles, the coast is bordered with rocks which extend about half a mile; its general direction is N. $\frac{1}{2}$ W. and S. $\frac{1}{2}$ E. A village named Mahambo, in Lat. 17° 29′ 40″ S., and Long. 49° 35′ 29″ E., has a fort half a mile westward from it; hence the coast runs W.N.W. to the river Sirt, and between are three small points surrounded by reefs. In the little bay formed by the second and third of these points, small vessels may anchor in $4\frac{3}{4}$ to $5\frac{1}{2}$ fathoms, at a short distance northward of the village, with the mast of the fort bearing W. $\frac{1}{3}$ S. The outer roadstead is thickly strewn with banks, of which that most dangerous is at about a mile N.N.E. $\frac{1}{2}$ E. from the fort, and half a mile from the entrance of the river Azafo. Upon all this part of the coast the depths at a corresponding distance from the land are less than those south of Foule point; at a mile from the shore the soundings are scarcely 8 fathoms.

At 5 miles northward of Mahambo is point Takondro, a moderately high and wooded projection of the coast, which may be passed at the distance of half a mile by vessels approaching Fenoarivo from southward.

FENOARIVO (**FENERIVE**) is a large village in Lat. 17° 23′ 16″ S., and Long. 49° 32′ 4″ E., having on its western side a little river the water of which is lost at a short distance inland. The trade is chiefly in rice, the landing being too difficult to permit the shipment of cattle. At $1\frac{1}{2}$ miles south-westward from the village is a battery on a hill, said to be in ruins.

At a short distance south-eastward from the village there is a small island at a quarter of a mile from the shore, named Nossy Ilansambo, which is covered with trees, but being so close to the land, and of but very moderate elevation, it cannot be distinguished as an island beyond 3 or 4 miles. Around the island there is a reef, which extends from it two cables' length to the N.E.; between it and the shore, and also westward of it, are several shoals of 8 to 12 feet; hence vessels cannot anchor under its shelter. The coast eastward and westward of the island should have a wide berth given to it.

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The anchorage of Fenoarivo is safe only during the fine season (from April to October), when vessels may anchor in $4\frac{1}{3}$ fathoms, muddy sand,—at a little north of the line, the masts of the battery and custom-house in one. In winter the anchorage is further out, in 6 fathoms, sand and gravel, with the two masts in one, and the extremity of point Tokondro open of Nossy Ilansambo. The roadstead is quite open to winds from northward and eastward.

River Manangory—From Fenoarivo a low and but little wooded coast trends to the N.N.W. The river Manangory, in Lat. 17° 13′ 30″ S., is one of the largest and deepest on this side of Madagascar, but is inaccessible, its mouth being closed by a sand bank. Northward of this river the hills advance to the sea and form a projecting point, after which the shore has a N.N.E. direction about 8 miles; the hills then increase considerably in altitude, and the shore is lined with reefs to about 2 cables' length out, beyond which are regular soundings, and a depth of about $7\frac{1}{2}$ fathoms at a mile from the beach. At 25 miles from the river Manangory is point Ansiraka or Larrée, in the channel of Nossy Bourah (Island St. Mary).

NOSSY BOURAH (ISLAND ST. MARY).—The south end, point Blevée, of this island, is in Lat. 17° 7′ S., and Long. 49° 54′ E. It is a very narrow island, having an extent of nearly 30 miles in a direction parallel to the coast, from which it is distant 13 miles, excepting near its centre, where a point of land projects from Madagascar and narrows the channel to only 4 miles. Its vegetation is dense, giving the island an extremely attractive appearance, but unfortunately making it very unhealthy. The south point is formed by a small flat islet, named Nattes, separated from it by a narrow channel only deep enough for boats; from this islet a reef extends $1\frac{3}{4}$ mile to the S.W. by S., South, and S.E. Point Albrand, the north end of the island, has a reef extending from it about half a mile. The east and west shores of the island are fronted by a reef, in the former instance to the distance (seaward) of $2\frac{1}{2}$ or 3 miles. This reef is, we believe, so steep, that from it the lead falls at once into 11 or 15 fathoms. A rock, named Whale rock (or Ankhorraka) is two miles from the eastern shore; its position is about Lat. 16° 55′ 30″ S.; Long. 50° 4′ E.

The principal anchorage is on the west side of the island off Madame island, at about 8 miles from point Blevée. When running for it from southward, the coast of Nossy Bourah should be approached as closely as the soundings permit, until the vessel is westward of a white tower (Whaler's tower) erected upon a small rock, from which a *small light* is occasionally exhibited (1864). Madame island, with its houses and buildings, will now be perceived at less than a mile distant. Some care is required in the selection of the anchorage, a 10-feet head of coral having been discovered in it so recently as 1849; the best place is in $16\frac{1}{2}$ fathoms, sand, shells, and coral, with the jetty of Madame island in one with the jetty of the large island. At the anchorage the flag-staff of the island bears S. 13° E.; the church and the extremities of the two jetties S. 32° E.; Sorcier's point, a little hill north of the village of Ambodifotra, which is easily recognised, N. 67° E., and the Whaler's tower, S. 34° W. Or a vessel may anchor in 18 or 20 fathoms with Madame island bearing S. by W. $\frac{1}{4}$ W., and point Ansiraka nearly N. by E. $\frac{1}{4}$ E., about 3 leagues.

From northward the anchorage off Madame island is easily gained, and there is no difficulty in recognising the settlement, as it is about 10 miles southward

from point Ansiraka, and with the exception of Antsarak, is the only place where there are buildings of masonry. Antsarak is 13 miles northward of Madame island, and about 8 miles from point Albrand, the north extremity of Nossy Bourah.

Port St. Mary.—Madame island is in Lat. 17° 0′ 10″ S., Long. 49° 57′ 5″ E. It has an extent of not more than a cable's length, and is surrounded by a reef to the distance of a cable's length, upon which is a smaller islet joined to it by a dike. The port will not admit vessels drawing more than 10 feet, and these, on account of the numerous heads of coral scattered about, must be navigated by some one having local knowledge. Water of indifferent quality may be procured in abundance. Provisions and fruits are scarce and dear. The forests are being so rapidly cleared that timber is difficult to obtain. Attempts have been made to introduce the sugar-cane, but without success. The settlement is very unhealthy, but is still held by the French, on account of its important geographical position.

Channel of Nossy Bourah.—The channel separating Nossy Bourah from the shore is about 30 miles long, and from 17 to 32 fathoms deep. In nearly its centre a low point of land, named Ansiraka or Larrée, juts out 9 miles from the coast of Madagascar, and narrows the channel considerably. This land can be seen only from a distance of 10 miles. On the north side of this point vessels may anchor during the southerly Monsoon, at about a mile from the village, where fresh provisions may be obtained in abundance.

In Nossy Bourah channel the currents are strong, and frequently in the direction of the wind; in the narrow part of the channel, where its breadth is confined by point Larrée, their force is considerable. Their direction is generally northward.

Tintingue, or Tangtang.—This bay is situated on the north side of point Ansiraka, at about 10 miles north-westward from its extremity. It is 3 miles in extent, and has a depth of 7 to 3 fathoms, but is so much encumbered with shoals that no one should attempt to enter it without a pilot. When within, a ship is in a perfectly secure anchorage, well sheltered from almost all winds.

ANTONGIL BAY (Manghabes Bay).—From the north end of Nossy Bourah the coast of Madagascar runs northward 30 miles to cape Bellones, the south point of the extensive bay of Antongil, from which Durnford Noss, its south-eastern point, is distant about 24 miles in an easterly direction. Between these two points the bay extends northward 40 miles, with a width of 23 to 15 miles. The soundings at the entrance are 40 and 35 fathoms, which decrease gradually to port Choiseul at the head of the bay, where the depth is 13 and 10 fathoms. The coast from Durnford Noss eastward is bordered by a reef to the distance, seaward, of 2 or 3 miles, upon which are two islets—that near Durnford Noss bearing the name of Behentou, and that 6 miles more eastward, Nepatte. As this part of the entrance of the bay does not appear to have been thoroughly examined, it will be prudent to give it a wide berth when passing.

Port Choiseul is an excellent anchorage, where vessels ride in 7 to 5 fathoms, immediately westward of the entrance to the river Tungumbaly, and close to the village of Maran Seetzy. The river is barred, and can only be navigated by boats: the bar has 6 to 9 feet upon it, and within it for a short distance is a depth of 24 feet, which is succeeded by 10 to 7 feet, and less.

At 1½ miles southward from port Choiseul, and almost fronting the river Tungumbaly, is an island named Marosse, whence wood and water may be procured with

facility. Southward of this island are some islets, or rocks, the furthermost being 4 miles from it. The anchorage westward of the island is known as Hastie road; the depth at a mile from it is 12 fathoms, mud. Vessels may also anchor at a similar distance north-eastward from it, in 14 and 15 fathoms.

During the southerly Monsoon, Antongil bay may be approached from the southward, either eastward or westward of Nossy Bourah; but in the northerly Monsoon, it should be run for direct. When running up the bay, either shore may be taken as may be convenient, provided such a berth be given it as will clear all outlying dangers. When leaving the bay and bound northward, steer along the eastern shore, taking advantage of favourable breezes, with the ebb-tide; if necessary, vessels may anchor southward of Behentou.

Veninguebe Bay.—At about 3 miles northward of Nepatte island, is a small bay named Veninguebe, in Lat. 15° 54′, and Long. 50° 15′ E. It is a rocky place, unsafe for large ships, but contains anchorage in 7 fathoms, under shelter of the reef at the entrance. The *Gloire* was wrecked on this reef in 1761, when leaving the bay.

N'goncy.—From Veninguebe bay the coast of Madagascar trends N.N.E. (*true*) 40 miles to N'goncy or cape East, in Lat. 15° 16′ S., off which is a small islet seated upon the reef projecting from the coast; all this coast is fronted with reefs, and should consequently have a good berth given to it. N'goncy road $1\frac{1}{2}$ miles north of the islet, is an anchorage between the reefs; it is about half a mile wide, and has soundings of 8 to 5 fathoms, except in its southern part, where the depth at a mile within the entrance is 4 and $3\frac{1}{2}$ fathoms. The shelter in this inner part is from all winds but those from north-eastward; protection from eastward being afforded by the reef extending out from cape East, and from northward by the reef in the north part of the bay. The seaward edge of the reefs is steep, the soundings close to it being 7 to 14 fathoms.

In the northern part of N'goncy bay is the town of N'gabè, on the south shore of a large river, the entrance to which is barred. In the southern part of the bay is the town of N'goncy.

From cape East the shore of Madagascar, northward as far as cape Amber, is rocky and fronted with coral reefs to the distance seaward of four miles in some places. The land is generally high and uneven, except near the sea; in some places it is level and of moderate height. In Lat. 13° 20′ S. is Vohemar bay, fronted with reefs, and with soundings inside of 18 to 10 feet, access to which is difficult for strangers. Northward of this, 4 or 5 miles, is Manambatoo, a large village.

Andrava Bay.—At 22 miles northward from Vohemar bay is Andrava bay, in Lat. 12° 55′ S., which is about $1\frac{1}{4}$ miles in extent, of circular form, and with an island in the middle of the entrance. This island has a reef jutting out from its north and south extremities, leaving a channel on either side of 4 to 9 fathoms. The bay is open to North and N.E. winds, but in its southern part there is probably shelter from easterly winds in 4 or 5 fathoms, at about three-quarters of a mile south-westward of Berry Head, its eastern point. In this part the soundings rapidly become shallow.

PORT LEVEN.—Northward of Andrava bay, about a mile, is the south end of a

reef, which thence extends northward 7 miles, and has upon it several islands; of these the northernmost and largest is named How. This reef is separated from the reef lining the shore by a channel 9 to 6 fathoms deep, bearing the name of port Leven. On the western side of the northern entrance to this channel is Manambeedy island, surrounded and connected to the shore by a reef; close to the south side of this island is a bay in the reef, in which the depth is 6 to 3 fathoms. Port Leven is $1\frac{1}{4}$ miles wide at the entrance, and continues of this width for about 2 miles, when it begins gradually to narrow, and thence continues southward with a width of $\frac{1}{2}$ a mile for another two miles; the depths are 8 to 7 fathoms throughout the harbour, except in the bay in the reef on the south side of Manambeedy, just alluded to; and there is a coral head of 3 fathoms in mid-channel of the harbour. The course into the harbour is S. by W. for $2\frac{1}{2}$ or 3 miles, then S. $\frac{1}{2}$ E. through the upper or inner harbour, where is shelter from all winds; vessels may also anchor on the south side of Manambeedy island, and be in perfect security.

An excellent mark for this part of the coast is mount Amber, a high mountain in the interior, the centre of which is in Lat. 12° 35′ S. It extends north and south several miles, and can be seen from a great distance.

Port Leven was visited in 1849 by M. Bolle, of the French navy. The following description is chiefly from his report:—

"The north-east part of Madagascar is remarkable for its indented coast, and for its numerous bays, containing excellent anchorage. Port Leven consists of a narrow channel of $6\frac{1}{2}$ to 8 fathoms, having an opening to the south at the cape forming the north side of Andrava bay. On its eastern side are a number of islets on the reef, and on its western side is the reef which borders the coast; the port is, therefore, between these two reefs. When bound to the port from seaward, it is necessary to make the land south of Andrava bay, to avoid the effect of the northerly set of the current. A good mark to seek for is Pouce mountain, a lofty mountain in the interior, 6 miles southward of Port Looké, the summit of which will be recognised by its resemblance to an eagle's beak, and by its having a deep cleft on its right side; this should be brought to bear W. by N., and it will lead to Andrava bay, approaching which the reddish land forming the south point of the bay will be recognised. In 1849 there were two large trees, the only trees visible on this land; when first seen they were supposed to be a tower or a high rock.

"The Leven islands are low, and covered with high shrubs; but How and Manambeedy, the two largest isles, have trees upon them. The anchorage may be approached either from southward or northward; the southern channel, between Point Liverpool and Manampaha islet, is, however, so tortuous, narrow, and full of dangers, that it should be attempted only by those having a good knowledge of its intricacies, and, even then, a man should be aloft to point out the coral heads; the north channel is, consequently, the better of the two for large ships.

"Whether making Barracouta islet direct, or first making Andrava (? Berry head), and thence coasting to Barracouta, care must be taken that the ship be not carried to the northward, in which direction the current always runs in the offing, but especially so towards evening, as the wind veers to the southward; a day or two may otherwise be lost.

"When up with Barracouta, and having passed it at the distance of 3 cables, make for North islet, which is but a few yards above the sea level, of a dark colour, and easily seen. Passing to the north-eastward of North islet, do not approach it

nearer than 4 cables; after which you will soon make out the entrance to the North channel between the reefs eastward of Manambeedy island, and those westward of North islet; for this channel you may steer, bearing in mind that these reefs, which are continued on each side of the channel, are equally dangerous, and must not be approached too closely; therefore, when beating in, keep sounding. The anchorage is in mid-channel, 1 mile to the westward of, and abreast the, north point of How island; this point is sandy, and uncovers for a considerable distance at low water.

"The Little Middle bank, though sandy on the surface, is based on coral, as are most of the obstructions in the channel.

"If the wind be not favourable for beating in during the latter part of the day, it were better to anchor outside for the night, and wait the next mid-day breezes.

"There is another anchorage at port Leven; it is in mid-channel between Mooree, How, and Shatta islands,—abreast of and scarcely $\frac{3}{4}$ of a mile eastward of the centre of Mooree. Here there is good shelter, and all parts of the bay are within easy reach —especially the sandy beach on the main opposite Manambeedy, where landing is easiest. A vessel intending to stay at port Leven for any length of time should select this anchorage; but if merely calling for a day or so, the anchorage between How and Manambeedy islands (previously mentioned), is sufficiently safe—especially during the fine season.

"On the west side of the channel there is a bay between Manambeedy island and the main, which would give good shelter even to frigates, but it is difficult of access, —contracted at the entrance, and therefore dangerous. The reef, extending to some distance southward of the south point of Manambeedy, is broken into *many* separate knolls, between which there are good depths of water, but these are not easily distinguished;—therefore, if intending to anchor in this bay for repairs or other purposes, the channel must be buoyed to the north and south. The reef on the south side of the bay—and which also fringes the mainland—does not consist of knolls, and at low water is nearly bare throughout its whole length. On the other hand, the reef on the north side of the bay is always under water, and must be approached with great caution;—above all, avoid placing a buoy on a knoll, leaving others unmarked to the southward. In the bay the bottom is of black sand, covered with *algæ*.

"Manambeedy island is girt with rocks, projecting in knolls from the coral bank which surrounds it on every side. The island is low, gently undulating, and covered with clumps of trees. At low water the south shore is a strand of sand, with an admixture of mud.

"How island is sandy, and well wooded at the north end; this wood burns well, and makes good charcoal. The south and east ends of the island are higher than any other part,—but are chiefly dry ridges or hillocks wholly destitute of verdure (1854).

"The surface of the other islands is irregular and covered with briars, which render them difficult of access. Shatta island abounds in large bats—peculiarly delicious in a culinary sense. Mooree island is surrounded by mangroves, and is scarcely above the level of the water.

"The most remarkable point on the coast, in the vicinity of the anchorage, is cape Artémise, formed by a hummock slightly elevated above a plain covered with palms and other (less important) trees. This hummock, at most not more than 65 feet

high, overlooks the bay, and is the only point visible in every direction. At its base, on the N.W. side, there is a pool of stagnant and muddy water.

"Fresh water is not readily procured near the shores during the dry season, though it must be abundant enough during the rains; still there must be water not far distant, for the sustenance of the wild cattle.

"Tree hill, not far from Bird island, is close to the shore, and from this point the land rises into small ranges of hills, which finally unite with the mountains in the interior.

"Point Liverpool is formed by a chain of hillocks, commencing with a pointed hill in the south; towards the north point, as well as in the interior and in Andrava bay, the hills decrease in altitude, and finally disappear.

"The current along the main is always towards the north; but in the N. channel, between How and Manambeedy islands, the flood tide runs in the opposite direction.

"Boating is no easy task, owing to the innumerable heads of coral in every part of the channel, near the coast, and around the islands; during the day there is also at times a chopping sea, very fatiguing to the rowers; landing is always difficult, but generally impossible at low water.

"The prevalent S.E. wind is tolerably fresh during the day; it hauls to the southward in the evening and during the night,—occasionally interrupted by squalls from the land."

PORT LOOKE, or Louquez, is an inlet at about 8 miles westward from port Leven. Its direction is S.S.W., and the soundings are 17 to 9 and 3 fathoms on a very rugged bottom. The channel lies between reefs, is only half a mile wide, and very irregular in its general direction, so that great care is required when running to the inner anchorage. The extent of the harbour is nearly 8 miles, but the greater part of it is too shallow for vessels of moderate size, hence such proceed not further than perhaps 4 miles from the entrance; the soundings in this part are of sand. The shelter is almost landlocked, as the port is closed to all winds except those from N.N.E. The entrance between the reefs is only half a mile wide, is 17 to 30 fathoms deep, and at 2 miles outside it there is no bottom at 100 fathoms.

When approaching port Looké from eastward, it is necessary to be careful and not mistake a bay between it and Manambeedy islet for the port; from the possibility of this error occurring this bay is named False port. At 4 miles outside the entrance of port Looké, and at a short distance from the coast, there is a large island named Kahoomby; it is joined to the shore by a reef, and from it a reef borders the coast as far as the entrance to the port.

Ambavaranou (Port Rigny).—From port Looké the coast trends N. $\frac{1}{2}$ W. 22 miles to a large inlet named Ambavaranou, the entrance to which may be recognised by a white sandy mount on the shore at about 2 miles south of it and by Whale islet, a large rock $1\frac{1}{2}$ miles N. by E. from it, upon which the sea breaks even during calm weather. The channel in is one-third of a mile broad, and more than 13 fathoms deep; it is bounded on the north by the south end of an island named Cuvillier, and on the south by a point of moderate height, from which a reef projects a short distance; on this reef outside the harbour there is a small islet. At a very little within the entrance, off the north shore, there is an island named Oyster island, northward of which the water is all shallow. The soundings in the inlet for $2\frac{3}{4}$ miles

from the entrance are 13 to 6¾ fathoms on a very irregular bottom; they then become shallow, and navigation to the head of the inlet can only be accomplished by boats.

The mark by which vessels should enter Ambavaranou inlet is the south point of Oyster island in one with a cliffy mount, bearing W. ¼ S. (S. 87° 55′ W. *true*). As the island is approached the course should be directed to W. by S. ¾ S., as that will lead up the inlet clear of the extensive reef which occupies the whole of its southern part; anchor where most convenient. Care should be taken when running in to keep closer to the north than the south side of entrance, that side being deeper.

During the greater part of the year the currents outside the inlet run with great strength to the N.W.; yet while the N.E. Monsoon prevails it is not unusual to find a current setting to the S.S.E. at the rate of half a mile an hour.

BRITISH SOUND.—This magnificent harbour is 15 miles north-westward from Ambavaranou inlet, and 17 miles southward from cape Amber, the north extremity of Madagascar, Clarence island, at its entrance, being in Lat. 12° 13′ 8″ S., and Long. 49° 23′ 4″ E. Its extent is 7 to 11 miles, and the irregularity of its shores forms several bays, named Irish, English, Scotch, and Welsh pool, in all of which there is good anchorage, according to the draught of the ship, well sheltered from all winds. At about 3 miles within the sound is a small islet situated in mid-channel, named Langour or Chapman rock, close to the rocks surrounding which is a depth of 10 and 7 fathoms; and in other parts of the sound are islets at various distances from the land. Welsh pool, in the south-west corner of the sound, is probably dangerous for the greater part of its extent, as the natives report that it contains many banks of coral rocks, generally awash at low tide, but between and among which the bottom is of soft mud.

The entrance to British sound is not more than ½ a mile wide, as it is much contracted by Clarence island (Nossy Volane), situated nearly in mid-channel, on the south side of which is the navigable channel, the passage north of it being filled up by a reef; in this navigable channel are soundings of 14 to 26 fathoms on a very irregular bottom. When entering it will be prudent to keep over to the south shore, as the French chart of the sound represents a reef extending a short distance southward from Clarence island. When in the sound and up with Chapman rock, a berth may be selected for anchoring.*

Diego Suarez Bay.—From Clarence island the coast immediately northward of British sound is fronted by a reef, on the edge of which are some islets, the southernmost bearing the name of Diego, and that next to it to northward, Suarez. An inlet in this reef, 4 miles from Clarence island, is called Diego Suarez bay; it has not been surveyed, nor is it known if its soundings are sufficient to accommodate vessels.

Cape Amber.—From British sound an indented coast succeeds to cape Amber, the north extremity of Madagascar, situated in Lat. 11° 57′ 30″ S., and Long. 49° 19′ E. This cape is represented as comparatively low land, having some

* British Sound is named Diego Suarez bay by the French, and Mahazeba by the natives. In the French chart, No. 851, the native names for its bays are given—Irish (*Varats*), English (*Tatou Foutchi*), and Scotch (*Vasa*). A considerable trade is carried on between the sound and Antsianaka and Iboina, where cattle are plentiful.

rocky islets off it at a moderate distance, but connected to it by a reef. At a short distance from these islets are soundings of 15 fathoms, increasing rapidly to 25 fathoms, soon after which is no bottom at 100 fathoms. The depth at a short distance from the coast between British sound and the cape is 18 to 20 fathoms.*

A conspicuous object, when making this part of Madagascar from northward or eastward, is the lofty Amber mountain, in Lat. 12° 35′ S., and Long. 49° 11′ E., or 23 miles south-westward from the entrance to British sound; it is a regular, sloping mountain, extending several miles north and south, and visible many miles at sea. Another mountain, Windsor Castle, between the head of British sound and the western coast of Madagascar, of less elevation than mount Amber, is also an important landmark; between Windsor Castle and the cape are also several conical hills, which gradually decrease in height as they advance northward.

CARGADOS CARAJOS.

This is a reef 31¼ miles long, the south end of which is in about Lat. 16° 50′ S., and Long. 59° 34′ E., whence it extends in a crescent form in a N.N.E.-ly direction. Its eastern side formed no portion of the survey by Sir Edward Belcher, and all that is known of that part of it is derived from a sketch by Lieutenant Mudge, in 1825, who passed through the reef from westward by means of boats, as no vessel could venture to approach it. There is said to be a good port on this side of the reef for small vessels, the entrance to which is in Lat. 16° 30′ S., but during the eastern trade-winds it is unapproachable. At its south end there is a small island, named Coco, from some cocoa trees growing upon it. In nearly its centre there are two islets, Avocare and Mapare, of which the latter is just within the eastern edge of the reef; and at its north end there is a small island named Establishment island, where a few fishermen from Mauritius reside during the fishing season. Some parts of it become dry at low tide; these are mainly in the middle, and in the southern parts of the reef.

The above remarks apply only to the main body of the Cargados Carajos reef, but there are several detached islets and patches of reef off its western and northern sides, which with the reef itself occupy a space extending from Lat. 16° 50′ S., and Long. 59° 34′ E., to Lat. 16° 15′ S., and Long. 59° 40½′ E., the latter being the position of an islet (the northernmost of the group) named Albatross. This island is distant 10¼ miles North from the north end of the main reef, from which it is separated by soundings of 15 to 12 fathoms. North island lies 2¾ miles N.E. ¼ E. from the north end of the reef, and at 2¼ miles on the same bearing from North island, there is probably a reef, breakers having been seen in that direction. A reef also lies 1 mile due South from North island, with Establishment island bearing S.W. ½ W. distant 3 miles.

It is impossible, by any written description, to convey an adequate idea of the

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* The master of the *Elphinstone* says: "Cape Amber is a low level point, and cannot be seen more than 5 leagues from an Indiaman's poop, but about 3 miles southward of it the land rises to a moderate height; ships making the land hereabout late in the day should pay attention to this circumstance, as this land may be mistaken for the cape itself, which might occasion ships not to give it a sufficient berth if bound to the westward. There are some rocks eastward of the cape, upon which the sea breaks very high, and there is a very strong rippling off the pitch of the cape. The current experienced in the day on which we passed cape Amber was W.N.W. 52 miles."

Cargados Carajos reefs; reference should, therefore, be made to the chart of them.* Let it suffice, therefore, to say that there is anchorage under the west side of Establishment island in 8 to 12 fathoms, and that vessels may also anchor on the west side of the south end of the reef in 15 to 13 fathoms on sand (the depth here must, on no account, be decreased to less than 11 fathoms); protection from the eastward being furnished, in both instances, by the main body of the reef.

The bank of soundings upon which the Cargados Carajos reefs are based extends from them in a N.N.E. direction to a distance of probably 20 miles; that shown on the chart extends from them about 15 miles to the westward and northward, deepening gradually to 32 fathoms at this limit; its actual extent is unknown. The eastern edge of the main reef is steep, and believed to have a depth of not less than 32 to 34 fathoms within a quarter or half a mile of it.

But little, if any, fresh water can be procured from the islets of the Cargados Carajos, and that only of very inferior quality.

Mr. Henry Davey, R.N., has described the Cargados Carajos as follows :—

"Immediately in the track of vessels from the Mauritius to India are the group of reefs named Cargados Carajos. The south end of this group bears from Cannonier's point, Mauritius, N.E. by N. about 220 miles; it is, therefore, necessary that the track should be well to the southward to effect the windward passage. The current generally runs to the N.W., directly on the islands at the rate of from 1 to 2½ miles per hour; and should night intervene while yet to the southward, it would be extremely hazardous to attempt to pass to windward. Indeed, in all cases it is advisable to avoid crossing the parallel of these dangers during the night, which can be easily avoided by regulating the time of sailing from port Louis.

"In H.M.S. *Hyacinth*, we sailed from port Louis, at 1h. P.M. of 13th August, 1833, and keeping a good full to the Trade, which was from E.S.E. to E., just fetched the south island sufficiently early on the morning of the 15th to enable us to get sights for the chronometers; we also got a noon observation for the latitude; these gave, for the Latitude of south extreme, 16° 53′ S., and Longitude 2° E. of flagstaff on Tonnelier island, port Louis.†

"The morning was fine and clear, with a moderate breeze; and when land was reported, the only objects visible were the tops of four cocoa-nut trees, the wreck of a ship, and broken water to the N.E. as far as the eye could reach; we were distant at this time from the nearest broken water, which was the very south extreme, certainly not more than 10 miles, which may be considered a sufficient reason for avoiding this dangerous vicinity by night. We were quickly up with the south point, and ran under the lee of the island to the anchorage abreast the cocoa-nut trees, where we hove to, and despatched a boat to examine the wreck; from the south point to the anchorage the shore may be approached to within half a mile in 9 fathoms water. The south or main island is of sand, very low, and almost destitute of verdure, nearly 9 leagues in length, in a N.E. by N. direction, and is intersected by several boat-channels, which are mostly dry at low water. The island on

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* See the survey of the reef by Capt. Sir Edward Belcher, R.N., 1846; published by the Admiralty (No. 1881).

† The flagstaff on Tonnelier island is nearly a mile westward of the Observatory, Port Louis, which is considered to be in Long. 57° 29′ 30″ E.; hence, according to Mr. Davey, the longitude of the south end of the Cargados Carajos is about 59° 28′ 30″ E., which places the reef 5½ miles westward of the position determined by Sir Edward Belcher, R.N.

the windward side is fronted by a broad coral reef, over which the sea breaks with great force, presenting a continued line of heavy breakers reaching to the most distant verge of the horizon. Like most other coral reefs, it is remarkably steep; the lead is therefore of little use, and a vessel once within the influence of this terrific danger is without hope. Between the reef and the island is a lagoon of shoal water, about three miles in length; close to this, at the distance of two or three miles from the south point, was the wreck before-mentioned. She was a vessel apparently of about 600 tons, had evidently run on the rocks during the night, and most probably was a wreck as soon as danger became known; she was well up on the reef, with her bottom out, and her anchors at the bow with cables bent. The cables were of coir, from which circumstance, together with her not having any name on her stern, it may be inferred that she was an Arab vessel.

"At 1h. P.M., we made sail from the anchorage, and had to keep away to pass westward of the Baleine shoal; this shoal always shows itself by the swell or sea breaking on it; we passed about a quarter of a mile outside of it, and hauled up for Frigate island, this we passed at a moderate distance, as well as Pearl island, from which we hauled to the Trade, but passed far to leeward of Albatross island. These islands, which are not high, bound the main island to the N.W. and N., the whole being situated at the south end of an extensive bank, on which we sounded during the night, in 20 to 50 fathoms; and on the following noon, in Lat. 13° 20′ S., Long. 61° 30′ E., had 85 fathoms; the soundings were on coral, sand, and shell. Supposing the last cast (85 fathoms) to have been on the edge of the bank, it will give a distance of 80 leagues N.E. by N. from the south point of the main island, and 68 leagues for the extent of the bank to the N.E. of Albatross island."

NAZARETH BANK.

Soundings of 16 to 37 fathoms have been obtained on a bank situated 60 to 180 miles north-eastward from the Cargados Carajos reefs. This bank is frequently crossed by vessels from the Seychelles and India bound to Mauritius. It is believed that there are no dangers on it, and that the least depth of water is as mentioned, 16 fathoms. It has not been examined, and its extent is therefore uncertain, but its southern part is considered to be in Lat. 15° 21′ S., Long. 60° 21′ E.; its eastern part in Lat. 14° 30′ S., Long. 61° 36′ E.; and its northern part in Lat. 13° 30′ S., Long. 60° 51′ E.;—its western limit is unknown.

Captain F. Moresby, R.N.,* says:—"Nazareth bank is separated by deep water from the Cargados Carajos reefs, but the extent of the deep sea I have not been able to ascertain; it must, however, be narrow. The colour of the water indicates when a ship is between the banks. Between this bank and that of the Saya de Malha the current sets to the westward with great rapidity. I have passed it on the meridian of 57° 30′ E. to 59° 10′ E. several times, and at all seasons of the year, experiencing a westerly current of from 25 to 50 miles in the 24 hours, when on the succeeding and preceding days after passing the parallel of deep water between the banks we had the usual westerly current of from 10 to 20 miles in the day."

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* N.B.—Capt. F. Moresby's longitudes depend on Port Louis being 57° 28′ E., and Mahé (Seychelles) 55° 32′ 24″ E.; both of which are within 2′ of more recent determinations; this correction, however, cannot well be applied to the respective longitudes of the different islands, as they are a mean between chronometric and lunar observations.

SAYA DE MALHA BANK.

The Saya de Malha bank commences in Lat. 11° 39′ S., Long. 61° 54′ E., and continues in a north-westerly direction, somewhat in the form of the letter S as far as Lat. 8° 40′ S., Long. 60° E. It is narrow in width, and has soundings upon it of from 26 to 9 fathoms. Its eastern edge is very steep, there being no bottom, sounding in 175 fathoms, at only a short distance from it;—its extent in a westerly direction is unknown, as the surveyors did not prolong their examination so far as the 100 fathoms line.

In Horsburgh's *East India Directory*, 1864, it is stated that "various ships which have crossed the bank and recorded their soundings, give them from 6¾ to 75 fathoms, according to their position on it. The following are the positions of some of the shoaler parts of it:

6¾	fathoms	in Lat.	9° 21′ S.,	Long. 60° 14′ E.
6¾ to 8	do.	„	9° 47′ to 9° 50′	„ 61° 21′ to „ 61° 29′
7 to 10	do.	„	9° 3′	„ 60° 43′
9	do.	„	8° 35′	„ 59° 58½
10	do.	„	9° 45′	„ 60° 32′
			8° 42′	„ 63° 10′
12	do.	„	10° 30′	„ 61° 50′
			8° 30′	„ 60° 0′
			8° 19′	„ 60° 0′

"Navigators are still left in a state of uncertainty as to whether any part of this bank is dangerous; but as the *Cornwallis* had 7 fathoms,—the *Northumberland* 7 fathoms on another part,—the *Preston* only 6¾ fathoms, coral rock, on a different part,—and the *Colombo* 6¾ fathoms on the eastern edge,—caution ought certainly to be used by those who happen to get near this bank; more so, as a navigator of the Mauritius states that there are dangers on its southern extremity, where a ship would be liable to strike on some of the coral patches; and the *Elize*, French schooner, is said to have been in 4 fathoms, close to breakers on this part of the bank."

Captain F. Moresby, R.N., says: "It being now ascertained that on the north-west extremity of the Saya de Malha bank numbers of coral patches exist, between which there are no soundings, I am inclined to believe that off the north-west extremity of the Saya de Malha bank it is precisely *under* water, what those coral islands which are scarcely elevated *above* water, now appear. At no distant time it is probable islands will rise similar to the sand-banks of Cargados Carajos; the débris of coral, shells, and madrepore will form in the lagoons, which are encircled by reefs. There is in one place, as I have marked, only 3½ fathoms, and the next cast 30 or 40 fathoms. This is the case with all the reefs. I have seen islands as it were forming the sand-bank, assuming in twenty-four hours a different shape, sometimes two feet above the level of high water, at others awash. A log of wood or large branch of coral broken by the violence of the ocean, and thrown on the sand gives these banks their first stability; from this moment they gradually become the deposit of the ocean. First, the resort of turtle, next of birds, that bring the seeds of

trees, and the first cocoa-nut that lodges is the germ from which in ten or fifteen years the island will be covered. I directed an officer, whom I sent from the Seychelles in a Colonial schooner, to ascertain the north and south limits. The weather proving bad, with a heavy breaking swell, he did not think it safe to heave-to hourly to sound. He struck ground first on the parallel of 8° 50′ S., Long. 60° 10′ E., 38 fathoms, sand, broken coral, and shells. Shortly after, steering S.S.W. he had 10 and 11 fathoms, then no bottom with 45 fathoms; the sea appeared to break to the north-west. Thus he passed the Galebea rocks, and lost soundings off the western limits. Since that period I have inquired of every person whose veracity I could trust, and amongst those who are not to be doubted are the Rodouls. On the north-west extremity they found 3½ fathoms. The day was fine, and they sounded in 5, 5½, and 7 fathoms. This has been corroborated to me by more than one. Lieut. Hay, in the *Wizard*, has sounded the Saya de Malha bank, particularly on the north-west extremity. The soundings he found, with those I have before mentioned, and others given in Horsburgh's Directory, as marked in my chart, will, I think, place the Saya de Malha and the coral patches off the north-west extremity with great precision.

"M. Mondor reports that he anchored on the Saya de Malha bank in 3½ fathoms, close to a small sandy island covered with birds. This is another instance of the power of fancy. It was nearly dark, and he left his anchorage before daylight, at the break of which he could not discover the island. Probably it was one of those fields of spawn so frequently met with in these seas, having the appearance of sand-banks scarcely covered with water, over which myriads of birds are on the wing. The sea breaks in several places during violent weather. It therefore behoves large ships to navigate with the utmost caution, and choose a route clear of lurking dangers, if it is in their power.

"The edges of the Malha bank to the eastward and northward are steep, as are all the coral reefs in this Archipelago."

TROMELIN ISLAND.

This is a small pear-shaped island, the narrow end of which faces N.N.W., situated, according to Captain Owen, R.N., in Lat. 15° 53′ 12″ S., and Long. 54° 36′ 27″ E. It was discovered by the *Diane* in 1722, but appears to bear the name of Tromelin from the master of the *Diligente*, who landed in 1776, and rescued the survivors of the crew of the *Utile*, which was wrecked upon it in 1761. It is a flat sandy island, 15 feet above the water, nearly one-third of a mile long from N.N.W. to S.S.E., and about two furlongs in width.* From it a reef projects three-quarters of a mile to the S.S.E. It has not been surveyed.

Captain F. Moresby, R.N., says: "This island I sent a schooner to reconnoitre in September, 1821, a wreck having been seen upon it. Its Latitude is 15° 51′ 45″ S., Longitude (by chronometer rated at port Louis) 54° 33′ 45″ E., but by sun and moon 54° 38′ E. The island is very low and sterile, with a reef extending from the south point, and is about three-quarters of a mile in length; the north point appears to be a steep sand-bank, up which the sea rolled a considerable distance.

* According to the sketch of the island in the Admiralty Chart (No. 677) it appears to be 1½ miles long and 9-10ths of a mile broad.

We kept the deep-sea lead constantly going, both on approaching it on the south-east and leaving it on the north-west, without gaining bottom."

GALEGA ISLAND.

This island is about 11 miles long in a N.W. and S.E. direction, and not more than a mile broad. It is very low, and appears from a distance like two islands, there being a gap in the middle through which the sea flows at high tide. A reef surrounds it, and there is almost always a heavy surf, rendering a landing difficult. When examined by H.M.S. *Clorinde*, in 1811, the north end was found to be in Lat. 10° 20′ S., Long. 56° 37′ E.; and the south end in Lat. 10° 31′ S., Long. 56° 40′ E. It has not been surveyed.

Captain F. Moresby, R.N., says: "I landed on the extreme north-west point on August 29th, 1822, and found its Latitude to be 10° 21′ 30″ S., and Long. 56° 32′ E. I had not time to examine its south-east point, but I take it to extend far more eastward than its breadth would admit, as stated by Horsburgh on the authority of Captain Briggs, H.M.S. *Clorinde*,—that is, it extends in a N.W. and S.E. direction, the easternmost reefs being at least in Long. 56° 42′ E. I give its position from a nine days' run to Mauritius, when the chronometers were verified. A schooner was at anchor when I visited it, under the lee of the north-west point, in 8 fathoms, at two cables' length from the shore. The island is low, but the trees on it may be seen from a distance of about 15 miles."

FARQUHAR ISLANDS.

This is a group of islands consisting of two large and ten small ones, situate about 135 miles from cape Amber, the north point of Madagascar, in a N.E. ¾ E. direction. They have not been surveyed. They have been described as "an elliptical chain of low islets and reefs, extending N.E. and S.W. 6 or 8 leagues, having a basin in the centre, with 7 or 8 feet water on the bar leading to it at the north part of the chain, where is good ground for anchoring. The soil of the islands consists of decayed coral, on which grow trees of small size. Turtle and fish of various kinds are plentiful, and some fresh water may be obtained by digging. The tide sets about N.E. and S.W., and rises 4 or 5 feet."

Captain F. Moresby, R.N., anchored off the northern part of the Farquhar islands in 1822, in 17 fathoms, sand, and made the anchorage in Lat. 10° 7′ S. by good observations, and Long. 51° 5′ E. by three chronometers. He made the extreme of North reef in Lat. 10° 6′ S. and Long. 51° 7½′ E.; North-west island (in sight of the ship) Lat. 10° 11′ S. and Long. 50° 59′ E.; south extreme, Lat. 10° 26′ S. and Long. 50° 54′ E. The wind was fresh from the S.E.; the flood-tide ran N.N.E. 1½ miles per hour, and the ebb to the S.W.*

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* Horsburgh's Directory, 1864, p. 196. The islands are so inserted on the Admiralty Chart, No. 677, and these positions may be considered to be approximately correct. Being but little above the surface, they are very dangerous, and it is necessary to be more than ordinarily vigilant when in their vicinity. We are unable to reconcile these positions of Capt. Moresby, R.N., with the following extract from the "Nautical Magazine," 1842, p. 680, where he says, "Farquhar islands, north point in Lat. 10° 6′ 30″ S., Long. by sun and moon 50° 40′ 30″ E.; south point in Lat. 10° 24′ S. These islands I sent Lieut. Hay to visit in May, 1821, in the *Eliza*, colonial schooner; he refitted in a small harbour on the south-west side of the north island. Vessels

Rajaswarre Breakers, in Lat. 11° 25′ S. and Long. 52° 2′ E., are believed not to exist, otherwise they must be frequently seen by some of the numerous vessels that adopt the Farquhar passage as their route to India. The following is a copy of the report of discovery made by the master of the *Stree Rajah Rajaswarre*:—

"November 21st, 1858, at 7h. 30m. P.M. Slight and variable breezes from the S.E.-ward, the evening very fine and beautifully clear, and the vessel going about 2 knots an hour; passed quite close to a reef or bank, but more probably a reef,—a line of tremendous breakers rolling in from the eastward, and just reaching the ship in their spent state, causing her to roll and heel over very much; it appeared to extend in a N.N.E. direction about a mile, the sea all round the ship indicating the approach to danger. I am sorry I could not sound, my anxiety to get the vessel out of danger as speedily as possible, in the first instance, preventing my so doing, and as we were only a quarter of an hour in the confused sea, there was no time to spare."

McLEOD BANK.

This is a bank of soundings situated about 40 miles N.W.-ward from the Farquhar islands, in about Lat. 9° 54′ S. and Long. 50° 25′ E. It was discovered in 1818 by CAPTAIN D. McLEOD, of the *Marquis of Huntley*, with the *Duke of York* in company, bound to Bombay from Mauritius. Its extent is uncertain, and it is considered probable that the Farquhars, Providence, and St. Pierre islands are all seated on a bank of soundings of which this may be a portion; from this remark it will be seen that it has not been surveyed. The following is the report of discovery:—

"Steering N. by E., with a light breeze at S.S.W., the rocks were observed under the ship's bottom at 7h. A.M., when we sounded in 10 fathoms. The breeze being light and the water clear, we stood on till 7½h. A.M., in 10, 10½, 11, and 13 fathoms, then hove to and sent two cutters, one to the northward, which deepened soundings gradually from 13 to 40 fathoms at about 1¼ miles from the ship, and then lost bottom at 40 fathoms. The other cutter, which went eastward, deepened soundings from 13 to 20 fathoms, and then had no ground at 30 fathoms at about a mile from the ship. The *Duke of York* hove to, bearing S.S.W. ½ W. about 2 miles distant, and obtained bottom in 10, 13, and 17 fathoms. At 8½h. A.M. we bore away and steered N. by E., keeping a cutter ahead of the ship until 9½h. A.M., having run 4 or 5 miles N. by E. from 7h. A.M. when we first sounded; after 9½h. A.M. we got no soundings at 75 and 105 fathoms. When hove-to on the bank at 7h. A.M. we were in Lat. 9° 57′ S., deduced from observations at noon, and Long. 50° 18¾′ E. by chronometers measured from lunar observations. The mean result of various lunar observations taken before and since the 28th March, measured to the position in 13 fathoms, places that part of the bank in Long. 50° 20′ E., latitude stated as above; and the last soundings of 40 fathoms in Lat. 9° 53′ S., and on the same meridian.

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drawing 10 feet water can enter it; there is good anchorage also off this harbour in 10 fathoms, sand and shells. The Farquhars consist of several small islands, generally surrounded by coral reefs.

"The foregoing is LIEUT. HAY'S report; but as this island was again seen by LIEUT. HAY on March 12th, 1822, then commanding the *Wizard*, in company with the *Menai*, whose signal I had made to look out for it, I am enabled to give its exact position, taking its bearings from St. Pierre, where, on March 13th, the following day, I had excellent observations—viz., in Long. 50° 54′ E., and as such I have indicated it on my chart. Water may be procured by digging pits; there is also a fishing establishment."

Probably this bank is not dangerous, as the ship appeared to pass over the shoalest part, by the water deepening all round, but there were not means of forming a correct opinion of its extent. During the morning no appearance of shoal water or breakers could be discerned from the mast-head, but only ridges of strong ripplings at short distances from each other, in one of which the boat found the water much agitated, but no ground was got at 40 fathoms; here the current was found setting strongly to N.E., and when out of the rippling it appeared to set weakly to N.N.W. While in soundings, the ship was surrounded by many sharks and rock cod, several of which we caught, and the bottom seemed to be white coral rocks in ridges, with apparently deep chasms between them; but from the regularity of the soundings, this must have been occasioned by the various colours of the coral."

ST. PIERRE ISLAND.

This is a small island, having an extent of not more than $1\frac{1}{4}$ miles, situated, according to CAPTAIN F. MORESBY, R.N., in Lat. 9° 20′ S., and Long. 50° 54′ E. by chronometer.* It is very low, and of peculiar form, being cavernous, through which the sea is thrown to a great height, giving it the appearance of whales blowing, when the island is first made. Its formation is different from the neighbouring islands, as it has a thin bed of soil resting on rock which is neither granite nor limestone. The anchorage for small vessels is close to the reef, the bank not extending a cable's length from it. It has not been surveyed.

A reef is inserted in the Admiralty Chart, No. 677, in Lat. 9° 12′ S., and Long. 50° 51′ E., or at about 8 miles north-westward from St. Pierre, and 20 miles westward from Providence island. The authority for placing it on the chart is M. VAILHEU, of the French ship-of-war, *Madagascar*, 1834. We possess no particulars of it.

PROVIDENCE ISLAND.

This small, low island has an extent of about 2 miles from North to South, and of only one-third of a mile from East to West. It is composed of sand and coral, or white madrepore, and has such a moderate elevation that at high water, equinoctial tides, the sea flows over it. Its north part is, or was, covered with cocoa-nut trees, and its south part with a spongy tree resembling the European fig-tree—this is straight, and 40 or 50 feet high, with joints like the bamboo, 6 feet from each other, and its fruit is not unlike small mangoes. Fresh water is abundant by digging. Turtle, land-crabs, and rats are numerous. The anchorage is inside the island at half a mile from the shore, on uneven ground consisting of sand and gravel.

According to CAPTAIN F. MORESBY, R.N., the island bears E.N.E. (*mag.*) from St. Pierre, distant 18 miles, and its north point is in Lat. 9° 10′ S., and Long. 51° 9′ E. by chronometer. It is high water on the days of full and change of the moon at 3h. 30m. P.M.; the rise of tide is 8 feet.

Providence island is surrounded by a reef, the edges of which are said to be so steep that but little, if any, warning of its vicinity is given by the lead. This reef is said to extend 25 to 30 miles from the island in a S.S.W. direction, or as far as Lat. 9° 35′ S. and Long. 51° 3′ E. In 1769, the French frigate *L'Heureuse* was wrecked on the

* By observations of the sun and moon in Long. 51° 15′ E.—CAPTAIN F. MORESBY, R.N.

south part of this reef, and the commander reported that it had a breadth of about 2 leagues, and that it was wholly occupied with banks of sand and coral, several of which were above water; so that at low tide it was scarcely passable by a canoe, nor even at high tide unless with great care. The crew escaped to a dry sand just within the edge of the reef, and eventually reached Providence island, whence by means of their boat they afterwards escaped to Madagascar. Providence island and reef have not been surveyed.

Wizard Breakers.—At about 20 miles N. by E. from Providence island, breakers were observed by Lieut. Hay, of the *Wizard*, in 1821. The position, according to the Admiralty Chart, No. 677, is Lat. 8° 50′ S., and Long. 51° 12′ E. They have not been surveyed.

St. Lawrence.—This island, said to be in Lat. 9° 37′ S., and Long. 50° 20′ E., is believed to have no existence, being in all probability only the dry sandbank at the south end of Providence reef, upon which the crew of the *Heureuse* were saved, or possibly even St. Pierre island.

Captain F. Moresby, R.N., has remarked:—"In the neighbourhood of the Farquhar and Providence islands the currents set generally to the westward, their velocity being accelerated by the winds. Strong ripplings frequently occur; when we experienced these, a change of current has sometimes taken place. I have seen the surface of the ocean in light winds appear for a considerable space to be much agitated, and I at first thought it was occasioned by uneven ground and overfalls, but I could not obtain soundings; and by a boat steadied with a pitch-kettle to 140 fathoms of line, could only observe a slight surface current. A pendant 3 fathoms below drew the contrary way, but not strong, or sufficiently so to cause the violent and partial agitation of the ocean. Should a stranger to these circumstances observe them in passing, it is more than probable he would report some undefined dangers."

ALPHONSE, ST. FRANCIS, AND BIJOUTIER.

This is a group of islands, the north point of the northern island of which (Alphonse island) is in Lat. 6° 59′ 30″ S., and Long 52° 41′ E. by chronometer, or 52° 45½′ E. by observations of sun and moon, according to Captain F. Moresby, R.N. His remarks are—"I rounded this point at a quarter of a mile from the reef, which extends half a mile from the point. The extreme southern point is fast rising into an island of greater extent than Alphonse. On March 15th, 1822, we were in latitude at noon 7° 14′ 30″ S., this island bearing East (*true*) from us, and the reef still further south, so that between Latitudes 6° 59′ 30″ S. and 7° 20′ S. dangerous reefs nearly unite North and South Alphonse. There is a passage, but it is very intricate and dangerous; the currents are strong and uncertain. I remained off Alphonse turning turtle two days, and was obliged to carry sail to keep under the lee of the island, the currents setting strongly to the eastward."

These islands are known as the Alphonse islands. They are all low, and upon them are or were some trees and shrubs. South Alphonse is estimated to be about 12 miles southward from the northern island; it is but little above the water, and is surrounded by a reef which causes heavy breakers, especially when the wind blows with strength. The reef upon which this group of islands is seated, like all the coral reefs in the Indian ocean, is very steep, especially on its eastern side, the lead consequently gives but little indication of its vicinity.

The two southern of the Alphonse islands were named St. Francis and Bijoutier by Captain Owen, R.N., who considered the centre of Alphonse island to be in Lat. 7° 0′ 30″ S., and Long. 52° 47′ 45″ E. The Alphonse islands derive their name from the commander of the *Lys*, who discovered them in 1730.* None of the islands have been surveyed.

AMIRANTE ISLANDS.

These islands are considered to be nine in number, but as they have not been surveyed, and according to M. Vailheu, the commander of the French ship-of-war *Madagascar*, in 1834, there is an additional island (King Ross) the number must be regarded as uncertain. The names of the known islands, reckoning from the northernmost, are African, Eagle, Daros, St. Joseph, Poivre, Etoile, Roches, Bordeuse, Marie Louise, and Neuf. The islands scarcely differ from each other, being usually from $1\frac{1}{2}$ to 2 miles long. Situated on coral reefs, the débris of which, and shells, have formed their first soil, their elevation does not exceed 20 feet; they are crowned with trees (*mapor wood*), and various shrubs of a spongy nature that attain the height of 25 or 30 feet. Cocoa-nut trees are abundant. Water may generally be procured by sinking 12 or 15 feet. Fish and turtle are plentiful. As but very little is known of these islands, they should be avoided, especially by large vessels, the masters of which have no reason to visit them. The frequency of calms during several months, with the velocity and uncertain run of the currents, added to the want of good anchorage, makes it advisable not to approach them unless compelled by necessity. The seasons partake of the same changes as at the Seychelles, but the currents are more variable.

African.—This island (appearing as two when the tide is up) is situated in Lat. 4° 53′ 30″ S., and Long. 53° 33′ E., according to Captain Owen, R.N.† It is low, and of but small extent, its length being not more than 2 miles from North to South. Its peculiar appearance of two islands arises from its formation in two hummocks, joined together by a reef which is dry only at low water; the southern portion is the larger. It is so little above the surface, probably not more than 4 feet, that it can be considered little better than a dry reef; at high water, spring-tides, the sea almost covers it. There is little, if any, vegetation except a few shrubs. It abounds with turtle and sea-fowl, and is destitute of fresh water.

On August 25th, 1801, the armed tender *Spitfire* struck on the southern part of the reef surrounding African island, having only just previously sounded with 20 fathoms of line without getting bottom; the swell soon after drove her over the reef into a sort of sandy basin in the reef. The east side of the island was described by the commander of that ship as "surrounded by breakers. On the west side of the island there is a safe and commodious anchorage in a bay formed by the extremes of the islands, and the reefs which join them. We could find no fresh water, although we dug to the depth of 40 feet." This anchorage can be safe only during the S.E. Monsoon.

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* "Alphonse island is 3 miles in length from north to south, and there are two low sandy islets 4 or 5 leagues southward from it, upon a reef several leagues in extent. There are no soundings at a mile from the shore."—*Commander's Report of Discovery.*

† M. Tricault, of the French Imperial Navy, observed, in October, 1864, the position of the northernmost of the African islands to be in Lat. 4° 53′ S. and Long. 53° 32′ 9″ E. (depending upon the meridian of St. Denis, Réunion), which closely corresponds with this determination by Captain Owen, R.N. Four trees were growing on the island in that year.

A bank of 5 to 9 fathoms is said to extend 4 or 5 miles southward from African island; and the Admiralty chart (No. 677) represents the channel between African and Eagle islands (8 to 10 miles wide), as free from danger, and with a depth of 18 to 22 fathoms; although a reef has been reported to exist in nearly mid-channel at about 4 miles N.W. by N. from the latter island. The *Mary* is stated, in "Horsburgh's Directory 1864," to have safely passed through this channel.

Eagle.—This low, sandy island, about ¾ of a mile across, is situated in Lat. 5° 8′ S., and Long. 53° 32′ E. according to the Admiralty Chart (No. 677); but 53° 22′ 30″ E., following Captain F. Moresby, R.N., 1821.* It is, or was, covered with shrubs, and is destitute of fresh water.

At two or three miles from the north and east sides of Eagle island there are reefs, on which the sea breaks heavily, especially with the wind on shore. The channel between these reefs and the island, although said to have a depth of 9 to 14 fathoms, cannot be considered safe for a large vessel, in our imperfect knowledge of the hydrography of the island. This island is named Remire by the French.

A bank of 6 to 14 fathoms is represented on the Admiralty Chart as extending in a S. by W. direction from Eagle island, 16 miles towards Daros island, approaching that island to within the distance of 4 miles. As a shoal spot of 12 feet is inserted at the extremity of this bank, the passage between the islands must be regarded as dangerous to strangers. Lieutenant Hay, R.N., is reported to have had 4½ fathoms in 1821, on rocky bottom, at 12 miles N. by W. from Daros island, which would be in nearly mid-channel, whence he steered N.W. 3 miles, and was off the bank.

Daros.—A small, low, sandy island, in Lat. 5° 27′ S., and about Long. 53° 27′ E., which, like the other islands, is surrounded by a reef. Between it and the reef, extending westward from St. Joseph island, there is a narrow but dangerous channel, having probably a depth of about 12 fathoms.

St. Joseph.—At 5 or 6 miles E.S.E. from Daros is St. Joseph, another small, low island, surrounded by a reef. Its position, according to Capt. F. Moresby, R.N., is Lat. 5° 29′ S., and Long. 53° 29′ E.; Lieutenant Russell, R.N., observed the Lat. 5° 26′ S., and the longitude corresponded to Capt. F. Moresby's.

Poivre.—Situated in Lat. 5° 43′ S., and Long. 53° 21′ E. This low, sandy islet has a small islet off its south-east point, and together they occupy an extent of less than a mile. The reef upon which they are seated extends from them some distance, and we believe has a depth of not less than 8 fathoms close to its edge.

When steering northward from Poivre island, a good look-out must be maintained for a small reef dry at low water, situated 4 to 8 miles N. by W. from the island. Generally it shows itself by breakers. Its position is uncertain.

Etoile.—At about 14 miles in a W.S.W. direction from Poivre island is Etoile island, low and sandy, and covered with bushes. It is about half a mile in extent, and the reef upon which it is seated projects from it southward about a mile. Its position is estimated to be Lat. 5° 50′ S., and Long. 53° 8′ E.; Captain F. Moresby, R.N., considers its Latitude to be 5° 57′ S.

According to M. Jehenne, of the French ship *Prévoyante*, Etoile island has an extent of not more than half a mile, and is only about 8 feet high, being little else than a dry coral reef. It is bare of verdure, with the exception of a few marine

* Lieut. Russell, R.N., 1820, observed the Longitude 53° 21′ E.

plants. Its formation appears to be white sand on coral. A bank of soundings surrounds it on all sides, apparently to the distance of 1½ or 2 miles, upon which, with the island bearing N.E., the depth is 8 to 10 fathoms; this bank is thickly strewn with coral patches, upon which the soundings are probably less.

In a N.N.W. direction from Etoile island (distance not stated) there is a bank upon which the sea breaks. And, according to M. VAILHEU, of the French ship-of-war *Madagascar*, 1834, there is an island, which he named King Ross, situated about 15 miles W.S.W. from Etoile, in Lat. 5° 57′ S., and Long. 52° 56′ E.

Roches.—This island is in Lat. 5° 40′ 15″ S., and Long. 53° 42′ E., being distant about 18 miles* east from Poivre and 12 miles south from St. Joseph. It is low and sandy, about 3½ miles long in an east and west direction, and very narrow. On its north and south sides there is anchorage, which may be taken according to the prevailing wind. A reef surrounds it, and stretches from its eastern end about 8 miles towards the N.E., and from its western end about 4 miles to the S.W. M. D'APRÉS DE MANNEVILLETTE says: "The eastern edge of the reef of Roches island extends north and south about 7 miles, and the south edge of it (running along the south coast of the island, and at half a league westward of its south-west point) W. by S. and E. by N. about 11 miles." In HORSBURGH's Directory it is stated that "the island has a bank extending around it about four leagues to the north or N.W., and two leagues to the east, with only 2½ fathoms on it in this part, and mostly from 5 to 13 fathoms to the N.W.; but in a southerly direction the bank extends only a short distance from the island."

Bordeuse.—According to M. JEHENNE, this island is in Lat. 6° 5′ 33″ S., and Long. 52° 56′ 47″ E., the latter depending upon the correctness of the longitude assigned to Etoile island.† It is not more than one-third of a mile in extent, and has such moderate elevation that the sea in rough weather almost flows over it; there are, consequently, no trees upon it, but only a few small shrubs. From its west side a reef extends two-thirds of a mile, and another reef runs out from its east side 100 to 150 feet. The bank upon which the island is seated lies in an East to E.N.E. direction, is about 2 miles in extent, and has a depth over it of 8½ to 13 fathoms, sand and coral.

According to M. VAILHEU, there is a reef of 1½ fathoms at about 7 miles N.N.E. from Roches island, and also a reef at about 5 miles S.W. from the island.

Marie Louise.—This small sandy island is in Lat. 6° 12′ S. and Long. 58° 18′ E. It is possibly 1¼ miles in diameter, and is surrounded by a reef, on which, at two miles westward from the island, there is a depth of 3¾ fathoms. In the channel (about seven miles wide) between this island and Neuf there is a depth of 12, 15, and 17 fathoms;‡ CAPTAIN MORESBY, R.N., passed through this channel in 1821, and on a N.E. course for three miles had regular soundings of 17 fathoms.

Neuf, the southernmost of the Amirante islands, is in Lat. 6° 13′ 15″ S. and Long. 53° 12′ 15″ E. Its formation is similar to that of the other islands, but it is perhaps smaller. It is or was covered with wood, and is seated on a coral reef.

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* CAPTAIN F. MORESBY, R.N., says 22 miles.

† In the Admiralty Chart (No. 677) it is placed in Lat. 6° 12′ S., and Long. 52° 56′ E., on the authority of M. VAILHEU, of the French ship *Madagascar*. M. JEHENNE does not give the longitude of Etoile Island.

‡ M. DU ROSLAN, 1770, says, 25 to 30 fathoms, and that soundings are lost at a little southward of the channel.

M. DU ROSLAN states that he had soundings of 9 to 15 fathoms, rocky bottom, within a league of its south side.

Of Neuf, Marie Louise, and Bordeuse, it may be remarked that they are of sand crowned with trees, and environed, except a few small openings, by coral reefs. Seals of a large size resort to them. There is anchorage in some places amidst these islands; but it is advisable to use only a chain cable, the ground being rocky. The white sandy bottom can generally be distinguished from the coral patches, while in a depth of from 12 to 15 fathoms.

FORTUNE BANK.

This bank of soundings, according to the Admiralty Chart (No. 677), is situated in Lat. 7° 15′ S. and Long. 57° 10′ E. It was discovered on May 31st, 1770, by CAPTAIN COMPTON, of the *Verelst;* and on 14th September, 1771, soundings were again obtained upon it by M. DE KERGUELEN of the *Fortune*, who attached the name of his vessel to it, believing that it had been till then unknown; this name it still bears on the charts. In 1861 COMMANDER DE HORSEY, of H.M.S. *Brisk*, passed eastward of its assigned position, and obtained no bottom with a line of 50 and 49 fathoms. It has not been surveyed; its extent, soundings, and position are consequently uncertain. The following reports contain all that is known of the bank:—

CAPTAIN COMPTON says, "On the 30th May, 1770, I was in Lat. 7° 24′ S., and Long., east from St. Mary's island, Madagascar, 7° 44′. I supposed that we were on a bank, but did not sound till at about a quarter before 1h. P.M., when we had 15 fathoms, coral rocks, then 14 fathoms for several casts. It was very fine weather, and I could not see the least appearance of shoals or breakers from the mast head; the water was very smooth. I then steered N.E. ½ E., which was almost close to the wind, going about 4 knots; by a quarter past 1h. P.M., we had shoaled to 12 fathoms, and continued that depth till 2h. P.M., when we deepened to 14 fathoms for a few casts, and shoaled again to 12 fathoms. From 2h. 30m. till 3h. P.M., we had very regular soundings of 11 fathoms, then for half an hour regular soundings of 10½ fathoms, when we lost bottom, as we could get no soundings as fast as we could pass the line along, sounding 20, 50, and 100 fathoms. Though the north-east edge be steep, we supposed the south-west part to shoalen gradually as the water was observed to be discoloured so early as at 8h. and also at 10h. A.M. the preceding day. Immediately after losing soundings the water returned to its proper colour, and also the usual swell. All the time we were in soundings we had great numbers of ground sharks. The north-east end of the shoal we found to be in Lat. 7° 11′ S., and Long. 7° 54′ east from St. Mary's island."*

M. DE KERGUELEN says, "On leaving Mauritius, September 13th, 1771, I made my course, *corrected North*, to traverse the archipelago northward of the island; in the night between the 18th and 19th, at about 1h. A.M., there was a violent squall of rain and wind, with thunder and lightning; at 11h. P.M. we had no ground, but on sounding during the squall we found only 30 fathoms, and had on the next east only 19 fathoms, rocky ground. I stood on the other tack under a foresail till I had got

* The south point of St. Mary's island, Madagascar, has recently (1864) been determined to be in *about* Long. 49° 54′ E.; hence, with the meridian distance from St. Mary's, the Longitude will be *about* 57° 48′ E., according to CAPT. COMPTON'S observation.

my anchor ready, and shoalened the water to 17, 15, and 14 fathoms, sand, when, being apprehensive of driving upon some sand-bank, I anchored, and veered out 100 fathoms of cable; the ship brought up and rode fast during the squall, which lasted till 2h. A.M. I continued at anchor all night, and we were surrounded at that time with sharks, of which we caught about fifty, and with a prodigious number of crabs, with which the sea was covered; the multitude of sharks about us made the sea luminous as breakers. At length day came and relieved our uneasiness, when we saw neither land nor rock. On weighing anchor I let the vessel drive, and continued sounding for a long time; I had 14, then 20, 25, and 28 fathoms, and then at once no ground. The bank lies N.W. and S.E., and is in Lat. 7° 16′ S., and Long. 58° 10′ E."*

The *Surat Castle* crossed the bank from the southward, on the 22nd of February, 1789. The longitude by lunar observations was found to be 57° 38′ E. The first cast of the lead was 15 fathoms, whence in the run over the bank they were irregular, being from 15 to 10 fathoms, the latter being the least depth found. There was an appearance of breakers on the western edge of the bank. The bottom consisted of coral rocks and coloured shells, and there were large white spots towards the north end of it, and many ripplings around it.

In 1817 the *Sir Stephen Lushington* struck soundings upon Fortune bank, and for a distance of 7 miles obtained bottom in 10 to 12 fathoms, steering at the time due East; coral rock and sand were plainly visible under the ship, and as far as could be discerned from the mast-head to the northward and southward. At noon the depth was 38 fathoms, and soon after soundings were lost. The Latitude was found to be 7° 7′ S., and the meridian distance eastward from Coetivy island, by chronometer, was 31′, which, supposing the longitude of the island, as determined by M. TRICAULT (*see* p. 574), to be correct, places the bank in 56° 53′ E.; this differs only 3′ from the determination of M. BRIDET, and but 4½′ from the result arrived at by CAPTAIN INNES.

CAPTAIN J. INNES, of the *Abercrombie Robinson*, in April, 1830, reported that he carried regular soundings of 10 to 17 fathoms for a distance of 5 or 6 miles over what he supposed to be the north-west edge of Fortune bank, steering at the time N. by E. The latitude was found to be 7° 6′ S., and longitude by lunar observations 56° 31′ E.; but by chronometers, 56° 49′ 30″ E.

M. BRIDET, of the French ship *Nisus*, a lieutenant in the Imperial Navy, obtained soundings on the bank in 1857, and reported its centre to be in Lat. 7° 6′ 45″ S., and Long. 56° 56′ E., and that its extent was only 3½ miles† from North to South. The depth was not stated, nor were any further particulars furnished.

CAPTAIN F. MORESBY, R.N., says: "Fortune bank lies due East from Coetivy 14 leagues. The least water that has been found by the small vessels which frequent the Seychelles is 9 fathoms; they describe it as having the same extent North and South as Coetivy and the southern sand-banks, and from three to four leagues broad. Between the bank and Coetivy there is no bottom at 100 fathoms."

To the above it may be added, that CAPTAIN TAYLOR, of the ship *Simlah*, when

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* This longitude is rejected by DALRYMPLE, who (in a foot-note) says—
"M. D'APRES places it in Lat. 7° 30′ S. } In Long. 54° 48′ E. from Paris (equivalent to 57° 8′ E.
The CHEVALIER GRENIER { 7° 22′ S. / 7° 42′ S. } from Greenwich), or 1° 2′ further West than M. DE KERGUELEN."

† M. D'APRES considered the extent of the bank to be 3 leagues.

at Coetivy island in 1848, was informed by a resident on the island that the depth on the north end of Fortune bank is only 2 fathoms.

COETIVY ISLAND.

This small sandy island was discovered by M. DE COETIVY in 1771. It is situated in about Lat. 7° 10′ 56″ S., and Long. 56° 19′ E.,* according to the observations of MR. RUSSELL, R.N., of H.M.S. *Topaze*, who visited it in 1820, and from whose published plan it appears to be not more than $3\frac{3}{4}$ miles long from E.N.E. to W.S.W., and about half a mile broad; on this plan of the island is also shown a reef, partially dry at low water, extending $2\frac{1}{2}$ miles in a westerly direction from its west end, and another reef $1\frac{1}{2}$ miles easterly from its east end. The island has not been surveyed; our information respecting it is therefore necessarily imperfect. When discovered in 1771 it appeared (viewing it from a distance of about 6 miles), to be covered with trees, excepting its south side, which was bare.

CAPTAIN F. MORESBY, R.N., says:—"Coetivy island is low and sandy, and has an extent from S.W. by S. to N.E. by N. of about $7\frac{1}{2}$ miles. Off the north and north-west points, in the South-east Monsoon, there is good anchorage in from 7 to 17 fathoms on a bank of sand extending half a mile from the shore. Water may be procured close to this anchorage. We found turtle in abundance. The reef extends far to the southward."

MR. TAYLOR, of the ship *Simlah*, 1848, reports:—"Being in want of water I anchored off the small island of Coetivy in $5\frac{1}{2}$ fathoms, with the large tope of cocoa-nut trees directly over the flagstaff, bearing E. $\frac{1}{2}$ N.; north extreme of the island N.E. $\frac{1}{2}$ N. and south extreme S.S.W., and found good water close to the anchorage. From the south-west point of the island a coral reef extends, as I was told by a person residing on the island, 9 miles, on which the sea constantly breaks; it certainly broke as far as the eye could reach from the poop of the ship. From the north end of the island there extends a reef about $2\frac{1}{2}$ miles, on which the sea breaks when there is any swell.

"In the event of a shipmaster wishing to anchor at Coetivy I would recommend his rounding the island at the north point, at 3 miles distance at least, and to be careful of not standing too far to the south-west, as there are some shoal patches south-westward of the anchorage. By keeping an officer on the fore-topsail or top-yard, these will always be seen in time to avoid them."

We consider it probable that Coetivy island may be seated on a bank of soundings of considerable extent, of which Fortune bank may form a part, as M. LESPORT, of the French ship *Constant*, 1844, is reported to have obtained soundings of 11, 20, and 30 fathoms, sounding for a distance of 10 miles S.W. to N.E., at about 10 miles W.N.W. from the island.

CONSTANT BANK.

This bank is inserted in the chart on the authority of M. LESPORT, just mentioned. The report is:—"Continuing her course towards the N.E. the *Constant*

* M. TRICAULT, of the French Imperial Navy, made the N.E. end in 1864 in Long. 56° 22′ 9″ E. He describes the island as about $5\frac{1}{2}$ miles long from N.N.E. to S.S.W., and one mile broad. At $2\frac{1}{2}$ miles seaward from this end of the island there was no apparent danger. The longitude was measured from St. Denis, Réunion.

discovered, on the 7th December, 1844, another bank, on which she sounded several times, working across it by estimation. A boat which was sent to find the shoalest part of it had nothing less than 11 fathoms, the bottom being principally coral. At noon CAPTAIN LESPORT returned to the shoal part of the bank, when he determined its position, which he has given as Lat. 6° 19′ 30″ S., and Long. 56° 18′ and 56° 15′ 54″ E., deduced from two chronometers regulated at Mauritius. This second bank appeared from 12 to 15 miles from North to South, and from 18 to 20 miles from East to West."

The Admiralty Chart (No. 677) shows a line of soundings in a south-east direction from the Seychelles, by COMMANDER DE HORSEY, of H.M.S. *Brisk*, 1861, who succeeded in obtaining bottom at 36 and 40 fathoms, rock, at a short distance eastward of the position assigned to this bank, so that its existence may be considered in some degree confirmed.

PLATTE ISLAND.

This low flat island was discovered by M. DU ROSLAN in 1770, who described it as about 3 miles in circumference, and surrounded by a reef which appeared to run off from it about a mile in a northerly direction. CAPTAIN F. MORESBY, R.N., visited it in 1822, and observed it to be in Lat. 5° 48′ 30″ S., and Long. 55° 27′ E. He says:—"Passing it at 3 miles from its east side I found no bottom at 100 fathoms, but off its south-west end a bank of sand and coral extends 4 or 5 leagues, having upon it from 5 to 12 fathoms. From the north end of the island a reef extends 4 or 5 miles W.N.W., and also a mile E.S.E. from the north point. Vessels anchor off an opening in the reefs on the south-west side. The island is a mile in length, and is, in all respects, what is denominated a coral island."*

In the Admiralty Chart (No. 677) a reef of 14 feet is inserted in Lat. 6° 8′ S., and Long. 55° 24′ E., on the authority of M. VAILHEU, of the French ship *Madagascar*, 1834. Its position is about 15 miles S. by W. from Platte island.

SEYCHELLES ARCHIPELAGO.

This archipelago of islands is situated between Latitudes 3° 40′ and 4° 50′ S., and Longitudes 55° 15′ and 56° 5′ E.† They are seated on an extensive bank of soundings which, commencing in Long. 54° 5′ E., extends eastward beyond the meridian of 57° 5′ E., but how far has not been ascertained;‡ nor is its southern limit known, as it is probable that the Constant bank, Platte island, and even Coetivy island, are all on a bank of soundings, forming a portion of the Seychelles bank. The northern edge of the bank is in Lat. 3° 40′ S. The islands are about twenty-five in number, and the largest, Mahé, is the seat of Government; the town on the east side of the

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* In 1829, this island was reserved by the Government of the Seychelles for the use of vessels infected with contagious diseases.

† The Seychelles were discovered in 1743 by M. LAZARUS PICAULT, and named by him Mahé islands, from M. MAHE DE LA BOURDONNAIS, then Governor of Mauritius. The largest of the islands alone retains the name.

‡ M. TRICAULT, of the French Imperial Navy, obtained soundings of 11½ to 17 fathoms in December, 1864, when crossing the east part of Seychelles bank from southward. Latitudes from 5° 11′ to 5° 8′ S., and Long. 57° 5′ 9″ E. The track was as nearly as possible North (*true*).

island is in Lat. 4° 37′ 30″ S., and Long. 55° 30′ 9″ E., according to the observations of Captain Owen, R.N., 1825.*

The Seychelles islands are of primitive rock, and generally high excepting the more distant islets, which are of sand and coral, and only a few feet above high-water mark. The larger islands are well watered by innumerable small streams, and several still possess a quantity of good timber fit for shipbuilding and other useful purposes. The climate is considered healthy, particularly for children; and although the thermometer usually stands from 82° to 84° throughout the year, yet the heat in the day is seldom felt to be oppressive in the shade, and the evenings are particularly pleasant and cool.†

The South-east Trade-wind prevails here from May to November, at which season vessels make their passage hence to Mauritius in about twenty days on an average, and from Mauritius to Seychelles in seven days. During the other months the winds are variable; principally, however, from the S.W. and N.W.; at this period fourteen days is a common run from Mauritius to Mahé. Hurricanes are rare, but from the beginning of December to the middle of April the inhabitants do not like sending their vessels to Mauritius.

It rains at the Seychelles most during the months of October, November, December, and January.

The only fruits very common in the islands are plantains and pine-apples, though many other tropical fruits may occasionally be obtained. The Seychelles are most famed for the *cocos-de-mer*. Vegetables are scarce, the pumpkin and sweet-potato being the commonest. Fish is plentiful, and only one kind poisonous—namely, the sardine, or sprat. The flesh of the hawk's-bill turtle (that species whose scales are tortoise-shell) is never eaten; they are generally taken from May to the latter end of October, and are extremely valuable, being the sole source of revenue to many families. Green turtle are common from November to April. Supplies for shipping are not abundant, but might become so if vessels frequently touched here. There are no venomous snakes or wild beasts, and scarcely any game.

Captain F. Moresby, R.N., says, "From the salubrity of the climate, as well as from the absence of destructive hurricanes, the Seychelles must ever be of importance to those nations having possession of or trading to India. Their position for commercial intercourse with the coast of Africa, as well as Madagascar (for in both Monsoons small vessels have a leading wind to and from cape Amber), give them a

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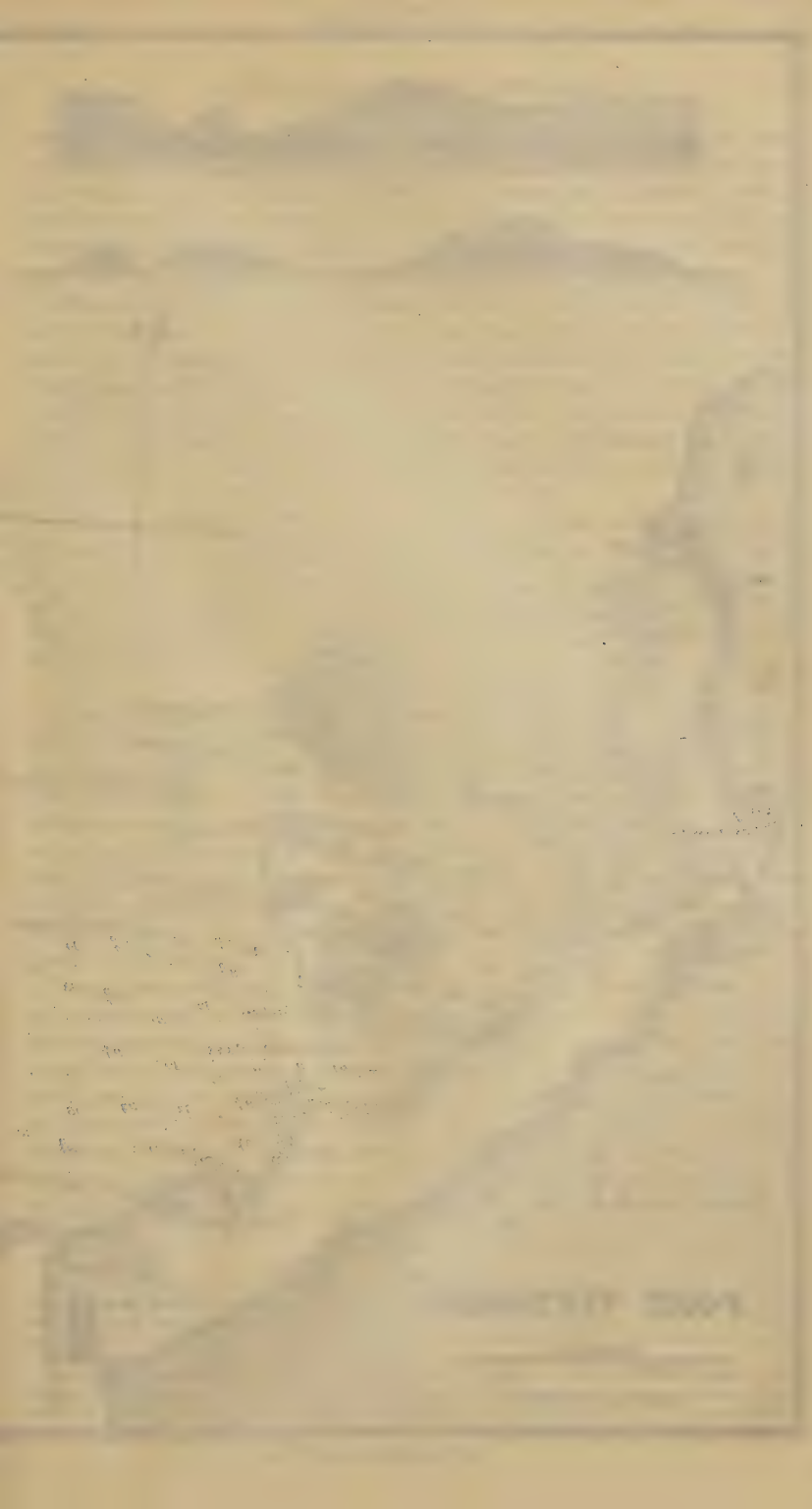
* This closely corresponds with the observations of Messrs. Cloue and Leblanc, of the French ship *Berceau*, 1864 — namely, 55° 30′ 21″ E.; with those of Mr. Russell, of the *Topaze*, 1820, who made the town in Long. 55° 31′ E. by lunars; and with those of Captain F. Moresby, 1821, who determined the anchorage of St. Anne (two miles eastward from the town) to be in Long. 55° 32′ 45″ E.; hence the longitude of Mahé may be considered as well determined.

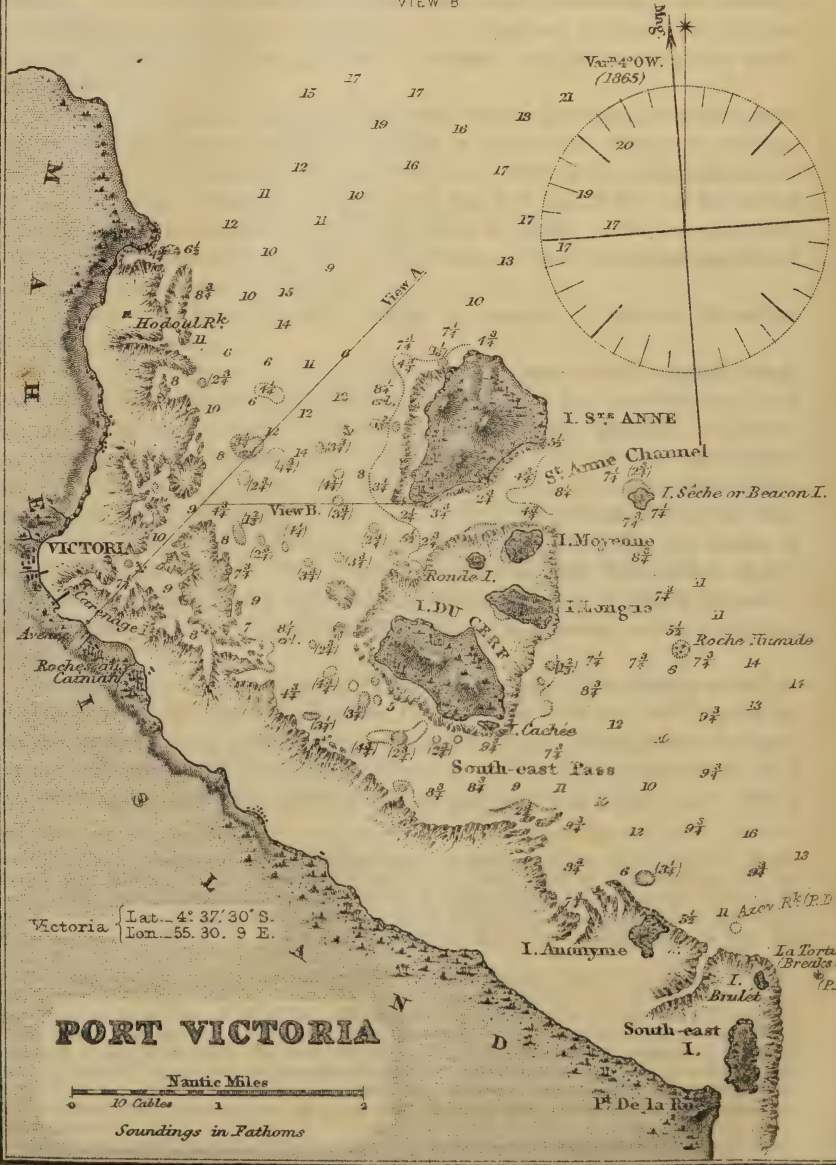
The Abbe Rochon in 1768 observed the S.W. end of St. Anne island to be in Lat. 4° 38′ S., and Long. 55° 35′ E.; and M. Paris, of the French ship *Favorite*, in 1830, determined the same point to be in Lat. 4° 36′ 22″ S., and Long. 55° 29′ 27″ E. We do not know from what meridian this last position by M. Paris was measured, but if from the Cape of Good Hope (supposed at that time to be in Long. 18° 23′ 36″ E., but subsequently determined to be in Long. 18° 28′ 45″ E.), it will be necessary to add 5′ 9″, which will make it 55° 34′ 36″ E. This point of St. Anne island is three miles eastward from the town; hence by these observations the latter will be in longitude about 55° 32′ E., a result differing but little from the longitude previously given.

† See an interesting article on the Seychelles in the "Nautical Magazine," 1839, by G. Harrison, Esq.



VIEW A

VIEW B



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facility of communication, which neither Réunion nor Mauritius possesses; and should it ever become an object to watch the Mozambique channel, or look to the Portuguese or Imaum of Muscat's possessions, Mahé is the place where a squadron would be within a few days' sail, where water and refreshments are easily attainable, and where, during the hurricane months on the coast of Madagascar, or the unhealthy months on the African side, the finest season prevails."

Mahé.—This island is about 16 miles long in a N.N.W. and S.S.E. direction, and 5 miles broad in its widest part—the north end. It is of very irregular shape and nearly 2000 feet high, with lofty, jutting, perpendicular, cliffy peaks, intersected freely by ravines, and plentifully supplied therefrom by water. It is crowned with wood, and may generally be seen from the distance of 36 or 40 miles. The soil is reddish, consisting principally of a decomposed granite, well adapted for vegetable production, and well watered by the streams, natural as well as artificial, from the ravines.

On the west side of the island there are two islets close to the shore, named Therese and Conception, of which the latter is the westernmost; and according to the chart of Captain Owen, there is also a reef at a short distance from its south point. During the S.E. Monsoon there is good anchorage on the west side of Mahé, but heavy gusts come from the high land at a time when the winds are moderate and steady on the east side of the island.

PORT VICTORIA is situated on the east side of Mahé, and is formed by a group of islets 1½ to 3 miles from shore, the two largest of which are named St. Anne and Cerf; the former is most to the north, and it is immediately westward of this islet that vessels anchor. The town is at the entrance to a valley formed by a chain of high mountains, bristling with rugged rocks, and surmounted by large trees; the most elevated of this range of mountains is termed Morne Blanc. The houses are built entirely of wood; they consist solely of a ground floor, and are generally surrounded by fruit-trees within a palisade.* In the roadstead there is accommodation for thirty or forty vessels, but there is not sufficient room to allow all these to select their berths.

The port and roadstead of Mahé were surveyed in 1825 by Captain Owen, R.N., and again in 1846 by MM. Cloué and Leblanc, of the French ship *Berceau*. From these surveys it appears that the coast of Mahé is bordered by a coral reef, which extends out so much as a mile in some places, and that there are three islets on this reef in the vicinity of point Rue (the east point of the island, which forms the south side of the South-east channel to the roadstead); these islets are named Anonyme, Brulée, and Southeast; the latter, which is also the largest, is close to the shore.† Opposite the town there is a channel through the reef in a South-west direction to the shore, having a depth of 12 to 5 fathoms; this channel is called the Inner roadstead.

* Capt. F. Moresby, R.N., wrote in 1821:—"Mahé is without fortifications, and easy to defend, from its precipitous hills and deep ravines; nor could ships approach sufficiently near the town to fire effectually without entering the port, which is narrow and intricate. The trade is carried on in a few small schooners to Mauritius, exporting cotton, cocoa-nut oil, tortoise-shells, &c. The language of the country is French."

† These islets must be very carefully approached, a sunken rock having been reported to be situated at about half a mile eastward from Brulée, the smallest islet. In the Admiralty Chart (No. 721) a rock named Azof is inserted at about a mile northward of this islet,—possibly it is the same rock.

The islands forming the east side of the outer roadstead are surrounded by a coral reef, which connects them more or less together. St. Anne, the largest island, is separated from the others by a narrow channel of 4 to 5 fathoms.

The outer roadstead has a depth of 8 to 10 fathoms on ground good for holding, but there are several coral patches of less than 4 fathoms scattered about, which it is necessary to carefully avoid. The shelter is from all winds but those which come from northward. The best anchorage is said to be in 8 to 13 fathoms, sand, with the centre of St. Anne island bearing east, distant three-quarters of a mile, and the town of Mahé W.S.W. The approach to this anchorage is round the north end of St. Anne, the S.E. channel (between Cerf island and the shore) being intricate and dangerous.

In the inner roadstead the bottom is of white sand, good for holding. If of less than 18 feet draught vessels may run into this roadstead from the outer roadstead by keeping open an avenue of trees situated a little to the left of the city,—which avenue will be immediately recognised as it rises at once from the sea, and has a house at its termination. Strangers require a pilot.

Captain F. Moresby, R.N., says:—"It seldom blows fresh at this roadstead, and never hard. In the S.E. Monsoon, heavy gusts come from the land, in which the wind varies. In this season ships may conveniently lie between St. Anne and Moyenne islands."*

Mahé was visited by Captain Sir E. Belcher, R.N., in 1842, who reported as follows:—"Owing to the transparency of the water, all absolute dangers are visible, and the port or inner harbour may be safely resorted to, where vessels intending to remain any time will find the water smoother and without that swell which renders the outer anchorage (by reason of a heavy ground swell constantly turning in) very unpleasant. We also found the anchorage near St. Anne's rocky, but the pipeclay between the rocks holds well. I would advise any vessel anchoring near that island to run out the stream-anchor astern in the direction of the swell; otherwise, upon any sudden flaw off shore during the night, she may be subjected to a sudden fit of rolling before it can be remedied; and kedges at that moment are liable to injure men as well as boats.

"Although situated so near the equator, the Seychelles do not experience a high temperature; the range is very limited, and the only atmospheric changes which are remarked are the N.W. Monsoons, or gales accompanied by lightning and heavy rains. The hurricanes of Mauritius rarely reach these limits. The two Monsoons, S.E. and N.W., observe nearly the same periods and character as those of Hindostan. The S.E. Monsoon, or dry season, commences in April and terminates in November. The N.W. Monsoon, or rainy season, commences in November and terminates in March. Sometimes, however, the breezes from the south-east die away, and are succeeded by variables, accompanied by rain, but never of long duration."

Silhouette and North Islands.—At 11 miles from the west point of Mahé island, in a N.N.W. direction, is the south end of a high round island, 3 miles across, named Silhouette; and at nearly 4 miles northward of this is North island, also lofty, but of smaller extent. Silhouette is considered to be the most elevated of the Seychelles; it has or had upon it an abundance of timber. It is difficult to land on both these islands.

* It seems possible that there is a mistake here, and Captain Moresby meant "N.W. Monsoon."

In the passage between Silhouette and North islands, the shoalest water is about 14 fathoms, and in that between the islands and Mahé about 30 fathoms.

Praslin.—This island is distant from Mahé about 23 miles in a north-easterly direction, its west point being in Lat. 4° 17′ 24″ S., and Long. 55° 44′ 9″ E. It is very irregular in outline, and of about the same height as Mahé, but it is not intersected by so many deep ravines. The anchorage is on the north-east side of the island, under an islet named Curieuse, which protects it from northerly winds. **Curieuse** is about a mile in extent and of moderate elevation compared with Praslin; its shores are bold, except that which faces the south-east. The anchorage is in the channel formed by this islet and Praslin, and is sufficiently commodious to accommodate a number of vessels, which can ride here at all seasons of the year; the depth is 4 to 10 fathoms.

When at anchor under Curieuse islet, if in a large ship, it will be necessary to avoid a 4-fathoms coral patch lying about half a mile from its south-east shore. From this patch a detached rock off the south-east end of Curieuse is said to bear N. by W., and St. Pierre islet S.S.E. ¼ E.

Dangers between Mahe and Praslin.—At about four miles northward from the anchorage at Mahé are two rocks, named Brisans (or the Breakers), which bear from each other S.E. ½ E., and N.W. ½ W. At three-quarters of a mile N. by W. from the northern Brisans there is a small coral patch of 6 fathoms. The Mammelles, 40 feet high, is distant 4½ miles N.E. ¾ E. from the Brisans, and 15 miles W.S.W. from the south-east end of Praslin; between it and the Brisans the ground is uneven, as from 7 fathoms the lead will drop into 13 and 15 fathoms. At a musket-shot from the Mammelles there is a rock, 6 feet under the surface, upon which the sea generally breaks, but in calm still weather it is difficult to be seen;—a sunken rock also lies at two ships' length from the north end of the Mammelles. Half way between the Mammelles and Praslin are the Madge rocks, two dangerous rocks covered at high tide, distant from each other between two and three cables' length N.E. and S.W.;—in the South-east Monsoon the sea generally breaks high upon them; but to Captain F. Moresby, R.N., who passed them in 1821 within two cables' length, the southernmost appeared now and then above water, and the position of the northernmost was only indicated by the reflux of the sea;—the marks for these rocks are the highest point of St. Anne in one with the Mammelles; the south point of La Digue E.; and Silhouette W. ¾ S. The Trompeuse, a bed of rocks, E. by N. ¼ N., 3 miles from the Madge rocks, has obtained the name (*trompeuse*—deceitful), from having been frequently taken for the Madge rocks. North-eastward from Trompeuse are two islets named the Cousins, and the channel between is said to be so full of rocks that a vessel cannot pass in safety; but between the Cousins there is a safe channel, and also between the North Cousin and the reef extending from Praslin. The Baleine or Whale rocks are said to lie at about 2½ miles N. ¾ W. from the North Cousin, with Miller's point, the west end of Praslin (near which is a sunken rock) bearing E. ⅓ S. 1½ mile; Booby islet N.E. by N. 2½ miles; and the highest part of Aride islet N. ¾ E. 5 miles.

Captain F. Moresby says:—"The Baleine is a small dangerous rock, covered at high tides. I sought for this rock, but not having any decisive marks could not find it; it is, however, frequently seen, and generally awash at half-tide. W.N.W. from the North Cousin there is a coral patch half a mile distant, having 2½, 3, and 4 fathoms upon it. I passed between this patch and the Baleine, steering for Booby

islet, and left on the starboard hand a coral patch of 4 fathoms, situated half way between Booby islet and the north-west point of Praslin. When Booby and Aride islets are in one, bearing N. ¾ W., Mary Anne island being just open of Curieuse islet, a ship may haul up with safety to anchor or pass between Curieuse and Praslin." *

Reciffe.—This island is only about 1½ miles in length, but of not less than 150 feet in height. It has a remarkable rock, like a building, on its summit, which is white in colour, owing to the almost innumerable birds that resort to it. Its position is about 18 miles eastward from port Victoria, being in Lat. 4° 34′ 48″ S., and Long. 55° 50′ 9″ E. The *Menai*, Captain F. Moresby, anchored here in 1821, at about 1¼ miles N.N.W. from the island, in 17 fathoms, sand and shells.

Frigate Island. — The centre of Frigate island, the easternmost of the Seychelles, is in Lat. 4° 35′ 12″ S., and Long. 56° 1′ 9″ E. This island is about 2½ miles long, and 550 feet high; it should be cautiously approached, because a reef of rocks lies off its south-east end, and there is also probably a reef off its north end. Ships running for port Victoria in hazy weather will pass this island before Mahé comes into view, and will even sometimes reach so far as Reciffe island. The island is inhabited, and has anchorage under its lee.

Lelot Island is a small islet on the south-west side of Frigate island, from which it is distant about 2 miles. In the channel between, the depth is 15 to 19 fathoms; some sunken rocks are inserted in Captain Owen's chart close to Lelot; in other respects the channel appears safe.

Chimney Rocks.—At about 8 miles N.N.W. ¼ W. from Frigate island there is a bed of rocks called the Chimneys, situated nearly midway between Frigate and La Digue Islands;† and W.N.W. 1½ miles from these is a dangerous rock, covered at half-tide, named in Owen's chart Renommée, but in the French chart (No. 1205) Le Cauman; in the channel between the depth is 15 to 20 fathoms. The Alligator and Shark are situated 4 miles W. ½ S. from the south point of La Digue, and at nearly 3 miles S. ¾ W. from the south end of Praslin. These comprise all the known rocks between Frigate and Reciffe islands on the south, and Praslin and La Digue islands on the north; but there are reasons for believing that the channel has not been sufficiently explored.

La Digue is about 3 miles in extent, and its highest part is in Lat. 4° 21′ 12″ S., and Long. 55° 55′ 9″ E. It is surrounded by a reef, and landing is difficult. The channel between this island and Praslin is about 3 miles wide, and has a general depth of 13 to 15 fathoms, but there are two dangerous rocks in mid-channel, distant from each other nearly a mile in a S.S.E. and N.N.W. direction, which are covered at half-tide. Captain F. Moresby sounded round the southernmost rock, and had a depth of 6 fathoms at a boat's length from it, and 12 fathoms at a ship's length, and recommended that an attempt to pass between them be avoided until the passage is better known.

In the direction of S.S.W., or 3 miles from the Round island (joined to the east end of Praslin by a coral reef), there are two rocks above water, named Requiems,

* There appears to be a mistake here, for in Captain Owen's chart Mary Anne island is eastward of Félicité island, and we should say not visible from the position alluded to.

† At about 1½ miles eastward and north-eastward from the Chimneys are said to be some rocks awash, on which the French frigate *Regenèrre* was nearly lost. These rocks are not inserted in any chart (French or English) that we have seen, and we suspect that they have been mistaken for the Chimneys.

which bear from each other about N.N.E. and S.S.W., distant two or three cables' length. The south point of La Digue, in one with the south point of Mary Anne island, will lead to them.*

Félicité, Mary Anne, and the Sisters are some small islands situated north-eastward from La Digue. The position of the north peak of Mary Anne, the eastern-most island, is Lat. 4° 19′ 24″ S. and Long. 56° 0′ 39″ E. At the south-east end of Félicité island there is a detached rock. A rock above water, named Ave Maria, lies between these islands and Praslin, at about 1½ miles eastward from the latter, and is reported to have a shoal projecting south-westward from it about a cable's length; this rock has a depth of about 11 fathoms in its immediate vicinity.

Between the Sisters and Praslin the ground is very uneven and rocky, the depth being from 6 to 25 fathoms. The channel between the Sisters and Félicité is reported to be safe, the only known danger being a bed of rocks, partly under water, which extends southward from the Sisters.

In the vicinity of the Sisters, two rocks are inserted in charts, on the authority of M. Vailheu of the French ship *Madagascar*, 1834. The first is 8 feet under the surface, and its position is about 2 miles N.W. from the western Sister; the second, named Mellow, also under water, is 5 miles North from the same island. The existence of these rocks requires confirmation.

Dennis is the north-easternmost of the Seychelles; its centre is in Lat. 3° 48′ 12″ S., and Long. 55° 43′ 21″ E. This island is about 1¼ miles in extent North and South, and has or had several thatched habitations on its northern side; it is very low, covered with trees, and may be seen from a ship's deck about 12 miles. Captain F. Moresby says:—"A reef appeared to project from its southern end, nearly a mile, with discoloured water beyond it; and a coral bank or spit extends from it to the northward 2 miles, upon which we shoaled suddenly, and found 3 to 5 fathoms, and there may be less water upon some of the patches. In approaching the island from the south-eastward, the soundings at 3 and 4 leagues' distance are from 25 to 30 fathoms, sand, coral, and shells; and when the island bears from S.W. to S. 4 miles, you are off the spit that stretches out from its northern extreme. If you suddenly shoal under 10 fathoms when passing, immediately haul out to the northward or N.E. From 10 fathoms the soundings gradually deepen as you stand to the N.W., and the bank slopes down to 40 fathoms when the island disappears from the deck. As this island is near the north-east extremity of the great bank of soundings which circumscribes the Seychelles archipelago, it is convenient for a ship to sight it when proceeding by the southern passage for the Arabian gulf, there being no known danger to be met with when steering for it in the night if the lead be kept going, which will give timely warning of an approach to it from any direction."

Bird or **Sea-Cow.**—This, the northernmost of the Seychelles, is a small, low, sandy island, of not more than 1 mile in extent North and South, and very narrow. Its centre is in Lat. 3° 45′ 42″ S., and Long. 55° 15′ 39″ E. Upon it there are or were a few shrubs. A coral reef which surrounds it is said to extend from it about 1½ miles. The island has been described as but little else than a coral reef surmounted by dry sand; and it is also stated that a bank extends from its south end, upon which is a depth of 9 fathoms, sand and coral, at 6 miles distance from it. If so unfortunate as to be lost on this island, it is probable that water may be obtained

* We suspect that these are the Alligator and Shark rocks, already mentioned.

by sinking a pit in the sand, the crew of the *Hirondelle*, a wrecked French ship, having sustained life by this means.

Reefs and Shoals.—The great Seychelles bank has not been fully explored, and it is probable that there are shoals upon it which have yet to be inserted in charts. The ANDROMACHE shoal is a shoal of 5 to 20 fathoms, situated in the north-western part of the bank, in Lat. 3° 50′ S., and Long. 54° 53′ E.; it was discovered by H.M.S. *Andromache*, in 1835, and its extent, and the possibility of there being less water than 5 fathoms, were not ascertained. The SWAN, a shoal discovered by a whaling ship of that name in 1824, situated in *about* Lat. 4° S., and Long. 54° 37′ E., is reported to be 5 to 6 miles in extent, and to have soundings upon it of 3 to 9 fathoms on coral.* The DUPONT, a shoal of 3½ fathoms, in Lat. 4° 15′ S., and Long. 54° 28′ E., is inserted in charts upon the authority of M. DUPONT. In the eastern part of the Seychelles bank, the brig *Zoroaster* is reported to have passed over a coral bank, in about Lat. 5° S., and Long. 56° 40′ E., sounding in 7 fathoms; it was believed that there was shoaler water in the neighbourhood.

Upon the Seychelles bank the depths are generally from 14 to 45 fathoms, but there is less water in some parts. As before observed, its eastern and southern limits have not been ascertained. The soundings at about 20 miles eastward from Frigate island are reported to be 8, 10, and 12 fathoms for a considerable distance; but this does not agree with CAPTAIN OWEN'S chart, in which the depth is shown to be 22 to 50 fathoms. The *Mary* is said to have had 11 fathoms, rock, at about 18 leagues eastward from Mahé, in a part of the bank where 30 fathoms is supposed to be the average depth. A patch of 3½ fathoms, which may be identical with the Dupont shoal, is also reported to be situated on the edge of the bank, in a direction due West from Silhouette; but it was sought for unsuccessfully by the *Wizard*, in 1821.

KEELING ISLANDS.

Keeling Islands.—This group of islets occupies an extent of nearly 8 miles; they are about twenty in number, and the largest is 5 miles long. All are very narrow, and most of them are separated only by narrow channels sufficiently shallow to be fordable at low tide; there is, however, one exception to this rule, and it is where Horsburgh island, the northern isle, is separated from Direction island by the deep channel forming port Refuge. This deep channel leads into the basin in the centre of the lagoon, where is anchorage in 5 or 4 fathoms on coral, or sand and clay, according to the locality. Every island is so thickly covered with cocoa-nut trees that it is difficult to make way through them. About nine varieties of other trees are found intermixed with these, palm trees, &c.; but, comparatively speaking, these form only a very small part of the verdure of the islands. Fresh water is easily obtainable in all parts of the islands at about two feet below the surface,—the springs rising and falling with the tide; the difference between high and low water in the basin being about 5 feet. A line of shelving rock, extending outwards from fifty to a hundred yards, surrounds the outer or sea-front of all the islands. The surf is very violent at high tide, but at low water a person may wade to the edge of the

* The SWAN may not be the only shoal in this vicinity. In the original report the position given was Lat. 3° 55′ S. to 4° 1′ S., and Long. 54° 42′ E. This part of the Seychelles bank has not been examined.

margin of this coral bank, and absolutely look down into an unfathomable sea. So small is the base of the group compared with its upper surface, and so little do the sides diverge from the perpendicular line.

It was attempted to form a settlement on these islands many years ago, under the charge of Captain J. C. Ross, with the view to afford supplies to India and China vessels. The settlement flourished a short time, and, after various vicissitudes, was abandoned.

The position of the south-west point of Direction island, the north-east island of the group, is, according to Admiral Fitzroy, who surveyed the islands in 1836, Lat. 12° 5′ 40″ S., and Long. 96° 53′ E.

The **North Keeling**, an island similar in appearance and in formation to those just described, is distant N. 2° 30′ W. (*true*) 14 miles from the west end of Horsburgh island, the northernmost of the cluster. It is not more than a mile in extent, is surrounded by a coral reef, and encloses a lagoon.

Admiral Fitzroy has thus described these islands:—

"When the islands came into view we saw them right ahead, distant about 16 miles. A long but broken line of cocoa palm trees, and a heavy surf breaking upon a low, white beach, rising not many feet above the foaming water, was all we could discern till within 5 miles of the larger Keeling (there are two distinct groups); and then we made out a number of low islets nowhere more than thirty feet above the sea, covered with palm trees, and encircling a large shallow lagoon. We picked our way into port Refuge (the only harbour), passing cautiously between patches of coral rock, clearly visible to an eye at the masthead, and anchored in a safe, though not the best berth. We subsequently sent out our boats in all directions, though there was so much wind almost each day as materially to impede surveying. Soundings on the seaward sides of the islands could seldom be obtained, but two moderate days were eagerly taken advantage of to go round the whole group in a boat, and get the few deep soundings which are given in the plan. The two principal islands (considering the whole southern group as one island) lie north and south of each other, 15 miles apart; and as soundings were obtained 2 miles north of the large island, it may be inferred, I think, that the sea is not so deep between the two as it is in other directions. Only a mile from the southern extreme of the South Keeling I could get no bottom with more than 1000 fathoms of line.

"The southern cluster of islets encircle a shallow lagoon of an oval form, about 9 miles long and 6 wide. The islands are mere skeletons, little better than coral reefs, on which broken coral and dust have been driven by sea and wind till enough has been accumulated to afford place and nourishment for thousands of cocoa palms. The outer edges of the islands are considerably higher than the inner, but nowhere exceed about thirty feet above the mean level of the sea. The lagoon is shallow, and almost filled with branching corals and coral sand. The small northern island is about a mile in diameter, a strip of low coral land, almost surrounding a small lagoon, and thickly covered with cocoa-nut trees."

Another description of the islands is as follows:—"Port Refuge has only one entrance for ships, which is at the northern part of the lagoon, and the navigable channel is only half a mile wide; this is bounded on the west side by Horsburgh island, the northernmost of the chain, and considerably detached from the others, and by Direction island on the east side. Straggling rocks, and an extensive reef, called Turk reef, stretch from Horsburgh island to the S.E. and S. 1¼ miles, and

to the S.S.W. $3\frac{1}{4}$ miles, uniting with Ross island, which forms the west side of the harbour, and is 5 miles in length. Scott island is in the form of a crescent, and lies at the S.E. angle of the harbour, the south and west sides of which are bounded by the coral reef. From the north end of Scott island, the east side of the harbour is encircled by a close succession of small isles, stretching to Clunie island, which approaches near to Direction island, there being only a few islets between them. This coral chain of islands, or rather *wall*, in the middle of the ocean, is elevated only from 3 to 10 feet above the sea at high water spring-tides. Most of the isles are covered with cocoa-nut trees, and two other species,—one of them soft, white, and spongy—the other heavy, hard, dark-looking, timber. The cocoa-nuts contiguous to the sea have a saline taste, and are small; but those in the middle of the islands are good. The beaches abound with land crabs, aquatic birds, and turtle.

"Soundings will be got suddenly when on a transit-line joining the two islands that form it, and when inside about a mile, having brought the north extreme of Direction island to bear about E.N.E.; you should cast anchor in 4 or 5 fathoms in the outer anchorage, which is perfectly smooth, and not proceed farther until you have examined the channels leading to the east or west harbours inside. These harbours are separated by a large rocky shoal in the middle of the port, called Dymoke shoal, or Middle ground, having on it from $1\frac{1}{4}$ to $2\frac{1}{2}$ fathoms water. The southern extremity of the port also is very shoal. The outer anchorage is sufficiently capacious to contain a great number of ships, but is in some parts spotted with *mushroom* coral, which may easily be avoided in anchoring, as the water is very clear. The bar, or flat, inside the outer anchorage, is extensive, also spotted widely with coral, and all the rocks are of this substance.

"Ships drawing above 18 feet should not attempt to sail in over the bar; but if on an emergency they do so, the coral patches may be avoided by a careful person on the foreyard directing the ship's course. These patches are elevated two or three feet above the natural level of the bottom, and being of the mushroom species, of a darkish colour, are easily discerned at a considerable distance, as the water is extremely clear, and the sandy bottom of snowy whiteness.

"Ships drawing about 21 or 22 feet, intending to go inside, may warp over the bar, and afterwards choose either the Eastern or Western harbours at discretion, taking care to avoid Dymoke shoal, which is an extensive coral flat with overfalls near its edges, and (lying on a dark bottom) is not easily discernible. The depths on the bar are 3 to $3\frac{1}{2}$ fathoms, and the best track is a little nearer to the islands (on the eastern side) than mid-channel, the depth increasing when over the bar from 4 to 6 fathoms,—avoiding the corally heads in approaching the inner harbour on either side of Dymoke shoal."

CHRISTMAS ISLAND.

Christmas Island, the north end of which is situated in Lat. 10° 27′ S., and about Long. 105° 33′ E., is an island 10 miles across, of square form, and of sufficient elevation to be visible from a distance of nearly 40 miles. It is precipitous all round, and no bottom was obtained at a cable's length from shore, sounding with a line 100 fathoms long; there is consequently no anchorage off the cliffs. It is possible to land on its north-west side on a beach composed of white sand and coral. The only animals it supports are probably wild hogs.

LACCADIVH ISLANDS.

This archipelago of islands and banks is situated between Lat. 10° and 13° 50′ N., Long. 71° 45′ and 74° E.* They are in general so low as to be visible only at a very short distance; hence the greatest care is necessary when approaching any of them. Many of the islands are surrounded by a steep coral reef, at a short distance from which soundings are lost in the depth of 100 fathoms. The islands were surveyed by Lieutenants Moresby, Selby, and Taylor of the Indian Navy, 1828—1848; they may be traversed with safety in fine weather, provided a good look-out is maintained, and the large chart (the result of the survey) is at hand for reference.†

Cora-divh is the northernmost of the Laccadivhs. It is a bank of 23 to 30 and 48 fathoms, extending between Lat. 13° 34′ and 13° 52′ N., and between Long. 72° 4′ and 72° 14′ E. Its average width is about 5 miles, and close to it there is no bottom at the depth of 100 fathoms. The shoalest part appears to be near its north-east edge, where soundings of 23 and 24 fathoms prevail for some distance. The bank is composed of sand, decayed coral and broken shells.

Sesostris Bank (a bank of 11 to 63 fathoms) is situated between Lat. 13° 0′ and 13° 14′ N., Long. 71° 52′ and 72° 5′ E. It is about 10 miles wide in its broadest (the western) part, whence it tapers to a point in a south-east direction; it is in this, the narrow part, that the shoalest water, 11 fathoms, is found. Soundings of 12 and 13 fathoms may also be obtained near its north-eastern edge. The bank is very steep, there being no bottom at 100 fathoms close to it all round.

Munyal-Par (Bassas de Pedro or Padua Bank).—This extensive bank extends from Lat. 12° 30′ to Lat. 13° 37′ N., between the longitudes of 72° 16′ and 72° 44′ E. It is nowhere more than 14 miles wide (in the middle only 7 miles), and has upon its soundings of 21 to 34 fathoms, sand, decayed coral and shells, being similar in its formation to Corà-divh and Sesostris banks. The northern end of the bank appears to be its shoalest part. Close to it all round there is no bottom at 100 fathoms.

Beleapani (Cherbaniani Reef) extends from Lat. 12° 16′ to 12° 24′ N., its centre being in Long. 71° 53′ E. It consists of coral rocks, mostly visible at low water, and is so steep that at half a mile from it there is no ground at 100 fathoms. Upon it are two sand-banks dry at low tide. This reef is very dangerous, as the sea does not always break upon it; high breakers have, however, been seen in its western part, when the sea was otherwise smooth. It is high water on the days of full and change of the moon at 10h.; springs rise 7 feet and neaps 4 feet. During the survey the flood was observed to flow to the north-eastward.

Chereapani (Byramgore Reef).—This very dangerous reef extends from Lat. 11° 48′ to Lat. 11° 59′ N., and between Long. 71° 44′ and 71° 50′ E.; it consequently has an extent of about 11 miles. For about two miles from its north end there are soundings over it of 4 and 6 fathoms, but all the remaining part of the

* The longitudes in our description of this archipelago of islands are dependent upon Bombay Observatory, recently ascertained to be in Long. 72° 48′ 4″·5 E. This is considered to be a well-determined position, and has been taken as a meridian in determining the longitudes of many places on the west coast of India, coast of Arabia, and islands in the Indian Ocean. Bombay (Kolaba) lighthouse is in Long. 72° 48′ 0″·5 E; and Bombay Flagstaff is 1′ 35″ east of the observatory, consequently in Long. 72° 49′ 39·5″ E.

† Published by the Hydrographic Office, Admiralty, No. 93. See also the plan of the Laccadivhs in the sheet of Plans of Islands in the Indian Ocean, published by Messrs. Imray & Son.

reef consists of coral rocks, more or less near the surface of the water. When the reef was examined by LIEUTENANTS SELBY and TAYLOR, the flood was observed to flow over it in a N.E. direction. "The bank, which is very steep, closely surrounds the reef, except to the N.E., where it projects 3 miles beyond it, with soundings from 4 to 8 fathoms. The coral rocks forming the reef are just discernible at low water, and the bottom is distinctly visible on the bank; but, as there are no soundings near this or the Beleapani, the approach to them is very dangerous, as the noise of the surf would not be heard unless a ship were to leeward in calm weather; and the current frequently sets 12 or 15 miles during the night, in uncertain directions, although usually between S.E. and S.W. during the months of February, March, and April."

Betra-Par is a coral reef extending between Lat. 11° 28′ and 11° 35′ N., Long. 72° 6′ and 72° 10′ E. In its northern part there is a low sandy islet having trees upon it (1848); and near its south-eastern edge is another, in the immediate vicinity of which are some rocks above water causing heavy breakers in tempestuous weather. There is said to be a gap in the reef close under the south side of the principal islet, where boats may lie for a short time, the depth being 2 fathoms. The reef is believed to be very steep, although in the chart a sounding of 12 fathoms is inserted close to its south end, and another of 39 fathoms immediately off its eastern side at two miles from its north end; its western side has not been sounded.

Chitlac is a small, low islet in Lat. 11° 41′ N., Long. 72° 41½′ E. A reef extends from its western side about 1½ miles, almost close to the edge of which is deep water. Its eastern side is very steep, there being no bottom at 70 fathoms at half a mile off. During the examination of the islet the flood was observed to set N.E. by E.

Kiltan.—This islet is 2½ miles long N.N.W. and S.S.E., and has a reef extending about 1½ miles from its west side. The island and the reef are both steep, there being no bottom immediately off them at 90 fathoms. Position: Lat. 11° 28′ N., Long. 72° 58′ E. When the survey was in progress the flood-tide was observed to flow E.N.E.

Peremul-Par is a sandy islet in Lat. 11° 9′ N., Long. 71° 59′ E.—(observations for latitude not good). It is situated at about two miles within the north-east end of a triangular-shaped reef, having an extent of about 7 miles, the base of which faces the north. The soundings close to the north-west side of the reef are 6 to 25 fathoms; other parts of it do not appear to have been examined.

Aucutta, Bingaro, Tingaro.—These three islands are seated on a reef which extends from Lat. 10° 48′ N., Long. 72° 7′ E. to Lat. 10° 56′ N., Long. 72° 19′ E. Aucutta, the westernmost island, is about 3 miles long N.E. by N. and S.W. by S., and half a mile broad. It is, or was, inhabited, and in 1848 there were cocoa-nut trees upon it. A small islet, named Calpooty, lies a mile from its south point, to which it is joined by a reef; and it is said that there are soundings at a short distance southward from this islet. "From Calpooty a coral reef projects westward and north-westward in the form of a semicircle, distant 1½ miles from the west side of Aucutta, and joins to the bank at its north end. On the edge of the reef, directly west from the northern extremity of the island, are soundings where a vessel might anchor in case of necessity, but the bottom is of coral rock."

Bingaro and Tingaro (the former is the westernmost and distant 6 miles from Aucutta) are two small islets surrounded by a coral reef. They are separated from Aucutta by soundings of 5 to 15 fathoms, where vessels may anchor if necessary.

The edges of the reef upon which Aucutta, Bingaro, and Tingaro are seated, are probably steep, like those of other reefs of the Laccadivhs. They do not appear to have been sounded, except at a short distance eastward from Aucutta, where no bottom was obtained at 100 fathoms.

Cardamum is an island 4 miles long N. $\frac{3}{4}$ E. and S. $\frac{3}{4}$ W. and scarcely a mile wide. Its centre is in Lat. 11° 13′ N., Long. 72° 44′ E. A coral reef surrounds it, stretching off from its west side about 2 miles. It is said that there are soundings of 16 and 20 fathoms near the south point of its reef, or at about midway between the island and Ameni, an island 5 miles S.S.W. from it. Cardamum has not been thoroughly surveyed.

Ameni is a small island in Lat. 11° 5′ N., Long. 72° 41′ E. It is of circular form, about $1\frac{1}{2}$ miles across, and surrounded by a reef which on all sides except the south-west extends out nearly a mile; on this side, the depth at a very short distance from it is 8 to 15 fathoms.

Pittie.—In Lat. 10° 45′ N., Long. 72° 31′ E. is Pittie, a small sandy islet, or bank, so little above the sea that during heavy tempestuous weather it is flooded. It is destitute of verdure, and generally covered with birds. HORSBURGH says, "On the east side of the bank, there is a black rock resembling a wreck. This sandy islet or bank seems to present an area of not more than two acres, and is probably in part inundated during the S.W. Monsoon. From Pittie, an extensive rocky bank of soundings projects 3 leagues to the N.W. towards Tingaro, and about 7 leagues N.E. towards Ameni; hence it stretches southward nearly on the meridian of Cabrutee, within 4 leagues of that island. The soundings on this bank, so far as it has been examined, are from 6 to 20 fathoms." It is believed that a deep water channel separates the bank from Ameni.

Cabrutee.—This island is about $2\frac{1}{2}$ miles long N.E. and S.W., and 1 mile broad, and is, or was, covered with cocoa-nut trees; its position is Lat. 10° 30′ N., Long. 72° 37$\frac{1}{2}$′ E. Its east side is, we believe, clear of danger, but not so its north-western and southern sides, whence a reef projects westerly $2\frac{1}{2}$ miles. At the north-east end of the island there is an opening in the reef, and openings occur also in other parts which are navigated by the native vessels. At the south-west end of the island there is a coral spot on the extremity of the reef where a vessel may anchor if necessary, with a chain fixed to a small anchor. During the examination of the island the tide was observed to have a velocity of two miles an hour.* Water may be procured on the island.

Seuheli-Par.—At about 32 miles from Cabrutee in a south-westerly direction, is the north-eastern end of an extensive reef, named Seuheli-Par, the edges of which are believed to be steep, like those of all the reefs hitherto described. This, the south-westernmost of the Laccadivhs, is situated between Latitudes 9° 57$\frac{1}{2}$′ and 10° 6′ N., Longitudes 72° 7$\frac{1}{2}$′ and 72° 16′ E.; it is very dangerous, as it cannot be seen beyond a very moderate distance, and the currents in its vicinity are strong, especially on the days of full and change of the moon, when the rise of tide is about 6 feet. Many of the black rocks are said to be of considerable height above the water. Upon the reef are two low islets, $6\frac{1}{2}$ miles apart N.N.E. and S.S.W., named

* It may here be observed that usually the currents among the Laccadivhs do not set directly upon the islands, but generally *along* them, or along the edges of the reefs, which lessens the danger to be apprehended in calms.

Seuvelli and Seuheli; of these, the former is situated at its north-eastern end, and the latter at its eastern side in nearly the middle of the reef. These islands are not inhabited, except in the fine season, when they are resorted to by the natives of the other islands for fishing. The water procured from them by digging is brackish and unfit for use. On Seuvelli a kind of soft wood may be cut for fuel; the trees on Seuheli are cocoa-nut, yielding fruit of a saline quality, and very unpalatable.

From Seuvelli a coral spit extends out about a mile in a northerly direction, with soundings upon it of 5 to 12 fathoms. It is here apparently that the only known passage over the reef is to be found, leading to Seuheli; it is navigable solely by boats.

On the chart of the Laccadivhs (to which reference has been made) it is remarked that from a distance of 20 miles westward of the Seuheli-Par no dangers were visible,—we supposed in the direction of the reef; there is consequently, we think, no reason for supposing that there are other reefs in the vicinity of its western side, nevertheless the following will be a caution to shipmasters approaching it from westward:—"April 9th, 1804. At 11 o'clock P.M. the ship *Anne*, from the Red Sea, struck on a reef, and bilged before day-light. From the wreck, Seuvelli, the northernmost island, bore E.S.E. 4 or 5 leagues, and Seuheli-Par S.E. about 6 leagues; the reef from S.W. to E.N.E. being 10 or 12 miles in extent." HORSBURGH has observed in reference to this report, that the distance estimated from the wreck to the islands is certainly too great, for they could not be discerned so far; but if the bearings are tolerably correct the reef upon which the wreck occurred is farther from the islands than hitherto supposed.

Elicalpeni Bank lies between Latitudes 11° 10′ and 11° 15′ N., Longitudes 73° 55′ and 73° 59′ E., and has consequently an extent of about 5 miles; but this is uncertain, as the *Premier*, in 1835, is said to have sounded in 9 to 3¾ fathoms in Lat. 11° 16′ N. when she supposed herself northward of the bank.* It is wholly composed of sharp coral rocks, and according to LIEUTENANT MORESBY has a depth over it of 7 to 15 fathoms. It is probable that the sea breaks upon it in heavy tempestuous weather.

Underoo is a small low island about 3½ miles long East and West and 1¼ broad, the centre of which is in Latitude 10° 47′ N., Longitude 73° 40′ E.; it is, or was, covered with cocoa-nut trees, and is said to afford tolerable water. The island is seated on a reef of coral, through which there is but one known passage, and this is only navigable by boats. From it a coral bank, having over it a general depth of 7 to 9 fathoms, extends 8 miles to the northward, and about the same distance to the north-eastward: there is, however, upon it a spot of 10 and 12 fathoms, sand, at about a mile northward from the island, where vessels may anchor. The edges of the bank are steep, and at a short distance southward from the island is deep water. The island and bank are situated between Latitudes 10° 46′ and 10° 55′ N., Longitudes 73° 34½′ and 73° 46′ E.

Kalpeni.—Between Latitudes 10° 3′ and 10° 9½′ N., Longitudes 73° 33′ and 73° 37′ E. is Kalpeni bank, upon the eastern side of which are two low islets; of these the southern and largest is named Kalpeni, the northern Cheria. These two islands are joined together at low water by a dry reef, and close to the south-west

* If we suppose a small error in latitude, the vessel obtained soundings on the bank itself; but the depth, 3¾ fathoms, is much less water than was found by LIEUT. MORESBY during his survey in 1828, or by CAPT. MCCLUER, who anchored upon it in 1790 in 6 to 6½ fathoms.

end of Kalpeni are two islets. Some of the rocks on the west part of the bank are above water. According to CAPTAIN MCCLUER, 1790, Kalpeni bank is steep on the outside, with high breakers, and there are no soundings till close to the surf; through one part of it there is a narrow channel with only $1\frac{1}{2}$ and 2 fathoms water, and from 3 to 4 fathoms on the coral flat inside. The boats of the natives lie at the south-west part of the island, nearly south from the gap or channel in the reef, about miles distant. The southern island, where are a few small villages, is well planted with cocoa-nut trees, and has soundings off its south end of 9 or 10 fathoms, coral. Kalpeni is the south-easternmost of the Laccadivhs.

Minicoy.—Although this island is nearer the Maldivhs than the Laccadivhs, it is considered to belong to the latter; its centre is in Lat. 8° 17′ N., Long. 73° 3′ E.; it is consequently distant from Kalpeni 108 miles in a S. by W. $\frac{1}{2}$ W. (*true*) direction. It is $6\frac{1}{2}$ miles long and half a mile broad, and so low that it cannot be seen from a distance exceeding 6 to 10 miles; upon it are cocoa-nut trees, and it is said to be well peopled. From its north-west side a reef extends 3 to 5 miles. On the reef near the west point of the island there is an islet with trees upon it, and at the north end of the island there is a narrow and intricate passage through the reef having a depth of about 2 fathoms. Within the edge of the reef is deeper water, as small vessels may there anchor in $2\frac{1}{2}$ and 3 fathoms on coral.

MALDIVH ISLANDS.

The following description of this group of islands is by COMMANDER MORESBY of the Indian Navy, 1839, who with LIEUT. POWELL, also of the Indian Navy, surveyed the Maldivhs during the years 1834–6. All the longitudes depend upon that assigned to Bombay Observatory, namely, 72° 48′ 4″·5 E.*

"Navigators in general are not aware, more particularly those coming from Europe, that the whole group of the Maldivh islands are inhabited by a civilized race of people, who carry on a considerable trade with the British possessions in India; more particularly Bengal, Ceylon, and the Malabar coast, as also to the Red Sea; and are expert navigators and sailors. Schools for teaching navigation are on some of the islands. They make and repair nautical instruments, such as the astrolabe and quadrant. On one occasion I was much surprised in seeing a wooden sextant very neatly made by them; the glasses and telescopes had been fitted from old instruments; they copy our nautical tables, generally using our figures, and translate the rules in our navigation books into their own language. They are an inoffensive, timid people, and there appears far less crime among them than with more polished nations; murder is not known among them, nor is theft or drunkenness; being strict Mohammedans, they are forbidden the use of spirituous liquors, which could be easily made from the fermented juice of the cocoa-nut tree, which they have in abundance.

"They are governed by a sultan, whose title and rank are hereditary; under the sultan are five viziers or ministers of state, as also a head priest, and judge, civil and religious; the hendeggeree, or custom master, is also a very great man; and

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* See the Note at foot of page 585. Refer also to the chart of the Maldivhs in three sheets, published by the Hydrographic Office, Admiralty, No. 66 a, b, c. Also to the plan of the islands in the sheet of plans of islands in the Indian Ocean, issued by the publishers of this work.

last of all is the Emir el bahr, or master-attendant of the port; all these reside at Malé, or King's Island.

"To the different Atolls are appointed one or two chieftains, or as they are styled Atoll Warrees; as also a Catib to each Atoll; the catib is priest and judge. Every Atoll pays a certain fixed revenue, a portion of their produce, to the Government at Malé, and none are allowed to trade with foreigners or strangers, except at Malé.

"The men, in appearance, are of a dark copper colour, rather short, and in person not unlike the natives of Ceylon and the Malabar coast; but their language is totally different; their women are not pretty, and are extremely alarmed at the sight of strangers. These islanders have been more than kind in their hospitality to ship-wrecked mariners, which was exemplified in their humane and liberal conduct towards the commander, officers, and crew of two vessels, the *Adonis* and *Vicissitude*, which were totally wrecked during the night, one on Colloomando Atoll in 1835, and the other on Heawandoo Atoll in 1836; nor would they accept of any payment, though liberally offered it by the Government of India; they accepted of presents from our Government as a mark of friendship, of which I had the honour of being the bearer. During the two years we were employed surveying among these islands, and in constant intercourse with them, they always treated us with kindness and respect, yet with shyness and suspicion, supposing our motives for making a minute survey of their islands had other ends than to guide shipping in their navigating to India. However, I think we left them with mutual good feeling and understanding, which, I hope, will not be broken. Further information respecting these curious islands will be found in several papers written by myself and officers, and published by the Bombay Geographical Society.

"The **MALDIVH** islands and Atolls extend from Lat. 7° 6′ 20″ N. to Lat. 0° 42′ S., and between Long. 72° 33′ and Long. 73° 44′ E. In this space there are nineteen Atolls, or groups; in the centre of the group the Atolls lie in double rows—east and west Atolls—with a space between them from 10 to 25 miles; at the north and south extremes, the Atolls lie singly. Between the whole of these Atolls are good channels for ships; in them there are no soundings, not even close to the outside of islands and reefs of the Atolls. The channels and their navigation I shall mention hereafter, as they follow in succession from north to south. A few preliminary remarks for a navigator will be requisite before I describe the channels and Atolls.

"It is only the three or four larger channels that ships ought to pass through at night time, which are as follow:—

"1. The **Cardiva Channel**, called by the natives CARDOO KANDOO, whose breadth is 25 miles, and length 67 miles; its direction, N. 63° E., and S. 63° W.; the centre of its west entrance is in Lat. 4° 34′ N., and Long. 73° 41′ 48″ E.; its eastern entrance in Lat. 5° 5′ N., Long. 73° 41′ 48″ E. The navigation of this channel is hereafter described.

"2. The **Vaimandoo Channel**, formed between the Atolls Colomandoo and Adou-Matte. This channel is 15 miles broad, by 27 miles long; its direction E. 37° N., and W. 37° S.; the centre of its western entrance is in Lat. 2° 1′ N., Long. 73° 6′ 48″ E.; the centre of its eastern entrance is in Lat. 2° 16½′ N., Long. 73° 27′ 48″ E. Although this channel is safe, a commander would have less anxiety

in passing through the larger channel, a little to the south of it, called the One-and a-half-Degree Channel.

"3. The **One-and-a-half-Degree Channel**, situated between the Atolls Adou-Matte to the north (whose south side facing the channel is in Lat. 1° 47′ N.) and the north extreme of the Suadiva Atoll, in Lat. 0° 55′ N., and Long. 73° 14′ 48″ E. This is a large channel, and a ship soon passes through it.

"4. The **Equatorial Channel,** formed between the south end of the Suadiva Atoll, in Lat. 0° 12′ N., and the small Atoll to the south, called Addoo Atoll, whose north side is in Lat. 0° 35′ S. The detached island of Phoowa Moloku is situated a little to the south and east of the centre of this channel or space, in Lat. 0° 17½′ S., and Long. 73° 23′ 18″ E. All the other channels may be passed through without danger during the day-time, even through the Atolls between the coral reefs and the islands, as all dangers are visible at some distance, from the mast-head.

"All the **Atolls** north of the Lat. 3° 30′ N. have no barrier reefs round them, excepting a few detached parts, such as Horsburgh Atoll, in the N.W. part of the Cardiva Channel; Ross Atoll, in the south part of the same; and Garfor Reef, in the S.E. part; as also the S.E. side of Phaidee Pholo Atoll, in the N.E. part of the same channel. The centre of Mahlos Mahdou Atoll, in Lat. 5° 35′ N., and Long. 72° 46′ 48″ E., is much too intricate for a ship to pass through.

"**Malcolm Atoll,** its centre in Lat. 6° 20′ N., and Long. 72° 35′ 48″ E., is one continued barrier reef of 15 miles in extent.

"**Heawandoo Pholo Atoll,** the most northern Atoll, has a large barrier reef surrounding its N.W. side, from Lat. 6° 58′ to 7° 6′ N., Long. 72° 46′ 48″ E. It was on this that the ship *Vicissitude* was lost in the year 1836, on her way from Mauritius to Ceylon, by running on this reef in the night, with westerly winds.

"**HEAWANDOO PHOLO ATOLL.**—This Atoll is the most northern of the Maldivh group; it extends N.W. and S.E., 12 miles long by 7 broad; it contains 24 islands, large and small, which lie on all sides of the boundary; seven of them are inhabited, and contain a considerable population; they afford wood, water, and some supplies. A barrier reef surrounds the north and west sides, on which the ship *Vicissitude* (from Mauritius to India) was wrecked. On the extreme north point of the Atoll is the small island called Turacoon, in Lat. 7° 6½′ N., Long. 72° 52′ 48″ E. W.S.W. from Turacoon, 1½ miles, is another small island; still more to the west, 2 miles, is the north extreme of the western barrier, between which and the island, as also between the islands, are good channels leading into the Atolls, with not less than 9 and 10 fathoms water in them. To the S.E. of Turacoon, half a mile, is the large island of Oolegaum, which island is two miles long. On both sides, to the north and south, are good channels leading in. South-east of Oolegaum island, one, two, three, and five miles, are four other islands; the two next to Oolegaum are small; those to the S.E. form the eastern boundary of the Atoll; the south point of the large island of Mooradoo is on the extreme point, in Lat. 7° 1′ N., Long. 72° 58′ 28″ E., S. ¾ W., three miles from Mooradoo, is the small island of Gulandoo, which gives name to the channel between Heawandoo Pholo Atoll and Tilladoo Matte Atoll. Between the small island of Gulandoo and the south point of the large island of Mooradoo, are two coral patches, having little water on them; they are in a transit line between the islands, and ought to be avoided by ships. S.W. of Gulandoo island, three miles, is the S.E. point of a large reef, which is on

the extreme south point of the Atoll, in Lat. 6° 55½′ N., Long. 72° 55′ 18″ E.; between it and Gulandoo is a good channel to enter. The N.W. point of the Atoll is the outer part of the great barrier reef, in Lat. 7° 4¼′ N., Long. 72° 46′ 18″ E. Close to this is a small island, low and bushy. Heawandoo island, in the south part of the Atoll, in Lat. 6° 58′ N., Long. 72° 53′ 48″ E., is the principal island of the Atoll, being the residence of the sultan's vizier; it is about one mile in length, and of a triangular form, covered with high cocoa trees and bread fruit. The island is well inhabited, and furnishes good water, and some supplies. I have recommended it as a coal depot. It lies nearly in a direct line between Point de Galle and Socotra island, and about one-third of the distance from Point de Galle; it is easy of access in every direction, and possesses safe anchorages for ships or steamers in all seasons. During the S.W. Monsoon a vessel could anchor on the east side of the island, between it and a small reef, dry at low water, situated about half a mile to the N.E. of the centre of the island. In the N.E. Monsoon the best anchorage is between the island and a large reef to the south, in 16 and 17 fathoms water. There is a fine channel through the barrier, W.S.W. from Heawandoo; it is nearly a mile wide, having 12 fathoms in it. There are three small islands in the centre of Heawandoo Pholo Atoll, which abound with fine green turtle, seldom disturbed by the natives, who do not eat them. The general depths in the Atoll are from 20 to 30 fathoms; several small coral patches are scattered about.

"**GULANDOO CHANNEL.**—This channel is formed between the south point of Heawandoo Pholo Atoll and Tilladoo Matte Atoll to the south; the N.E. entrance is 12 miles broad, situated between the south end of Mooradoo Island, in Lat. 7° 1′ N., and Long. 72° 58′ 28″ E., and the N.E. extreme of Keelah Island, in Tilladoo Matte, in Lat. 6° 59′ N., Long. 73° 11′ 48″ E. The west entrance of this channel is between the south point of Heawandoo Pholo, in Lat. 6° 55½′ N., Long. 72° 55′ 48″ E., and the N.W. part of Tilladoo Matte, distant 3 miles to the south. We could find no bottom in this channel at 220 fathoms; the ebb tide runs to the W.S.W., and the flood to the E.N.E.; high water at 9h. 30m. full and change; rise of tide 5 feet. Should a ship wish to anchor in passing through this channel, she may, without any danger, anchor in the north part of Tilladoo Matte, or south part of Heawandoo Pholo Atoll. The channels between the islands and reefs are all safe, and free from sunken coral patches. The currents about this part of the Maldivh islands set to W.N.W. in December, January, February, March, April; and in May, June, July, and August, to the eastward and N.E.; September, October, and November they set south. The east and N.E. winds commence here about the beginning or middle of December; the south-westerly winds in May, which only continue four months. N.W. and N.E. are the prevailing winds.

"**TILLADOO MATTE ATOLL.**—This Atoll extends from the N.E. island, Keelah, whose north point is in Lat. 6° 59′ N., Long. 73° 11′ 48″ E., to the S.W. extreme of the Atoll S. 36½° W., distance 35 miles, in Lat. 6° 30½′ N., Long. 72° 50′ 48″ E.; the N.W. point is the south boundary of the Gulandoo Channel, in Lat. 6° 52½′ N., Long. 72° 55′ 48″ E.; the S.E. point is the island of Mahwahdoo, in Lat. 6° 31½′ N., Long. 73° 1′ 18″ E. This Atoll is a continuation of the north part of Milladoo Madou Atoll, indeed they are joined, or rather situated on the same bank of soundings—having no channels without soundings separating them, like the other

Atolls; why the natives should have given them two names I cannot tell. There are about thirty-eight islands in this Atoll, generally of a larger size, particularly those on the eastern boundary, where the islands are principally situated; all the islands on the north and east sides are inhabited, affording good water and some supplies; safe channels are between all the islands. The soundings commence between the islands and the reefs forming the boundary; the general depth is from 25 to 28 fathoms. The western boundary of the Atoll has not so many islands but more reefs, between which are safe channels; a very large one leads into the Atoll on the N.W. part. The tides are felt in this Atoll—their strength from one to two miles per hour—accelerated or retarded by the currents.

"**MALCOLM ATOLL.**—This Atoll, or large lagoon reef, until the late survey was not known to Europeans; I therefore named it Malcolm Atoll, in honour of Sir Charles Malcolm, R.N. By the natives' account many ships have been totally wrecked on the barrier reef which surrounds it, and all lives lost—leaving scarcely a vestige of the wreck a few hours after from the violence of the surf and the perpendicular sides of the reef. On the extreme N.E. point is the moderate sized island of Mah-koondoo, whose centre is in Lat. 6° 24½′ N., Long. 72° 41′ 18″ E.; it contains 100 inhabitants and has good water. Three and a half miles to the westward of it, on the barrier, is a small island; and to the S.S.W. of it, 6 miles, another, which is on the east side of the entrance of the barrier; the south point of the Atoll is in Lat. 6° 13′ N., Long. 72° 34′ 48″ E.; the general breadth of the Atoll is about 3 miles; it is full of coral patches; and has two boat passages into it, on the east side near the centre. The distance between the island of Mah-koondoo and the N.W. part of Milladoo Madou Atoll is 10 miles; there is no bottom between them.

"**MILLADOO MADOU ATOLL.**—The northern boundary of this Atoll is the termination of Tilladoo Matte Atoll, the N.W. point in Lat. 6° 30½′ N., Long. 72° 50′ 48″ E.; the N.E. point the centre of the island Mah-wah-doo, in Lat. 6° 31½′ N., Long. 73° 1′ 48″ E.; from this, S. 9° E. 5½ miles, are two small islands, the south one Noomerah. From Noomerah, which lies in a bay on the east side of the Atoll, the islands on the east boundary lie considerably more to the east; the first island from Noomerah bears S. 60° E., distant 9½ miles, and is named Fea-war, its centre in Lat. 6° 21′ N., Long. 73° 10′ 48″ E.; between this island and Noomerah is free from danger, on a bank of soundings from 20 to 25 fathoms; the Atoll is only 10 miles broad at this place, in a S.W. direction, and a ship may pass through it with ease. Fea-war island is the northernmost of twenty-four islands, large and small, which lie in succession along the eastern boundary of the Atoll, having safe channels for any ship, from one to two and three miles broad between them. They are as follow:—From Fea-war S. 28° E., 10 miles to the north point of Far-oo-ko-loo, in Lat. 6° 12′ N., Long. 73° 15′ 48″ E., there are three islands; on the same reef with Far-oo-ko-loo, distant 1½ mile, and south from Far-oo-ko-loo, 12 miles, to Lat. 6° N. are five smaller islands, having channels between them; these islands lie in a bay. The islands to the south of 6° N. and 73° 15′ 48″ E. lie more to the eastward; the principal one is the large island of Kain-de-co-loo, 2½ miles in extent N.W. and S.E.; this island has two villages on it, and its interior consists of salt water lagoons; the south point of this island is in Lat. 5° 56¼′ N., Long. 73° 23′ 48″ E. There is a good channel leading into the Atoll, round the south point of Kain-de-co-loo, as

also between the three smaller islands, to the S.S.E. of it. There is a good anchorage to the west of Kain-de-co-loo, near its south point, where good water may be obtained from the village. Mah-far-roo island is the most eastern island of the Atoll, it lies to the S.S.E. of Kain-de-co-loo, distant seven miles; it is $2\frac{1}{2}$ miles in length, and off its north end, $1\frac{1}{2}$ mile, extends a coral reef; the centre and east side of Mah-far-roo is in Lat. 5° 50′ N., Long. 73° 26′ 48″ E. S.W. from Mah-far-roo island, $5\frac{1}{2}$ miles, is the large island of Man-ah-doo, between which is a good channel. There is good anchorage in 25 fathoms at Man-ah-doo island, either on the north or south sides, according to the season; the south point of this island is in Lat. 5° 46′ N., Long. 73° 22′ 48″ E. It is a beautiful island, filled with groves of bread-fruit trees, and other luxuriant foliage; it is well inhabited, and the village is on the north side of the island; there is a good landing-place on the north and south sides of the island, and a fine pathway through the island; good water, and some supplies may be obtained: the natives keep their boats inside the reef, on the N.E. part of the island. South of Man-ah-doo, $1\frac{1}{2}$ miles, is a long narrow island, between which is a good channel leading into the Atoll. On the south point of the Atoll is the small island of Kah-re-mah, in Lat. 5° $39\frac{1}{2}$′ N., Long. 73° 17′ 48″ E., as also two miles to the west of it the small island of Kharn-dhoo-doo, in Lat. 5° 39′ N., Long. 73° 15′ 48″ E.; these islands bound the channel on the north side, between Milladoo Madou and Phaidee Pholo Atoll; the distance from one Atoll to the other, across the channel, is $9\frac{1}{2}$ miles. There are not so many islands on the west side of this Atoll, but more lagoon reefs, not in one connected barrier, but in detached portions; on some are small islands, and between the whole are safe channels: the Atoll altogether contains 101 islands, twenty-nine of which are inhabited, containing a population of 1,700 or 1,800. The islands are more numerous in the S.E. part of the Atoll; the general depths are from 20 to 25 fathoms, sandy bottom, with clay at times; there are no dangerous reefs within the Atoll; the tides are felt in the Atoll, and on the springs, about $1\frac{1}{2}$ to 2 miles per hour; the flood to the E.N.E., the ebb to the W.S.W.; currents influence the tides much.

"**PHAIDEE PHOLO ATOLL.**—This Atoll, which lies to the south-east of Milladoo Madou 10 miles, is not of great extent, its southern part bounds the northern side of the Cardiva channel; on its extreme north part are two small islands, having a channel a quarter of a mile wide, leading into the Atoll between them; the eastern island of these two is named Koo-red-doo; its centre is in Lat. 5° 33′ N., Long. 73° 17′ 3″ E.; between the north and east sides of this Atoll are six islands, in a distance of 12 miles; between them are five small but deep channels, leading into the Atoll; facing the inside of these channels are a few coral rocks, for which a good look-out must be kept. The east and S.E. side of this Atoll is bounded by an extensive barrier reef of 18 miles in extent, on which the sea breaks in the N.E. monsoon with considerable violence; at low water large masses of coral rock, and some sand-banks are observed on the barrier. There are eleven islands on this barrier; a large one, called Deeve-poore, on its eastern part, is in Lat. 5° 24′ N., Long. 73° 37′ 18″ E.; another large one, on the S.E. part, whose centre (a large high tree) is in Lat. 5° 17′ N., Long. 73° 34′ 18″ E.; the southern island of the Atoll on the extreme point of the barrier is named Alligow, in Lat. 5° 15′ N., Long 73° 28′ 48″ E. From Alligow, the Atoll and islands on the boundary take a direction N.W. and west, to the extreme west point, in Lat. 5° 22′ N., Long. 73° 18′ 18″ E. Between

these south and west points are several islands, with good channels between them, leading into the Atoll. There are several islands on the N.W. side; the two most numerously inhabited are Madever and Nar-foree; the latter is the residence of the Atoll-warree, or chief of the Atoll. Nar-foree is a small island, in Lat. 5° 26½′, Long. 73° 20′ 3″ E. Good water and some supplies may be obtained at these islands, which lie close together. There are many small but deep channels on this N.W. side of the Atoll. Several coral patches, dry at low water, as also several sunken reefs, with one and two fathoms water on them, are within the Atoll; the general depths on a sandy bottom, are from 25 to 30 fathoms. There are only four islands inhabited in this Atoll, containing a population altogether of about 550 people. Several of the other islands have been inhabited, but the natives informed us, many of them had died off, the remainder had deserted. The tides and currents run strong through the channels leading into the Atoll.

"**MAHLOS MAHDOU ATOLL.**—This is one of the western Atolls; it extends from Lat. 5° 1′ N. to 5° 59′ N.; it is divided into two parts, the northern and southern, having a channel between them, which has been named Moresby channel. The breadth of the channel is about 2 miles, having 135 and 125 fathoms in it; the direction of the channel is N. 61° E., and S. 61° N., and in length 13 miles. Should a ship wish to pass through it, instead of passing through the northern or southern part of the Atoll, if from the west, the entrance is in Lat. 5° 19′ N., and Long. 72° 48′ 48″ E., and from the east, the entrance is in Lat. 5° 25′ N., Long. 73° 0′ 48″ E. There is also another deep gut or channel with 100 and 120 fathoms in it, leading through the northern part of the South Mahlos Mahdoo, it is only 1 mile wide, its direction nearly east, from the west entrance of Moresby Channel; the extent of South Mahlos Mahdoo, is from the east and west entrances of Moresby Channel, which is close to the northern part; the S.W. part is a large lagoon reef, in Lat. 5° 8′ N., Long. 72° 46′ 18″ E. On the south part are four small islands; the westernmost is Hoo-ree-gery, in Lat. 5° 1½′ N., Long. 72° 52′ 18″ E. To the west of this island, 3 miles, is a small island on a large reef; between them a good channel leading into the Atoll. N.W. 1¼ miles from this small island, on the same large reef bounding the S.W. point of the Atoll, is a larger island, inhabited, in Lat. 5° 2½′ N., Long. 72° 48′ 48″ E. Of the four islands in the south part of the Atoll, the second from the west, called Hee-tah-doo, is the principal one; it contains about 250 inhabitants, and is in Lat. 5° 1½′ N., Long. 72° 52′ 48″ E.; between these four islands are channels leading into the Atoll, the broadest channel is about 3 miles to the N.E. of Hee-tah-doo. The S.E. boundary of the Atoll, consisting of islands and reefs, extends from Hee-tah-doo, N. 54° E., 21 miles, having safe channels between all the islands and reefs on the boundary. The east point of the Atoll is a large lagoon reef, on which are several low bushy islands, called Mah-ba-roo, the centre part of them in Lat. 5° 15′ N., Long. 73° 9′ 48″ E. On the N.E. part are several islands, and good channels leading into the Atoll; the general depth within is from 27 to 32 fathoms. The chief of this part of the Atoll resides at an island called Dhur-an-doo, in Lat. 5° 10′ N., Long. 73′ 5′ 48″ E., which island is on the S.E. side of the Atoll, and contains about 100 inhabitants, and has good water. North Mahlos Mahdoo is different in form from the southern part; it is not more than 15 miles in breadth, east and west. From the east entrance of Moresby channel, its eastern side is a continuation of moderate sized islands, consisting of twenty in number; their direction from the

east entrance of Moresby channel is N.½W., 30 miles. Between all these islands are good channels leading into the Atoll; none of them have good water, except the island where the chief resides, called Fainoo, which is the second island from the south, and in Lat. 5° 28′ N. The north part of the Atoll is quite open, with a bottomless channel between its northern part and Powell's islands, which lie off its north part. These islands are inhabited, of a moderate size, and on one reef; the northern island is called by the natives Etin-gee-lee; the southern one, close to it, Ally-fooree, whose southern side is in Lat. 5° 58′ N., Long. 72° 54′ 48″ E.; between these islands and the north part of the Atoll is 4 miles, clear of dangers; the west side of the Atoll is principally lagoon reefs, between which are channels leading into the Atoll; its direction is from Ally-fooree island, S.S.W. 27½ miles, which is the extreme west point, a large lagoon reef, in Lat. 5° 32½′ N., and Long. 72° 45′ 48″ E. From this to the south part of the Atoll, or west entrance of Moresby channel, are large lagoon reefs, between which are channels. It would be impossible for ships to navigate with safety through the centre part of North Mahlos Mahdoo, it is so full of small coral patches and rocks, called by the natives the Jungle; it lies between the latitudes of 5° 30′ and 5° 34′ 48″ N. on the west side of the Atoll. The north and south parts of the Atoll a vessel might navigate through with ease; the general depths are from 20 to 27 fathoms.

"**MALE ATOLL.**—Little can be said in favour of this Atoll; it requires a sharp look-out even in the day time to navigate through it, coral reefs and patches are so numerous; the eye, and not the chart, must guide a vessel through. The general depths in the Atoll are from 25 to 35 fathoms; sandy bottom. From the northern part of Malé Atoll, in Lat 4° 41′ N. to the southward, as far as Malé or King's island, is 31 miles, or in Lat. 4° 10′ N. The small island of Kaghay is on the northern extreme, and Malé on the southern end, being nearly on the same meridian line of 73° 28′ 48″ E.; the centre of the Atoll is 22 miles broad, east and west. There are numerous channels leading into this Atoll, all of which might be used by ships; but as some of them, on the eastern side, are rather narrow, I shall describe those most useful for ships making this Atoll from the N.E. Should a vessel make the northern part of this Atoll, she will find a good channel exactly on its northern end: this is called the Kaghay Channel; it is about half a mile broad, having 23 and 24 fathoms in it. On the north and western entrance there is a large pile of coral stones; the small island of Kaghay, with a clump of trees on it, bears from the pile, S. ½ W. 1½ mile; and the centre of Gafor island, about north, distant a little more than two miles. The next best channel is about 5 miles to the S.E. of this; it leads in, on both sides of a long, low island, called Hellen-gelly, in Lat. 5° 38′ N. This island may be known by a peculiar single cocoa tree, the only one on the island. Kaghay and this island are the only two islands on the N.E. part of the Atoll. Between the island of Hellen-gelly and the centre islands in the Atoll to the S.E., is 14 miles. Several large lagoon reefs, with passages between them, are in this space; there are no marks to guide a ship; she may pass through by keeping a good look-out.

"As a vessel approaches the centre islands of this Atoll, which are conspicuous from seaward from the distance of 16 or 17 miles, two low islands will be observed in Lat. 4° 26′ N.; they sometimes look like one island. At the same time, a high clump of trees will be seen to the westward of the low islands: this is the small island called Asdoo, whose cocoa trees are very high—the island being in Lat.

4° 27′ 30″ N. Asdoo island lies a little inside the Atoll, but is a good guide to mark the channels hereabouts. N. 70° E. 2½ miles from Asdoo, is a good channel; as also N.E. 2½ miles. These channels are to the N.N.W. of the two islands from 2½ to 3½ miles. The two islands on the eastern boundary are named, the north one, Mefaing-feoree; the south one, Devam-pooree; the latter being well inhabited, and could supply men as pilots for Malé—but it is doubtful if they will come out. The centre of Devam-pooree is in Lat. 4° 26½′ N., Long. 73° 40′ 48″ E. Both the islands are on the N.E. point of a long lagoon reef, extending about 6 miles to the S.S.W. and S.W.; on the southern part of which are three small cocoa islands, which is the north boundary of the next channel, but not recommended. W.S.W. of this, 3 miles, is another channel; 3 miles more to the S.W. is another; but both these channels, though safe, are small. The best and largest channel is in Lat. 4° 16′ N., about 7 miles to the N.N.E. of Malé or King's island; it is from 1¼ to 1½ miles broad; a large reef bounds the north side of this channel, and a remarkable clump of cocoa trees on a small island is on its extreme point; but care must be taken not to mistake this clump for another which lies to the northward about 3 miles. On the southern side of this channel there are two small cocoa islands and a sand-bank with some bushes on it to the westward. A vessel may pass between all these; but the best route is round the north side of them. After rounding the sand bank, a vessel may steer to the S.S.W. and S. by W., to Malé or King's island, distance 5½ miles. The soundings are from 28 to 25 fathoms, sand; and in this depth a vessel may anchor at Malé anywhere off the island, as most convenient. As good a berth as any is with the flagstaff bearing S.E., distant half a mile. There are two good channels leading into the Atoll on each side of Malé, both of which are safe; but the tides run strong through these channels, as is the case with all the channels.

"**Male, or King Island,** is an oval-shaped island; its length one mile, by half a mile broad. The flagstaff, in the centre of the north side, on one of the principal batteries, is in Lat. 4° 10′ 20″ N., Long. 73° 28′ 48″ E. The variation we made by one theodolite 1° E., by another 0° 20′ W.; south dip of the magnetic needle 13° 27⅓′. It is high water here at 12h. 30m.; rise and fall 3 feet, sometimes 4 feet. The island has once been walled round, with bastions at different points. Only the north and west sides are now in any state of repair. They have several good cannon in the bastion close to the flagstaff and landing-place. The reef which surrounds the north and west sides is, on the outer part, built up as a wall, sheltering the small craft, which lie snugly within the lagoon. A gateway in this wall, close to the flagstaff, leads into the lagoon and landing place; at night time this gateway is closed, by a boom being drawn across. The sultan and head men are much pleased if a ship on her arrival salutes with a few guns, which compliment they return; and then the Emir el Bhar, or master attendant, comes on board to inquire after the health of the ship's company, that they may bring no contagion to the place, particularly the small-pox. Good water may be obtained, but no supplies. None of the islanders in any of the other Atolls are allowed to trade with foreign vessels, except at Malé; all trade must be carried on at Malé; and I was authorized by the government of India to attempt by treaty to open the trade with all the other Atolls and islands, but the sultan and his ministers would not agree to it. They carry on a considerable trade between Malé and Calcutta, Chittagong, Point de Galle, and the Malabar coast. Their boats or vessels are from 100 to 200 tons burthen. On their return from India they bring principally rice, and some of their largest boats will carry 7000 bags. They export from the islands, cocoa nuts, tortoise shell, dried fish, coir rope, money

cowries, and mats. A few small brigs belonging to the natives at Ceylon and Chittagong annually trade to this place. Some of them are commanded by Anglo-Indians, who are part owners. Strangers who would wish to participate in this trade would not be well received, and difficulties would be thrown in the way of their dealings. To shipwrecked mariners their conduct has been most kind; not an article that is saved from the wreck is ever stolen by them; the crew are housed, and if necessary, fed by the natives, who will, by the first opportunity, convey them in their boats to King's island, from whence the sultan always sends them to India to the first English port, providing them with everything necessary, and conveying them in one of their large trading boats; for all which acts of kindness nothing is ever charged. Malé contains a population of between 1500 and 2000. Exclusive of Malé, there are 11 other inhabited islands in the Atoll, containing together 700 inhabitants. The insalubrity of the climate is particularly injurious to strangers, either European or native; the latter feels its effects sooner than Europeans. No one ought to sleep on shore; and if every one sleeps afloat, a few days' or weeks' residence will not be attended with ill effects. During the S.W. Monsoon, from June to December, vessels anchor on the east side of a lagoon reef, distant $1\frac{1}{2}$ mile to the N.N.W. of Malé. On the edge of this reef are several anchors, dry at low water, which vessels make fast to in this season: an anchor will require to be let go to the eastward, as well as being fast to the reef. The western side of this Atoll is a continuation of lagoon reefs, between which, at every 2 and 3 miles, are good channels leading into the Atoll; a good one in the centre of the Atoll, in Lat. 4° $22\frac{1}{2}'$ N., Long. 73° 18′ 48″ E.; another, in Lat. 4° 28′ N. On the N.W. part are two other channels: one near a thick bushy island, in Lat. 4° $37\frac{1}{2}'$ N., Long. 73° 21′ 48″ E. On both sides of this island the channel is deep and safe. There is another channel about a mile to the N.E. of this last one. On the north part of the Atoll, near the west side, is a broad channel, with a sand-bank on its west side; this channel bears from Kaghay island about W.N.W. distant 3 miles.

"A navigator must keep in mind that all the channels leading into the Atolls are not distinctly seen at the distance of 3 or 4 miles, presenting in appearance one continued line of reef alarming for strangers to approach; but there is no danger to be apprehended when the winds are steady, and, by nearing them to the distance of 1 or 2 miles, the channels are distinctly seen, unless the sun glares in the face.

"**CARDIVA CHANNEL,** called by the natives, **CARDOO KANDOO.**—This channel is extremely useful for ships to and from India; no ship ought to attempt to work through this channel against the strength of the Monsoon, either the S.W. or N.E.; having wind and current against them, it would be next to impossible; it may be advantageously adopted coming from the westward with westerly winds; or from the eastward with easterly winds; or when the Monsoons are changing, and the winds are light and variable; calms are then very frequent, yet little or no danger is to be apprehended, the channel being sufficiently spacious. The channel takes its name from the island of Cardoo, or Cardiva, situated near the centre of the eastern entrance, in Lat. 4° $58\frac{1}{2}'$ N., Long. 73° 25′ 48″ E. This island is nearly two miles long, E.N.E. and W.S.W., and little more than half a mile broad. It is covered with a dense mass of high cocoa-nut trees; its eastern side convex, having no soundings at 240 fathoms close to the beach; on its western side, a circular reef extends to the westward about $1\frac{3}{4}$ miles, having a lagoon inside, where the natives snugly anchor their boats off the village on the north side of the island. The entrance

through the reef into the lagoon is on the N.E. side near the N.E. point of the island, marked by a few sticks placed as a beacon. A ship's boat can only land on the island by passing through the boat channel. There is generally a heavy surf round this island and reef, except at the channel for boats: it contains about 200 inhabitants. It affords good water, and some few supplies. A ship intending to pass through the Cardiva channel from the east ought to steer into Lat. 5° 5′ N., Long. 73° 41′ 48″ E.; from this position a straight course S.W. by W. ½ W. will lead clear through the channel, distance 67 miles, passing to the south of Cardiva island 1 mile. A ship from the westward, intending to pass through the Cardiva channel, ought to steer into Lat. 4° 34′ N., Long. 72° 41′ 48″ E.: from this a straight course N.E. by N. ½ E., distance 67 miles, will carry a vessel through with a fair wind; should the wind be variable when entering this channel, the boundaries of it are as follow:—

"**Hoo-wailee-fooree Island,** a large island on the barrier reef of the S.E. extreme of Phaidee Pholo Atoll, on which is a high clump of trees, in Lat. 5° 17′ N., Long. 73° 34′ 18″ E. Alligow island, a small island with high trees on the extreme south point of the same Atoll, in Lat. 5° 15′ N., Long. 73° 28′ 48″ E. On the south side of the east entrance is the large lagoon reef of **Gafor**—its N.W. point in Lat. 4° 47′ N., Long. 73° 22′ 48″ E.: the centre and north side of this lagoon reef of Gafor is situated S. by W., distant 12 miles from Cardiva island: it has no soundings near it, and ought not to be approached in light winds; it lies close off the north end of Malé Atoll, having a channel between them 1½ miles broad, with no bottom at 100 fathoms in it. On the east end of the reef is the small island of Gafor, in Lat. 4° 44′ N., Long. 73° 28′ 18″ E.; the lagoon reef extends to the west of Gafor 7½ miles into Long. 73° 20′ 48″ E., and Lat. 4° 44″ N.; from this, across the channel the distance is 24 miles on a W.N.W. bearing to Goidoo island, the east extreme point of **Horsburgh Atoll,** in Lat. 4° 54′ N., Long. 72° 57′ 48″ E. This Atoll is small, and is situated on the north and west boundary of the Cardiva channel; from east to west it is 10 miles long; its west end, the barrier reef, in Lat. 4° 52½′ N., Long. 72° 48′ 48″ E.; its south point facing the Cardiva channel in Lat. 4° 50′ N., Long. 72° 51′ 48″ E. At this part a good passage through the reef (for ships) leads into the Atoll; in the passage is 8 and 9 fathoms; it is known by several stony islands bounding the passage on the reef on each side. The west side of the passage is the deepest, the eastern side having 5, 4, and 3 fathoms. There is fine anchorage within, in 17 to 20 fathoms, sandy bottom, mixed with mud and clay, and free from rocks, except near the edges of the barrier reef. There are three larger islands on the north and east part of the Atoll, on the boundary—all of them inhabited—and afford wood, water, and some supplies. Goidoo is the largest and easternmost island—its situation formerly mentioned. Next to it, 1½ miles, is Fhen-doo; then still more to the west is Foo-roo-doo: they contain a population of 200 inhabitants. Between these islands and the south end of the south Mahlos Mahdoo Atoll is 6 miles; the south end of this Atoll lies directly north from Horsburgh Atoll, having a safe channel between them, which may be used by ships, either departing from or entering the Cardiva channel. The south part of Mahlos Mahdoo Atoll is available for ships to anchor, who wish to obtain a few supplies, and some wood and water, which may be obtained at Heetahdoo island, the centre of four islands in the extreme south part of Mahlos Mahdoo, in Lat. 5° 1½′ N., Long. 72° 52′ 48″ E. This island contains 250 inhabitants. To the E.N.E. of it 3 miles, as also to the west of it 2½ miles, are good channels leading into the Atoll. From this island, the S.E. boundary of the Atoll, which faces the Cardiva channel, lies N.E. ¾ N. 21 miles, to Lat. 5° 14′ N.,

Long. 73° 9′ 48″ E., which is the east point of Mahlos Mahdoo; between these points are several small islands and reefs, between which a ship may enter the Atoll. From the east point of Mahlos Mahdoo (just mentioned) the small island of Alligow, on the south point of Phaidee Pholo Atoll, bears east a little north 20 miles, and the west points of Phaidee Pholo, Kannee-fooree island, N.E. 12 miles. This is the breadth of the channel between Mahlos Mahdoo and Phaidee Pholo Atolls, and may be used by ships proceeding to the north-east or eastward. Having entered the Cardiva channel from the westward, after passing between the east point of Mahlos Mahdoo, and the west point of Phaidee Pholo, a vessel may steer north until she sights the southern islands in Milladoo Madou Atoll, in Lat. 5° 39′ N., Long. 73° 15′ 48″ E., she must then steer north-east, which will carry her clear between Milladoo Madou and Phaidee Pholo, or if she have daylight she may steer boldly up north through Milladoo Madou Atoll. The south and west boundary of the Cardiva channel is the north part of Ari Atoll, in Lat. 4° 17½′ N., Long. 72° 45′ 48″ E. East boundary of Ross Atoll, in Lat. 4° 17′ N., Long. 72° 54′ 48″ E.; the centre of Todoo island, in Lat. 4° 25¾′ N., Long. 72° 56′ 18″ E. A more particular description of this island and the north part of Ari Atoll will be found in the description of Ari Atoll. The flood tide in the Cardiva channel runs to the E.N.E., the ebb to the W.S.W.; high water full, and change at 12 hours.

N.B.—Having described all the Atolls and channels north of Malé, or King's island, I shall commence from the southern Atolls and channels towards Malé to the north.

"**ADDOO ATOLL.**—Addoo Atoll, erroneously called by former navigators Phoolah Moloque Atoll; this Atoll, being rich, well inhabited, and available for ships much in want of supplies, I shall be particular in describing it. This Atoll terminates the south extreme of the Maldivh chain of islands, is the smallest of all the Atolls, being only 10 miles from east to west, and 7 miles from north to south; it is of a half-moon shape, the concave side facing the north, and the convex side the south. The N.W. point is in Lat. 0° 35′ S., Long. 73° 1′ 18″ E.; the N.E. point in Lat. 0° 35′ S., and Long. 73° 10′ 18″ E.; the south and centre in Lat. 0° 41½′ S., Long. 73° 5′ 18″ E.; there are nine larger, and several smaller islands: the two principal islands lie, one on the N.W. point, the other on the N.E. point; that on the N.W. point of the Atoll is named Hit-ta-doo, and extends to the S.S.E. 5 miles, its breadth is from a quarter to half a mile; next to the S. of it, is Marra-doo, about 1 mile in extent; then Faidoo, which is smaller; next to the south, is Gung, which is 1½ mile in extent, and is the most southern and centre island of the group; all these islands, four in number, lie on the western side of the Atoll, and are connected by a barrier reef of coral, dry at low water, with no soundings outside of them.

"There are four channels leading into this Atoll: two in the centre, on the north side; and two in the centre, on the south side. The southern channels are the largest, and may be used at night time; the northern ones are not so broad, yet are safe, and available for vessels coming from the northward with northerly winds, or leaving the Atoll with southerly winds. A vessel could not work through the northern channels, but with a fair tide it could be done through the southern ones; the best way is to adopt that channel through which a vessel will have a fair wind. The northern channels are not easily seen by a vessel coming from the northward, as the northern barrier at some

distance appears like one unbroken reef; on a nearer approach, and almost in the centre of this barrier, between the eastern and western islands, lie the channels, which will be known by a small bushy island and a high bank of coral stones, both on the same reef; on either side of them is a channel leading into the Atoll. The eastern channel is the largest, being 400 or 500 yards broad, having not less than six and seven fathoms; its direction N.W. and S.E.; the western channel is narrower, yet longer, and its direction north and south; the depths are from ten to twelve fathoms. In both these channels the tides and currents are strong, as also in the southern ones; the flood tide sets into the northern channels, and the ebb sets into the southern ones; rise and fall of the tide about four feet; high water at one hour full and change of the moon. The southern channels lie on the east side of Gung island, the southern island of the Atoll; this I shall call Gung channel, and is formed between Gung island and two small islands to the E.N.E. of Gung, called Willing-gilly islands. Gung channel is half a mile broad, having no dangers in it, and the depths are from thirteen to seventeen fathoms; it is convenient for any ship entering the Atoll. The other channel I shall call the Willing-gilly channel, is on the east side of the Willing-gilly islands, formed between them and the south point of the dry coral reef bounding the east side of the Atoll; this channel is one mile broad, and has from seventeen to twenty fathoms water in it, deepening as a ship enters the Atoll; the direction of this channel is about N.W. and S.E.; about one mile inside the entrance, on the N.E. side, there is a small coral reef, and as a vessel proceeds on to the centre of the Atoll three coral patches will be observed, on which the sea breaks at times; but these are easily avoided by a common look-out. The depths in the centre of the Atoll are from twenty-five to thirty-five fathoms, sand and clay. The most convenient anchorage for communication with the natives is near the islands, the west side of which are inhabited; from the Willing-gilly channel, round the N.E. side of the Atoll, to the centre on the north side, is one continued barrier reef, on which are several islands; the only large one, of two miles in extent, is on the N.E. point of the Atoll; this is well inhabited, and an interesting island; it is called Me-doo and Hoo-loo-doo, from two villages situated in its centre.

"This Atoll is clear of reefs, except in the centre, where are the three small patches formerly mentioned, and which are easily avoided; 30 and 35 fathoms is the depth of water in the centre; near the islands on the east and west sides, are 20 and 25 fathoms; a vessel may anchor as most convenient, according to the seasons—during the N.E. Monsoon, on the north or weather side, and in the other Monsoon, on the west side. The islands afford a few supplies of fruit, limes, poultry, eggs; water and firewood in abundance. The natives are very civil and obliging, and will exchange their articles either for money or rice, biscuit, sugar, salt, onions, and garlic; they are extremely lazy and indolent, and very timorous, fearful of strangers, and will not be induced to assist a ship in wooding and watering unless paid for it, and obliged to work; they are under the government of the Sultan at Malé, or King's island; and the Atoll-warree, or chief of the Atoll, is the person strangers ought to apply to for assistance in getting supplies. Some of the natives speak the Hindoostance language; their principal occupation is making cotton cloths of white, red, and black colours mixed, all of which they dye themselves, and sell at a good price in the other Atolls. They are not allowed by their government to trade with foreigners, not even with the English, their allies; all their produce must be sold at the king's island, Malé. They seldom visit ships passing, from fear of

molestation; and it would be wrong of any ships stopping at these islands to allow their crew to intrude into the privacy of their houses, among their females, or wantonly and without permission take their fruit, cocoa-nuts, fowls, &c. They are poor and inoffensive, and have reason to regret the visits of some merchant ships. In religion they are all Mahomedans. The Atoll contains about 500 inhabitants, and in appearance they are like the natives of India on the Malabar coast.

"There are no soundings outside of this Atoll close to the barrier reef, and being southward of the line or equator, it is almost without the influence of the Monsoon—the winds and weather being very variable, subject to squalls and rain. The N.E. Monsoon is felt in January, February, and March; and westerly winds more in July, August, and September. The currents about this Atoll are very strong; for six months they set to the westward, and then back again to the eastward, according to the Monsoons, but are subject to checks from variable winds. They commence to set to the west about January, and to the eastward about June; their velocity from 40 to 50 miles per day, decreasing considerably in strength 40 or 50 miles from the islands. There was, in 1836, no variation of the compass.

"I have been thus particular about this Atoll, as so many ships pass this place on their way to and from India. I have also recommended it as a coal depôt for steamers.

"**EQUATORIAL CHANNEL**, with an account of **PHOOWA MOLOKU ISLAND**.—This channel is free from dangers. The island Phoowa Moloku, erroneously called by former navigators Addon island, is situated a little to the south and east of the centre of the channel, which is 46 miles broad between Suadiva Atoll and Addoo Atoll. Phoowa Moloku island is 2 miles long N.W. and S.E., by a-half to three-quarters broad; its centre is in Lat. 0° 17½′ S., and Long. 73° 22′ 18″E.; from its centre the S.E. extreme of Suadiva, in Lat. 0° 23′ N., Long. 73° 29′ 48″ E., bears N. 10° E., distant 41 miles; its south extreme, which is the nearest part to the island, in Lat. 0° 12′ N., and Long. 73° 7′ 48″ E., bears N. 27° W., distant 33 miles; and the S.W. point of Suadiva, in Lat. 0° 18′ N., Long. 72° 57′ 48″ E. A line drawn through these three situations of Suadiva will shew the boundary of the south part of the Atoll, and which is the northern boundary of the Equatorial channel. The southern boundary bears from the centre of Phoowa Moloku, the point of Addoo Atoll, S. 37° W., distant 21½ miles N.E.; the N.W. extreme of the same Atoll, S. 51° W., distant 28 miles. A ship passing through this channel, and coming either from the east or west, ought with light winds to borrow over towards Addoo Atoll, that in case of calms and variable winds, she may not be drifted too close to Suadiva Atoll; if this should be the case, a vessel might in the day time easily enter one of the numerous channels leading into the Atoll. One good channel (with plenty of water) lies to the W.N.W., 3 miles off the south point of the Atoll, whose latitude and longitude has been mentioned. To the N.W. and N.N.W. of this channel, distant 20 miles, is one continued barrier reef, with a succession of small islands, which appear at a distance nearly as one island. Between the S. and S.E. points of this Atoll, there are eight channels leading into the Atoll, all safe for ships, and in case of being drifted near them, may be used to enter the Atoll, where there is anchorage for the night; the depths are from 35 to 45 fathoms in the Atoll, and in the channels not less than 8 and 10 to 15 fathoms. Should the vessel not be able to return from the Atoll by the same channel she came in by, she may in the

day time steer boldly to the northward through the Atoll, in deep water from 35 to 45 fathoms, passing occasionally some small coral reefs and islands, hauling to the eastward or westward, as her distination may be, that she may pass through some of the channels either on the east or west side of the Atoll; some of the natives will gladly conduct them through for a few pounds of rice or bread. Between Phoowa Moloku island and Addoo Atoll the channel is free from dangers, and Phoowa Moloku may be approached quite close off the north, east, and west sides, having no soundings near it; but off the south side a shelving bank extends to the distance of $1\frac{1}{2}$ mile; the surf breaks very high on this, to the distance of $\frac{3}{4}$ of a mile from the island; yet on its extreme point a vessel may anchor in 6 and 7 fathoms water for a few hours, in moderate weather; the bank is hard sand, with small coral rock, and the anchor does not hold well; its sides, like the island, are precipitous. This island contains between 300 and 400 inhabitants, who are principally employed in fishing, and weaving cotton cloth. Here resides one of the royal family from Malé, or King's island; he is styled Deedee. From the islanders may be obtained turtle, fowls, eggs, fruit, lime, firewood, and fresh water. The natives often visit ships in passing, on shewing their colours; some of them speak the Hindoostanee language. The trees on the island are from 70 to 90 feet high; it is high water at one hour full and change of the moon; rise and fall between 4 and 5 feet; the ebb-tide in the channel sets to the westward, the flood to the eastward; they are little felt except in retarding and accelerating the currents; the prevailing winds are from west to south and S.S.E. from May to December, with much rain and squalls; January, February, and March, the weather is less cloudy and rainy, the winds generally from the north and north-east.

"**SUADIVA ATOLL,** or by the Natives **HOOAHDOO ATOLL.**—This Atoll is one of the largest of the Maldivh group, the depth of water inside from 35 to 45 and 50 fathoms, much greater than the other Atolls, also less obstructed by coral reefs. There are thirty islands in its centre, two of which in the N.W. part are inhabited. The islands on the boundary are very numerous, fifteen of them being inhabited, containing together a population of about 2000 persons. The principal employment of the men is in fishing, the women in weaving rush mats for couches, beds, &c., which are woven with different coloured rushes and in pretty patterns; the rushes grow on the islands, and are dyed by the natives; a good mat sells for 1*l.* to 3*l.*; the principal island for their manufacture is at Guddoo, on the S.E. side of the Atoll, in Lat. 0° 18′ N., and Long. 73° 23′ 18″ E. Close to the westward of this island, between it and a long bushy island called Ghang, is a good channel leading into the Atoll. Ghang island lies to the W.S.W. of Guddoo, distant one mile, and is a larger island, being a mile and a half in extent. Close to the westward of Ghang island there is a broad channel a mile and half wide, with 30 fathoms water throughout; also an island about three miles inside the channel, N. by E. from its entrance, having a projecting reef of considerable extent pointing south to the entrance of the channel; this island, after entering the channel, may be passed on either the east or west sides. The inhabitants of this Atoll are much subject to dropsical swellings of the lower extremities of the legs, called elephantiasis, common to Ceylon and the Malabar coast. On the N.W. part of this Atoll, in the year 1802, a Surat merchant ship was wrecked; she was a prize to some French privateer; one of her crew, a Frenchman, remained with the natives of the Atoll, adopted their manners and

religion (Mahomedan), married one of their women, and had a family; the man himself had died some few years before we came there, but his wife and children were living, whom we saw, and spoke to; they were much alarmed, supposing we intended taking them away. Poor creatures, they had little of the appearance of being the offspring of an European; the wife and children were dreadfully afflicted with elephantiasis.

"The Atoll is 42 miles in length, north and south, by 34 miles in breadth, east and west; on its west, south, and east sides are numerous islands; the north and N.W. part of the Atoll is bounded by a continuation of coral reefs, between which are numerous safe passages for ships, as also between the islands to the southward and eastward. The north point of the Atoll is in Lat. 0° 55′ N., Long. 73° 16′ 18″ E.; here are two channels of 34 fathoms' depth of water leading into the Atoll; 2 miles distant to the south and S.E. inside the Atoll, are two small islands; these are the most northern islands of the Atoll. To the W.S.W. of the north point of the Atoll, distant 10½ miles, is the moderate-sized island of Mah-fooree; this island lies on the north-west part of the boundary, in Lat. 0° 50′ N., Long. 73° 7′ 3″ E.; between these last two mentioned points numerous coral reefs, with safe passages between them, form the north boundary of the Atoll, having seven small islands inside the north part. Mah-foree island is well inhabited, has good fresh water, and plenty of poultry, &c. In surveying this Atoll, we were detained under the lee of this island for fifteen days in the month of December, 1836, blowing in hard squalls, and fresh gales, from W. to W.N.W., with heavy showers of rain. A ship wishing to stop at this island, if from the northward, ought to enter the Atoll at its north extreme, and then steer to the S.W. and W., passing between some small islands, keeping in mind Mah-fooree is the most western island, and is the largest among those in the N.W. part of the Atoll. With Mah-fooree island bearing W., distant 1 mile, in 10 fathoms, is a good anchorage. From Mah-fooree N. by E., distant 1½ miles, is the small island of Willee-gelly, on both sides of which there is a channel; that on its west side, between it and Mah-fooree, is rather shoal, having only 4 fathoms in it; the other to the eastward of the island, is deep. Two small islands are situated in the inner part of this channel. Another broad and safe channel is situated 4½ to 5 miles from Mah-fooree, with it bearing S. 40° W.; two small islands are also inside this channel, and bear from its entrance S. 34° E., distant 1½ miles. A ship may pass them either on their east or west sides. From Mah-fooree island a long barrier reef extends to the S.E. 4½ miles, on which are three small islands; close to the southward of the south one, there is a good channel leading into the Atoll, with some coral patches about 1½ miles inside the centre; 3 miles, S.S.E. of this last channel is another; here the boundary of the Atoll forms a deep bay, having this channel at the bottom of it, and bears from the centre of Mah-fooree island S. 32° E., distant 7 miles. Tin-a-doo island is the next principal island on the west side of the Atoll; its centre is in lat. 0° 31½′ N., and Long. 72° 55′ 48″ E. The island is about 1 mile in extent, and contains about 200 inhabitants; has good water, and a few supplies. From this island, the boundary of the Atoll to the north forms a deep bay towards Mah-fooree island, and which would be dangerous for a ship to be drifted into in calms and light winds; its direction from Tin-a-doo is N. 50° E., distant 19½ miles, which is the depth of the bay, and the entrance of the second channel south of Mah-fooree island, S. 32° E., distance 7 miles, as formerly mentioned. Between this channel and Tin-a-doo island, along the boundary, are seven channels: one of the

best is situated 4 miles to the N.E. of Tin-a-doo, and is off the east end of the reef which joins the island; there are several heaps, or dry banks at low water, of coral stones and sand along this boundary; on two of them are some bushes. A ship coming from the westward or south-west would suppose Tin-a-doo the most northern island of the Atoll. Should a ship wish to enter the Atoll, or if there is much chance of her being drifted into the deep bight to the northward, she ought if possible to enter the Atoll, either by the small, but safe channel, between the south end of Tin-a-doo and an island with low bushes, and one single cocoa-nut tree on it. This channel is not more than 150 yards wide, and has 6 fathoms water in it. There is a much larger channel, called by the natives the Kan-da-doo channel, being 1 mile in breadth, having not less than 6 and 7 fathoms water in it. This channel lies south from Tin-a-doo $3\frac{1}{2}$ miles; it is most convenient for ships; its Lat. is 0° $18\frac{1}{4}'$ N., Long. 72° 55′ 48″ E. Kan-da-doo is the name of the large island bounding the north side of this channel; it is not inhabited. This island and Tin-a-doo are the most western islands of the Atoll. Two other islands lie to the south of the channel, that forming the south side of the channel is not inhabited, but the second or southern one, which is the largest, is the residence of the Chief of the Atoll, called the Atoll Warree. The island is named Hoon-da-doo, and contains about 200 inhabitants. Good water, poultry, &c., may be procured here; good anchorage east of the island, from 27 to 35 fathoms water. From the Kan-da-doo channel to the southward, the S.W. boundary of the Atoll is one continued barrier of reef for 79 miles, thickly studded with small islands, which at a distance in some places look like one island. The S.W. point is in Lat. 0° 18′ N., Long. 72° 58′ 18″ E.; another point is in Lat. 0° 13′ N., and Long. 73° 4′ 48″ E. Here is a good broad channel leading into the Atoll between two larger islands, the western one named Fe-oor-warree, which is inhabited. Matura island is the most southern island in the Atoll, and is to the W.S.W. of the last-mentioned channel, 3 miles, in Lat. 0° 12′ S., Long. 73° 7′ 48″ E. This island is also inhabited. A coral reef extends to the eastward of it $1\frac{1}{2}$ miles, dry at low water: close to the east point of this reef is a good channel leading into the Atoll N.N.W., having not less than 9 fathoms water in its shoalest part; the breadth of the channel is about half a mile; the eastern boundary of the channel is formed by the reef extending $2\frac{1}{2}$ miles from the large island of Wah-doo to the N.E.

"Wah-doo island (the east end in Lat. 0° $14\frac{1}{2}'$ N., Long. 73° 12′ 48″ E.) is in length $1\frac{1}{2}$ miles, east and west, by $\frac{1}{2}$ to $\frac{3}{4}$ mile in breadth; by the natives' account it formerly contained 1,200 inhabitants, was very fertile and productive; for many years past it has been nearly deserted, having not more than 100 inhabitants, very poor: no cause is assigned why it has been deserted. The island is worth visiting, the ancient mosques, burial places, and other parts, are very interesting. On the N.E. side there is a broad channel, having 25 to 40 fathoms in it, leading W. and W.N.W. into the Atoll, and is more than 1 mile broad; there are two coral banks in the centre of this channel, having 5 and 6 fathoms on them, but in most parts 7 and 8; these banks are very narrow, and are convenient for ships anchoring who wish to obtain wood and water; the tides are strong in this channel. To the E.N.E. of Wah-doo, from 2 to $3\frac{1}{2}$ miles, are several small islands; between the two westernmost a safe channel with 34 fathoms, the least water in its deepest part, leads north into the Atoll. To the eastward of these islands, from 1 to $2\frac{1}{2}$ miles, are two other channels leading in N.W.; still further to the eastward is the large channel of

Ghang, off the west side of the large island of that name, which has been described in the first part of the description of this Atoll; the centre of Ghang island is in Lat. 0° 17′ N., Long. 73° 21′ 48″ E., on both sides of this island there is a good channel.

"From Ghang island the direction of the Atoll is N. 55° E. distant 10 miles to the S.E. point of the Atoll, which is in Lat. 0° 23′ N., and Long. 73° 29′ 48″ E.; in this space are several islands, looking at a distance like one island; they are all on one reef, and have no channels between them, except near the S.W. point of the Atoll, in Lat. 0° 21′ N., Long. 73° 27′ 18″ E.; this channel is wide and has 7 and 8 fathoms water in it, and leads into the Atoll, north; it is bounded on its east side by the island Kan-doo-hoo-loo-doo, which is inhabited, and contains good water and some supplies. To the N.E. of Kan-doo-hoo-loo-doo, distant 1½ to 2½ miles, lie two other islands; the northern one, Koo-boo-rah, is a little to the westward of the S.W. point of the Atoll, and in Lat. 0° 23′ N., Long. 73° 29′ 18″ E. North of this, at 2, 2½, 3 and 4 miles, are four smaller islands, all on the same reef, without any channels between them; these are the most eastern islands of the Atoll, in Long. 73° 29′ 33″ E. The barrier on which they lie, extends to the eastward (or seaward) from ¼ to ½ a mile. Mah-ra-rah island is the most northern island of these four last-mentioned islands, and close to the north of it, in Lat. 0° 27½′ N., is a good channel leading west into the Atoll, having 7 fathoms in it: opposite this channel, distant 1⅓ miles, inside the Atoll, is a small island; N. by E. of this channel, from 1 to 2 miles on the boundary of the Atoll, are two more islands, both on one reef. Then another channel, between Koon-day island, to the north, and Dec-ah-doo to the south; the channel is in Lat. 0° 29½′ N., and lies east and west, having 17 fathoms water in it. The islands on both sides of this channel are inhabited; the northern one, called Koon-day, in Lat. 0° 30′ N., and Long. 73° 28′ 48″ E., is a little more than 1 mile in length; it is situated on the south extreme of a part of the barrier reef, extending to the N.N.W. 3½ miles, on which are four small islands: on the north side of which is another safe channel for ships, in Lat. 0° 33′ N., leading into the Atoll W.S.W.; to the north and N.N.W. of this, from 1 to 2, 3 and 4 miles, four small islands are situated, on separate reefs (on the boundary), with channels between them; the channels are small, except between the two centre islands. This channel is in Lat. 0° 34½′ N., Long. 73° 26′ 48″ E., from this channel the Atoll and islands lie in a N.W. direction, 5½ miles, to the centre of Nillan-doo island, between which and the channel just mentioned are four islands and two good channels.

"Nillan-doo island (its centre in Lat. 0° 38½′ N., Long. 73° 22′ 18″ E.) is a little more than 1 mile in extent. On both sides of this island, north and south, are good channels leading into the Atoll, having 12 and 13 fathoms in them; the northern channel leads in west, the southern one W.S.W. Nillan-doo is inhabited, as also the island to the south of it, called Dan-doo; the former has good water, and some supplies, with good anchorage: on its inner side from 17 to 25 fathoms, from the centre of Nillan-doo island, as described, the islands and outer boundary of the Atoll lie N. ½ W. and N. by W., 15 miles; the first six islands north of Nillan-doo, 5 miles, are on one reef, with no channel between them; a little more to the north, in Lat. 0° 44′ N., Long. 73° 21′ 48″ E., is the island of Koo-ber-doo, having a safe channel on its north and south side; that on its south side is formed between the island Mah-men-doo, distant 1 mile, that on its north side by the island Willee-gillee, distant 1 mile; these three islands are inhabited. Willee-gillee island, which is on the north side of

the channel, is situated on the extreme south point of the barrier reef, extending from the extreme north point of the Atoll, 11 miles; close to the north of Willee-gillee are four smaller islands; and in Lat. 0° 50½′ N., Long. 73° 20′ 18″ E., on the barrier, are two other small islands, having no other nearer to them than 5 miles; these are generally first seen by ships coming from the north-east.

"**ONE-AND-A-HALF DEGREE CHANNEL,** situated between Adou-matte Atoll to the north, and the Suadiva Atoll to the south, is 51 miles in breadth between the Atolls. This channel is free from dangers, and a ship soon passes the north point of Suadiva Atoll in Lat. 0° 55′ N., and Long. 73° 13′ 48″ E., and 73° 16′ 18″ E., and the south part of Adou-matte Atoll in Lat. 1° 47′ N., Long. 73° 21′ 48″ E. Should a ship be drifted near to the south point of Adou-matte Atoll, she may enter the Atoll by a large channel 2 miles wide, situated from 3 to 4 miles to the E.N.E. of the south point of the Atoll, on which are two large islands looking like one island; round the east point of them is the channel, having from 12 to 20 fathoms in it. Should a ship drift near to Suadiva Atoll, the channels to enter this Atoll have been described.

"**ADOU-MATTE ATOLL** is a small Atoll, in shape like a leg of mutton; it lies N.E. and S.W., the smaller part of it to the N.E.; it is principally surrounded by a barrier reef; its length is 26 miles, its breadth in the S.W. part from 15 to 17 miles; its boundary as follows—N.E. extreme point, on which is the large island of Esdoo, 2 miles in extent, whose N.E. extreme point is in Lat. 2° 7′ N., Long. 73° 34′ 18″ E.; from this to the south, 6 miles, and a little to the westward, lie eleven small islands, all on the same reef; a little more to the south, in Lat. 2° 1½′ N., is the island of Mah-ba-doo (inhabited). North and south of this island are channels leading into the Atoll; the northern channel has from 3 to 4 fathoms in it; the south one has 8 fathoms, and is formed between Mah-ba-doo and Mundoo island to the south; from this last-mentioned island, Mundoo, in Lat. 2° 1′ N., the boundary of the Atoll then extends south a little east 6½ miles; then S. 30° W., 5½ miles; then W. by S., 4 miles; all this distance is one continued barrier reef, thickly covered with islands. A little to the eastward of the south point of the Atoll there is a large and safe channel, 2 miles wide, leading into the Atoll, by which a ship may enter; three small islands are situated inside the channel, a ship may pass between them, or on either side, as the winds may be. Heena-doo Adoo island bounds the west side of the channel, its east extreme point is in Lat. 1° 48′ N., Long. 73° 23′ 48″ E.; a reef extends off the island to the eastward from ½ to ¾ of a mile, on which the surf breaks high. Gahdoo island bounds the east side of the channel and its centre, in Lat. 1° 49′ N., Long. 73° 26′ 18″ E. Should a ship enter this channel, being in want of supplies of wood, water, and poultry, she may, when through the channel, proceed to the island of Mhow-ah, on the western boundary of the Atoll, distant about 11 miles to the W.N.W. of this channel, where wood, water, and poultry are to be procured; care must be taken to avoid the coral patches inside the Atoll, all of which are discernible on a clear day, more especially after entering the channel, and having passed between the island bounding the west side of the channel, and to the south of the three small islands inside the Atoll and channel, as several coral patches lie west from these islands, distant from 1 to 1½ miles. From the south extreme of the Atoll, in Lat. 1° 47′ N., Long. 73° 21′ 48″ E., the Atoll then turns to the north and

west, one continued barrier reef with several islands on it. On the extreme west point of the Atoll, on the boundary, is the island of Mhow-ah, in Lat. 1° 53½′ N., Long. 73° 14′ 18″ E.; this island contains between 300 and 400 inhabitants, who trade to Calcutta every year, in three or four vessels of their own construction, of from 80 to 100 tons burthen; the island is from ½ to ¾ of a mile in length and breadth, with good anchorage on its inner side, from 17 to 20 fathoms. North of Mhow-ah, 1½ miles, is a narrow but safe channel leading into the Atoll; the direction of the channel is about S.E. and E.; two small islands on the north side point it out, and lie to the N.N.E. of Mhow-ah, 1¾ miles, and are used as places of interment to those natives who die on board their boats. On the N.W. part of the Atoll is a small island called Hang-hooree, situated N.N.E., 4 miles from Mhow-ah, in Lat. 1° 57½′ N., Long. 73° 15′ 48″ E. From this island the northern boundary of the Atoll extends in a straight line N. 60° E., distant 20 miles, having only three small islands in this space, and two indifferent channels; the first channel is 4½ miles from Hang-hooree, close to the east of two small islands, called Mooneah-fooree; this channel has not more than 4 fathoms in it, and generally 3 to 3½; the next channel is close to the east of a small island, called Wad-i-noo, in Lat. 2° 1′ N., Long. 73° 21′ 18″ E.; this channel, though narrow, has deep water in it. From this to the N.E. point of the Atoll, Esdoo island is one continued barrier reef; there are no islands within the Atoll, except the three mentioned as being in the south part: the general depth within the Atoll is from 25, 35, to 42 fathoms.

"**COLLOMANDOO ATOLL.**—This Atoll is of considerable extent, and like Adou-Matte Atoll is principally surrounded by barrier reefs; it is of a circular form, except its S.E. side, which is nearly a straight line; there are only 6 islands within the Atoll, and those are near the western boundary. Numerous coral patches, dry at low water, lie within the Atoll, and the general depths are from 32 to 42 fathoms; the limits of the Atoll are as follow:—South point an island called Kim-bee-doo (inhabited) its centre in Lat. 2° 10½′ N., Long. 73° 3′ 18″ E.; from this to the east point is one straight line, N.E. by E. 22 miles. The east point is the south point of a large island, called Phalah, in Lat. 2° 23′ N., Long. 73° 21′ 18″ E.; this island is 3½ miles in length, north and south, and bounds the east end of the Atoll. The N.E. point of the Atoll is the centre of a moderate sized island called Willi-fooree (inhabited) in Lat. 2° 31′ N., Long. 73° 17′ 48″ E. The north point of the Atoll is the centre of a small island, called Bdoronee, in Lat. 2° 34′ N., Long. 73° 5′ 48″ E. The N.W. point of the Atoll, a small island called Kando-fooree, in Lat. 2° 32′ N., Long. 72° 58′ 48″ E. The N.W. point of the barrier, on which are no islands, is in Lat. 2° 28′ N., Long. 72° 52′ 48″ E.; from this to the S.W. point, the centre of a small island on the barrier, called Fooree, in Lat. 2° 12′ N., Long. 72° 57′ 18″ E.; between these two last points is the west boundary of the Atoll, preserving nearly a straight line, having two conspicuous islands, the north one in Lat. 2° 19½′ N., Long. 72° 54′ 48″ E., called Karn-doo-doo; the southern island called He-lan-doo, in Lat. 2° 16½′ N., Long. 72° 55′ 48″ E.: both these islands are inhabited, and afford good water, wood, and poultry. Between them is a wide channel leading into the Atoll, having two islands within the Atoll, facing the entrance of the channel, and about 1 to 2 miles inside, and four other smaller islands at the back of them. A reef extends to the south of the larger island, which bounds the north part of the channel, to the distance of half a mile; in the middle and entrance of this large channel there is some shoal water, with coral rocks, having 6 and 7 fathoms water on them, yet in

one small spot there is only 4 fathoms; this may be easily avoided, as on either side of it there is a deep gut, one close to the reef off the northern island, the other close to the southern island; either side may be used according as a ship may wish to anchor eastward of the north island (Karn-doo-doo), or the south one (He-lan-doo). There are no other channels on the west side of the Atoll, and from this round the S.W. and south part is one barrier reef. Passing the south point of the Atoll (the island Kim-be-doo as formerly described,) 2 miles to the E.N.E. is the island Vai-man-doo, its centre in Lat. 2° 11¼′ N., Long. 73° 5′ 3″ E.; close to the east of which, and between it and the next island, Kanhemeedoo, is a broad and deep channel, with a large coral reef within the Atoll, facing the channel, distant about 1½ miles. One mile to the east of Kanhemeedoo, is a small island, and between them a good channel. Further east, one mile, another larger island, called Te-mar-rah, and between the two latter a deep and safe channel, having 35 and 38 fathoms in it; these are the only channels leading into the Atoll on its south part. Te-mar-rah island is situated on the extreme of the barrier reef, which bounds the south-east part of the Atoll, and is in Lat. 2° 12⅓′ N., Long. 73° 7′ 48″ E. From this island, N.E. by E., 13 miles, there are no more channels; all is one barrier reef, thickly covered with islands. Three miles to the S.W. of the east point of the Atoll, is a good channel, half a mile wide, having 8 fathoms in it; the channel is between two islands, and in Lat. 2° 20½′ N., Long. 73° 18′ 48″ E.; from this, round the E. and N.E. parts of the Atoll, are no channels. Between the N.E. and N. points of the Atoll, as described, there are six straggling small islands on the barrier reef; close to the east point of each of the islands are channels leading into the Atoll, which though small are safe. The channel close to the east of Bdoronee island, the north part of the Atoll, in Lat. 2° 34′ N., Long. 73° 5′ 48″ E., is the best channel, being wider and deeper. On the N.W. part of the Atoll there are two other channels, a deep but narrow one close to the east of Kandoo-foree island, in Lat. 2° 32′ N., Long. 72° 58′ 48″ E.; and to the W.S.W. of this island, 1¼ miles, is another channel, much broader, having 12 to 14 fathoms in it; a large bank of coral shingle is on the east side of this channel. There are no more channels on the N.W. or W. sides, except the large one as formerly described on the centre of the west side of the Atoll.

"**VAI-MAN-DOO CHANNEL**, situated between Adou-Matte Atoll to the south, and Collomandoo Atoll to the north; the direction of this channel is N. 53° E. and S. 53° W., 27 miles long, and the breadth of the channel, or distance between the two Atolls, is from 16 to 17 miles, free from danger; the centre of the east entrance is in Lat. 2° 16½′ N., Long. 73° 27′ 48″ E.; the western entrance is in Lat. 2° 1′ N., Long. 73° 6′ 48″ E.; should a ship in calms and light airs be drifted near either of the Atolls, the channels to enter them and their boundaries have been described. The boundary of Vai-man-doo Channel is as follows:—East entrance—on the north side is Phalah island, its south point in Lat. 2° 23′ N., Long. 73° 20′ 48″ E., and is on the east extreme of Collomandoo Atoll: the south boundary on the east entrance is the centre of the large island of Esdoo, on the N.E. extreme of Adou-Matte Atoll, in Lat. 2° 7′ N., Long. 73° 33′ 18″ E.: the western entrance, north boundary, is the island Kim-bee-doo, on the south point of Collomandoo Atoll, in Lat. 2° 10′ N., Long. 73° 3′ 18″ E.: south boundary is the island of Mhow-ah, on the west side of Adou-Matte Atoll, in Lat. 1° 53½′ N., Long. 73° 14′ 18″ E., but the narrowest part of the channel at the west entrance is between the south point of Collomandoo Atoll, and

N.W. island of Adou-Matte Atoll, in Lat. 1° 57½′ N., Long. 73° 15′ 48″ E., situated by itself on the N.W. part of the barrier reef. It is high water in this channel, full and change of the moon at 3 hours; rise and fall, about 4 feet: the flood tide runs to the east, ebb to the west, velocity about 2 miles per hour in the springs.

"**KOODAH-HOOAH-DOO CHANNEL** is formed between the Atolls Nillandoo, and Moloque, to the north, and Collomandoo to the south; its western entrance is its narrowest part, being only ten miles wide, between the south part of Nillandoo Atoll, on which is a moderate sized island, called Koodah-hooah-doo, in Lat. 2° 40½′ N., Long. 72° 53′ 48″ E.; from this to the nearest part of Collomandoo Atoll across the channel is 10 miles, to an island on its N.W. boundary, called Kandoo-fooree, in Lat. 2° 32′ N., Long. 72° 58′ 48″ E.; the eastern entrance of this channel is bounded on the north side by the islands in the south extreme of Moloque Atoll, in Lat. 2° 46′ N., Long. 73° 23′ 18″ E., and the island Willi-fooree on the south side, which is on the N.E. extreme of Collomandoo Atoll, in Lat. 2° 30½′ N., Long. 73° 17′ 48″ E.; near the centre on the south boundary of the channel is the small island of Bdoronee, in Lat. 2° 34′ N., Long. 73° 5′ 18″ E., which is the north boundary of Collomandoo Atoll; N.N.W. of this island, 10 miles, is an open space between Moloque and Nillandoo Atolls, which are 19 miles apart. The tides in this channel have the same direction as in the other — flood to the east, and the ebb to the west.

"To the north of Collomandoo Atoll, from Lat. 2° 35′ N. to 6° N., the Atolls lie in double groups, east and west, with an open space of 10 to 20 miles between them, free from all dangers.

"**NILLANDOO ATOLL** is one of the western Atolls next to the north of Collomandoo Atoll; is 40 miles in length north and south, and is divided into two parts — the northern and southern — having a channel three and a half miles wide, without soundings, separating the two parts. South Nillandoo Atoll extends from Lat. 2° 40′ to 3° 1½′ N., Long. from 72° 49′ 18″ to 73° 1′ 48″ E.; North Nillandoo Atoll, from Lat. 3° 4′ N. to 3° 20½′ N., and Long. 72° 47′ 48″ E. and 73° 1′ 48″ E. On the south point of **South Nillandoo** is the moderate sized island of Koodah-hooah-doo, inhabited, and which gives name to the channel south of Nillandoo; this island affords some supplies of wood, water, and poultry; its centre is in Lat. 2° 40½′ N., and Long. 72° 53′ 48″ E.; on its east side is an excellent channel one mile wide, leading into the Atoll; between it and the next two small islands to the E.N.E., distant one mile and a half, there is 9 and 10 fathoms in the channel. From the N.W. of Koodah-hooah-doo a barrier reef extends 12 miles to the N.N.W. to Lat. 2° 51′ N., with three islands on the S.W. part of the barrier, from 2 to 3 miles to the N.N.W. of Koodah-hooah-doo. On the S.E. side of the Atoll there is another good channel to enter, N. 70° E., distant 4½ miles from Kooah-hooah-doo; and the third island from it to the E.N.E. is the moderate sized island Mah-im-boo-doo (inhabited); on its east side is the channel having 14 fathoms in it, and nearly one mile wide; to the N.E. of this last channel near the S.E. point of the Atoll is another channel, which though narrow is deep. The S.E. point of the Atoll, in Lat. 2° 45′ N., Long. 73° 1′ 18″ E., is the south extreme of a large group of 20 islands, situated close together on one reef, extending from the S.E. part to the northward 5 miles, where there is a channel to enter. The east side of the Atoll lies north from the S.E. point, nearly in a

straight line. On the northern part are several detached small islands on the boundary, all on separate reefs, with a safe channel on the south side of every island; they are situated as follows: — in Lat. 2° 51½′, 2° 53¼′, 2° 56′, and 2° 59′ N. The most N.E. island in the Atoll is the small island of Fooree, in Lat. 3° 1′ N., Long. 73° 0′ 18″ E.; south of it, one mile, there is another small island, and between them a good channel to enter the Atoll. On the north side of the Atoll there are no islands, two large reefs bound it; between them in the centre, in Lat. 3° 1′ N., Long. 72° 55′ 48″ E. is a wide channel with 17 fathoms in it, and to the W.S.W. of this channel 4 miles, is another broad channel between the boundary reefs; also to the S.W. 2½ miles on the N.W. part of the Atoll, is another broad channel. Two moderate sized islands are situated on the boundary on the west side of the Atoll, the northern one, Mar-dally, in Lat. 2° 53½′ N., Long. 72° 49′ 48″ E.; the other island, Hoo-loo-dally, is 2 miles to the S.S.E. of Mar-dally, and is the larger island of the two; between them is a broad channel 1¼ miles wide, with 19 fathoms in it; there is also a good channel close to the S.W. side of Hoo-loo-dally and the north point of the large barrier reef, which extends from this to the S.W. and south of the Atoll. There are 11 small islands in the N.W. part of the Atoll, distant 2, 3, and 4 miles to the N.E. of Mar-dally; on the N.E. one, called Doo-rais, reside a number of working jewellers, who voyage among the Atolls for employment. The general depths in the Atoll are from 27 to 35 fathoms. Within are several large and small coral reefs, dry at low water; and some in the south part that have 1 and 2 fathoms on them; they are all steep, and easily discovered.

"**North Nillandoo Atoll** has not many islands on its boundary, or within the Atoll; on its S. point is the moderate sized island of Nillandoo, in Lat. 3° 4½′ N., Long. 72° 53′ 18″ E.; this island is inhabited, and affords some supplies; on its east side a good channel (1 mile wide, with 20 fathoms in it) leads into the Atoll. The next island to the E.N.E. of Nillandoo is Dare-um-boo-doo, to the east of which is another good channel, nearly 1 mile wide. On the west side of the Atoll, N.W. from Nillandoo 4 miles, is one long reef on the boundary; a little north of this there is a good channel leading into the Atoll; then there is a circular lagoon reef, to the north of which in Lat. 3° 9½′ N. is another channel; these are the only channels on the west side of the Atoll, excepting two on the N.W. part, one close to the south of Himmittee island. Himmittee island is a small island with high trees on it, situated on the boundary of the N.W. part of the Atoll, in Lat. 3° 16′ N., Long. 72° 48′ 18″ E. The island, though small, contains between 200 and 300 inhabitants; they are great traders and navigators, sending annually to Bengal five or six vessels or boats, from 80 to 100 tons measurement each: here also is a large school for instructing the native youths in navigation; the natives also make nautical instruments here, and I was somewhat surprised at a very neat wooden sextant made by them. Although this island is thickly inhabited, the fresh water on it is bad. Ten or fifteen years past this island was twice the size it is now; the sea has been gradually washing it away. Close to the south of Himmittee is a good channel leading into the Atoll; a small island within the Atoll, two miles, faces this channel, the least water in it is six fathoms; a ship after entering may pass either to the N.W. or S.W. of the small island, and anchor: a reef extends from Himmittee north 1½ miles, between which and the next boundary reef, to the N.N.E. 1 mile, is a good channel, having 15 fathoms water in it. On the north part of the Atoll is a small island with a clump of cocoa-nut trees on it, in Lat. 3° 20′ N., Long. 72° 52′ 48″ E. Close to the east side

of this island are two channels, and to the west of it, 1½ miles, another channel, whose depths are from 15 to 20 fathoms. On the N.E. and east part of the Atoll are channels every 1, 2, and 3 miles, some of them are narrow, but safe. The general depths in this Atoll are 25 and 35 fathoms; several large coral reefs dry at low water are within.

"**MOLOQUE ATOLL.** — This Atoll, situated to the N.N.E. of Collomandoo Atoll 15 miles, is in length, north and south, 25 miles by 15 miles in breadth, east and west: the N.W. point is in Lat. 3° 10′ N., and Long. 73° 21′ 48″ E., the N.E. point is in Lat. 3° 7′ N., Long. 73° 36′ 48″ E., south or S.W. point Lat. 2° 45½′ N., Long. 73° 23′ 18″ E., the centre and eastern side of the Atoll is in Lat. 2° 56½′ N., Long. 73° 33′ 18″ E.; here are several islands, the largest one called Moloque, which faces a large channel leading into the Atoll. Moloque island may be known by a large banyan tree near its north and centre part; it is in Lat. 2° 57′ N., Long. 73° 32′ 48″ E.; it affords good water, plenty of wood, and a few supplies; there is a good channel on each side of its island leading into the Atoll, in which are soundings from 8 to 15 fathoms, sand and rocky bottom, deepening to 25 and 28 fathoms, as you enter the Atoll; in which depth a vessel may anchor on a sandy bottom. The village on Moloque island, containing about 200 inhabitants, is on the N.E. side of the island, whence the natives bring the water. The passage to the south of Moloque is the best, being nearly 1 mile in breadth, with the island of Molee forming the southern boundary of the passage. Molee contains 200 inhabitants, but does not produce good water: the Atoll Warre, or chief of the Atoll, resides here. N.E. of Moloque island, 1 mile, and bounding the north of the other passage leading into the Atoll, is the island Vaivand, 1 mile in extent: it has 200 inhabitants; the fresh water on it is bad. The passage between Moloque and Vaivand is rather contracted, as shoal water projects from the south end of the Vaivand and the N.E. end of Moloque; however, with a fair wind the centre of the passage is safe, having 8 fathoms sandy bottom. From Moloque or Vaivand island, N.N.E. 10 miles to the N.E. extreme of the Atoll, is nothing but a long barrier reef with no passages through it. There are three small islands in this space; and on the N.E. point of the Atoll are two moderate sized islands (both inhabited), called Rymun-doo, in Lat. 3° 5′ N., Long. 73° 36′ 18″ E.; they cannot be approached, except from the interior of the Atoll. From these two northern islands the barrier reef then takes a direction to the W.N.W., between which and the N.W. point of the Atoll are two small, inhabited islands, with high cocoa-nut trees on them. Near and between these islands are two narrow passages leading into the Atoll. The channels are safe, though narrow, being about 50 yards in breadth, and having not less than 7 fathoms in them. From these islands to the N.W. point of the Atoll, which is the elbow of a large barrier reef, there are only two passages, almost too narrow for ships to enter: they might be adopted in case of great emergency. From the N.W. point of the Atoll, in Lat. 3° 10′ N., Long. 73° 20′ 48″ E., as formerly mentioned, the outer and western boundary of the Atoll takes a direction south, a little west, distant 23 miles, to Lat. 2° 47′ N., Long. 73° 20′ 18″ E. In this space there are fifteen passages, or channels, all safe for ships, some of them rather small; indeed, almost at every mile you find a passage on this side of the Atoll; none of them have less water than 10 and 15 fathoms: there is only one small island in the centre of this space, to the south of which is a good channel; the island has neither inhabitants nor water,

and is called Too-ah, in Lat. 2° 54′ N. On the south point of the Atoll, from Latitudes 2° 45½′ to 2° 48½′ N., Long. 73° 23′ 18″ E., are situated on the barrier reef six islands close together, two of which are inhabited, and possess good water; they can only be landed upon from the inner part of the Atoll: from this to Moloque island is N.E. 15 miles, and is one continued barrier reef, without a passage through it; several heaps of coral stones are here and there seen above the surf, and on some are bushes: the surf from the long S.E. swell breaks very high here, even in N.E. Monsoon. As you approach Moloque several smaller islands are on the barrier to the S.S.W. of it, from four to five miles. The Atoll altogether contains 21 islands, nine of which are inhabited, having a population of about 900 inhabitants. There are a number of coral patches within the Atoll, and the depth of water is from 28 to 38 fathoms on a sandy bottom; the greatest depth is in the centre of the Atoll: it is high water at three hours, full and change of moon, rise and fall about four feet.

"**CHANNEL BETWEEN MOLOQUE AND PHA-LEE-DOO ATOLLS.**—Between these two Atolls is 8½ miles from the north part of Moloque to the south part of Pha-lee-doo, on which is a small island called Ra-chee-doo, in Lat. 3° 19′ N., Long. 73° 25′ 48″ E.; but this channel ought not to be used by ships, as it is nearly filled up by a large lagoon reef, dry at low water, called Wah-ter-oo reef, leaving a small channel on each side from 2 to 3 miles broad, having no soundings in them. The channel near Moloque Atoll is the larger; in both these channels the tides and currents run very strong, in which it is high water at three hours; flood to the east; ebb to the west. Wah-ter-oo reef, situated between the two Atolls, is almost circular, and nearly 4 miles in diameter; there are two low bushy islands on its south part: between these islands is the only opening for a boat, leading into the lagoon within the reef, in which there are soundings from 12 to 20 fathoms on a white sandy bottom; there are some young cocoa-nut trees on these islands, as also some wells, in which the fresh water rises and falls with the tide, being drinkable only at low tide. There are no inhabitants on them. Should a ship be obliged to pass through this channel from the eastward, she may clear the western Atolls by passing between the channel separating north and south Nillandoo, distant about 30 miles to the S.W.; and, should a ship coming from the westward enter the channel between the north and south Nillandoo, she may clear the eastern Atolls by passing through the channel between Moloque and Wah-ter-oo reef, or Pha-lee-doo Atoll and the reef; and, if the winds will not allow her doing so, she can steer to the S.E. round the south of Moloque, or to the north round Pha-lee-doo Atoll, into the Pha-lee-doo channel.

"**PHA-LEE-DOO ATOLL.**—This Atoll is the next to the north of Moloque, and is situated between Lat. 3° 19½′ and 3° 41′ N.: it is of an extraordinary shape, like a gouty foot and leg; the sole of the foot, or south part of the Atoll, is one immense barrier reef, extending 20 miles E.N.E. and W.S.W. On the eastern point, or toe of the Atoll, is an island (now uninhabited) called Fa-ta-o, which lies in Lat. 3° 27½′ N., Long. 73° 43′ 48″ E. on the extreme point of the barrier: there is no passage into the Atoll near this island. It is safe to approach from the eastward; coming from the northward, care should be taken not to be drifted to the westward of it, as there is a deep bay on the east side of the Atoll; the currents and tides run very strong into this bay, particularly during the N.E. Monsoon. A heavy swell sets direct on the islands in the centre and east side of the Atoll into this bay; and,

though there are channels close to all these islands, as well as several better ones to the northward of them, it would be hazardous for a vessel to steer for these channels or passages with light airs and a heavy swell. The north part of the Atoll, or Phoo-lee-doo island, is in Lat. 3° 41′ N., Long. 73° 22′ 48″ E.; the centre and west side of the Atoll is in Lat. 3° 30′ N., Long. 73° 15′ 28″ E.; at the south point, or heel of the Atoll, is an island called Ra-chee-doo, in Lat. 3° 19′ N., Long. 73° 25′ 48″ E. On either side of this island is a fine safe channel leading into the Atoll; within are numerous reefs and coral rocks, whose sides are precipitous, having soundings alongside of and between them, from 25 to 35 fathoms. There are three channels leading into the Atoll on the N.W. side, nine on the S.W., and two on the south point at Ra-chee-doo island. There are no channels on the south and east sides, but in the deep bay between the N.E. and east points there are 16 channels, all safe, some of them rather narrow. There are two small islands on the N.E. part of the Atoll, Dhiggherrie and Alley Mattar, the former the northern one, the latter the southern, in Lat. 3° 36′ N. Close to both these latter islands are good channels leading into the Atoll: there are only ten islands in the Atoll, five of them inhabited, containing a population of 300 inhabitants. The Chief, or Atoll Warree, resides at Tin-a-doo island, which is the northern one of those islands in the centre of the bay, between the East and N.E. points of the Atoll, in Lat. 3° 29½′ N., Long. 73° 30′ 3″ E. None of these islands afford wholesome drinking water, it is all brackish, the natives catch what they can when it rains; all kinds of pots and pans are then in requisition: the cocoa-nut trees are very useful for catching the rain, as round the base of their trunks they tie leaves to conduct the water into jars. Some few turtle are to be procured, and a few fowls; some limes and fruit; firewood is in plenty.

"**ARIADDOO CHANNEL AND PHOO-LEE-DOO CHANNEL.**—Ariaddoo channel is formed between the north part of Nillandoo Atoll and the south part of Ari Atoll, in Lat. 3° 30′ N., Long. 72° 49′ 48″ E.; the north part of Nillandoo Atoll is in Lat. 3° 20′ N., Long. 72° 52′ 48″ E.; it is 10 miles in breadth, free from dangers, and has no soundings in it. Should a ship from the westward enter this channel, she may clear the Atolls to the eastward when she is at the entrance of the channel, by steering N.E. by E. 36 miles, which will bring her between the Atolls of South Māle and Pha-lee-doo, called the Phoo-lee-doo channel, or she may steer from Ariaddoo channel to the E.S.E. through the channel, between Moloque and Pha-lee-doo, as formerly described.

"Phoo-lee-doo channel is safe, being bounded on its north side by the south point of South Māle Atoll, in Lat. 3° 48½′ N., Long. 73° 22′ 48″ E., and on the south side by the north point of Pha-lee-doo Atoll, on which is the island of Phoo-lee-doo in Lat. 3° 41′ N., Long. 73° 22′ 48″ E.: this channel is 8½ miles wide. Should a ship enter this channel from the east, she must clear the western Atolls, by steering to the S.W. through the Ariaddoo channel. The tides and currents in these channels set east and west, and are strong during the springs. Flood tide to the eastward, ebb to the westward; high water about two hours, full and change of the moon.

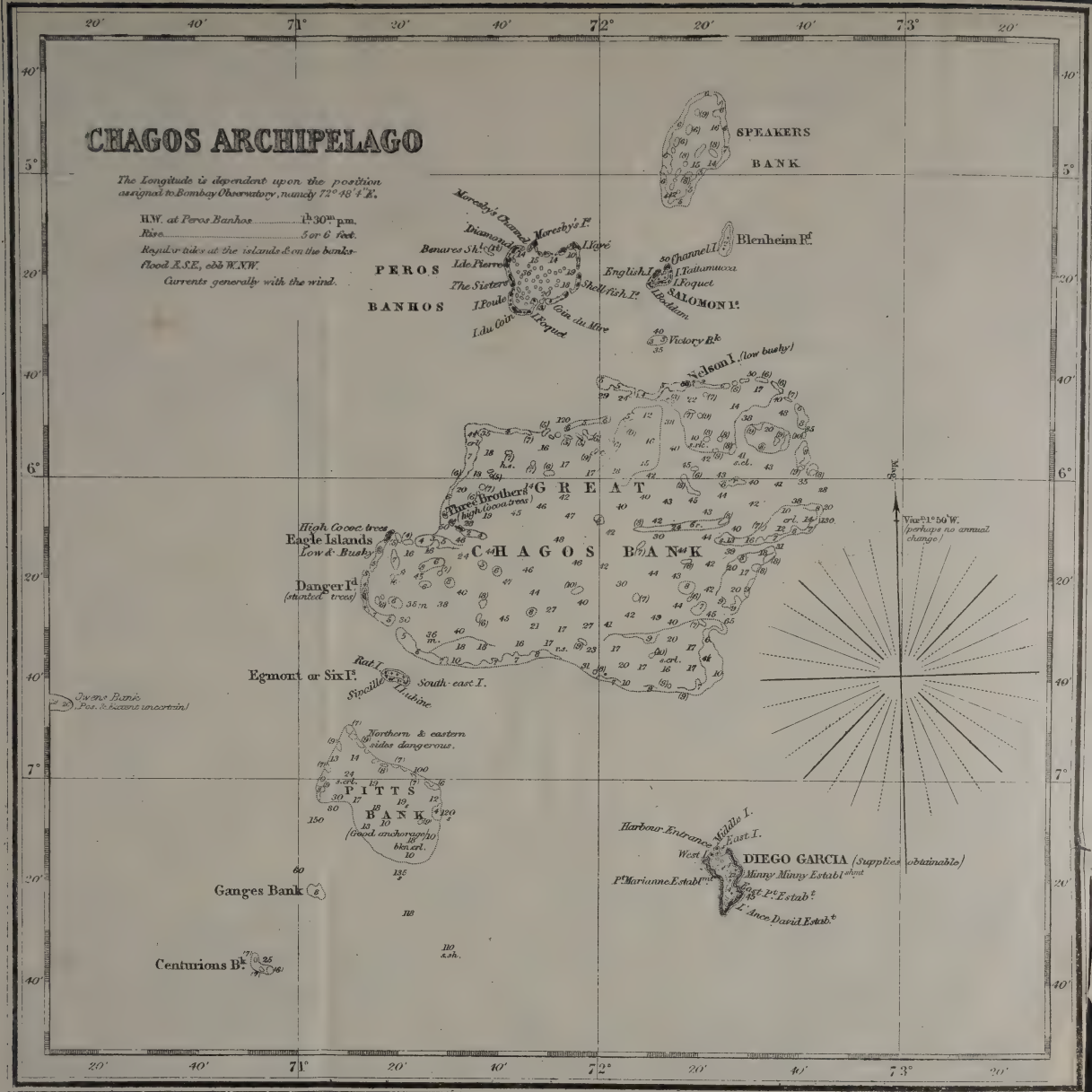
"**ARI ATOLL.**—This is one of the western Atolls, and situated between Lat. 3° 30′ and 4° 17′ N., Long. 72° 56′ 48″ and 72° 40′ 18″ E.: it is of oblong shape, 48 miles in length, north and south, by 17 in breadth, east and west. The greatest number of islands are situated on its eastern boundary, and they are generally small. The Atoll

has no barrier reef surrounding it, except a small space on the S.W. part; on all other sides, west, north, and east, are numerous good channels leading into the Atoll, safe for any ship to enter; those on the west side of the Atoll are the broadest, and are 13 in number, formed between the large lagoon reefs and the islands on the boundary: they occur every 3 and 4 miles. The principal islands on the western boundary are as follow:—Man-doo, in Lat. 3° 43′ N., Long. 72° 41′ 18″ E.; He-men-doo, in Lat. 3° 56′ N., Long. 72° 43′ 18″ E.; Mah-lus, in Lat. 4° 0′ N., Long. 72° 41′ 18″ E.; Feri-doo, in Lat. 4° 3½′ N., Long. 72° 42′ 3″ E. All the above islands are inhabited, and afford wood, water, and some few supplies. To the south of Man-doo is a good channel; south of He-men-doo another good channel between it and a small island, which lies 2 miles S. by W. from He-men-doo. Mah-lus island has on both sides of it an excellent channel, as also on both sides of Feri-doo island. On the N.W. boundary of the Atoll a small group of four small islands are situated on the south and west side of a lagoon reef: the northern one of the four is the largest, and is named Mattewaree, in Lat. 4° 12′ N., Long. 72° 43′ 18″ E. The island is inhabited, and affords good water and some few supplies. N. by E. of the island, 2 miles, is another small island with a narrow channel to the south of it; but close to the south of the group a large channel, 1½ miles wide, with 25 fathoms water in it, leads into the Atoll. There is a large lagoon reef on the north part of the Atoll, 5 miles in extent, which forms the north part of the Atoll, in Lat. 4° 17½′ N., Long. 72° 45′ 48″ E.: to the east of this reef is a channel 3 miles wide, leading into the Atoll, with not less than 22 and 27 fathoms in it. Soundings, from 100 to 170 fathoms, extend from the N. and N.E. of Ari Atoll, 5 and 6 miles. The island of Occulous, which is inhabited and affords some few supplies, as also wood and water, is situated on the N.E. part of the Atoll, in Lat. 4° 13¼′ N., Long. 72° 50′ 48″ E. A ship may anchor at this island without trouble or danger, except a few coral patches on the boundary to the S.E.; two small islands lie close to Occulous, distant 1 mile, one to the east, another to the north. The north part of Ari Atoll is very convenient for ships anchoring, as all dangers are visible, and the depths from 25 to 29 fathoms. To the N.E. of Ari Atoll, 5 miles, is a large lagoon reef, which I have named Ross' Atoll, in honour of Captain Daniel Ross, of the Indian Navy, formerly Marine-Surveyor-General. **Ross' Atoll** is nearly circular, its diameter 4½ miles, its north part in Lat. 4° 20′ N., Long. 72° 57′ 48″ E., its west side in Long. 72° 54′ 48″ E.; on its centre and south sides are three islands close together; the western one is the largest, and called Coura-mat-tee, in Lat. 4° 16′ N., Long. 72° 57′ 18″ E. It is inhabited. Between the islands is a channel for small vessels leading into the Atoll, and another channel with 8 fathoms in it on the N.E. side, near which, on the south side, is the small island of Welle-gan-doo, in Lat. 4° 18½′ N., Long. 72° 59′ 18″ E. The north and western side of this Atoll is one continued barrier reef; within are soundings from 15 to 20 fathoms, but it is full of coral patches. Between Ross' Atoll and Ari Atoll the channel is safe, having deep soundings from 100 to 140 fathoms. North of Ross' Atoll, 6 miles, is the moderate-sized island of **To-doo,** about 1½ miles in length, by 1 mile in breadth; it stands by itself, detached from any Atoll or reefs; it is steep, and safe to approach, the reef which surrounds it not extending more than 150 yards from the trees; its centre is in Lat. 4° 25¾′ N., Long. 72° 56′ 18″ E. It contains between 200 and 300 inhabitants, has good water, and some supplies; the natives on it are principally employed in fishing. To-doo island, Ross' Atoll, and the north part of Ari Atoll, bound the south part of the west entrance to the Cardiva

channel. The east side of Ari Atoll abounds with numerous channels leading into the Atoll; some of them are small, but all safe, if a good look-out is kept. On the S.E. part of the Atoll there is a large island called Dhig-hoorah, its north part in Lat. 3° 33½′ N., Long. 72° 54′ 48″ E. This island is inhabited. To the north of it, 1 mile, is a broad channel leading into the Atoll. Between it and the south point of a reef, extending to the south 2 miles, from the island of Dun-gah-tee, an inhabited island, lying 4 miles N. by E. from Dhig-hoorah; five miles to the S.W. of Dhig-hoorah is one reef, on which are three smaller islands, then two other larger ones, inhabited; the most southern one is Ari-ad-doo, and is on the extreme south point of the Atoll, in Lat. 3° 30′ N., Long. 72° 49′ 48″ E.; on either side of it is a safe channel leading into the Atoll; to the westward and north of Ari-ad-doo, 8 miles, is one continued barrier reef, on the S.W. boundary of the Atoll, on which are few islands. There are numerous large coral reefs within the Atoll, which are not all dry at low water, some having 2 and 3 fathoms on them: many of the large coral reefs whose edges are dry at low water, have deep lagoons inside of them; all may be avoided on a clear day with a good look-out. The general depths in the Atoll are from 30 to 40 fathoms; the tides on the springs are felt in this Atoll.

"**SOUTH MALE ATOLL.**—This is one of the eastern Atolls, and is situated between Pha-lee-doo Atoll and North Māle Atoll, between Lat. 3° 49′ and 4° 8′ N., and between Long. 73° 19′ 18″ and 73° 30′ 48″ E.; its greatest length N. by E. and S. by W. 20 miles, and 12 miles broad near the northern part. It contains 22 islands, three only of which are inhabited by about 200 people. None of the islands afford good water or supplies; they are all situated on the eastern side, except three on the western. Where islands are situated, there are safe channels to enter the Atoll; sometimes on both sides of the islands—excepting the smaller islands on the S.E. boundary, which are on a long and broad barrier reef, extending round the south side of the Atoll for 8 miles, leaving a channel on the S.W. part of the Atoll, with a heap of dry coral rocks on the west side of the entrance. The channel is half a mile broad, and has soundings in it from 5 to 8 fathoms. The west side of the Atoll is nearly a straight line, in Long. 73° 19′ 48″ E. There are several safe channels on this side, particularly one, in Lat. 4° 1½′ N. On the N.W. part are several channels, but they are small. On the N. part of the Atoll are two small islands, the easternmost, called War-doo, in Lat. 4° 7¼′ N., and Long. 73° 25′ 33″ E.; the westernmost small island is called Villar-sarroo; between them is a good channel leading into the Atoll, as also another channel to the east of War-doo; from thence, to the N.E. part of the Atoll, 4 miles, is one large reef, on the east part of which is a small island called Finorah, close to the south of which is a broad channel leading into the Atoll. A small island just within this Atoll faces this channel, and is named Heemboo-doo. The general depth in this Atoll is from 25 to 32 fathoms, sandy bottom; it is full of reefs and little coral patches, but these are easily avoided by a good look-out from the masthead.

"**WAR-DOO CHANNEL.**—This channel is formed between the south part of North Māle Atoll and the north part of the South Māle; it is only 2½ miles broad; its N.E. side is bounded by the island of Māle, or King's island, in Lat. 4° 10′ N., Long. 73° 28′ 48″ E.; the S.E. side by the reef and island of Finorah, in Lat. 4° 6′ N., Long. 73° 29′ 48″ E.; its western entrance faces Ari



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Words thus Amirante Islands signify unsurveyed, and of very doubtful authority

The Variation of the Compass is for the year 1863.

Atoll. On its N.W. boundary is the small island of Ge-rar-ver, on the S.W. part of Māle Atoll, in Lat. 4° 11½′ N., Long. 73° 22′ 48″ E. The S.W. boundary is the north part of South Māle and the small island of Villa-sarroo, in Lat. 4° 7′ N., Long. 73° 24′ 48″ E. This channel may be used by ships which cannot pass through the Cardiva channel. After entering by the westward, the direction of the War-doo channel is east and west 8 miles. The tides are very strong in this channel; the flood-tide to the east, the ebb to the west. During the Monsoons, when the tides are increased in strength by the currents, they run with great velocity, 4 miles an hour, and cause a great rippling in the sea, setting in whirlpools; difficult in light winds to steer a ship through. There is no bottom in this channel at 200 fathoms. From the west entrance of War-doo Channel to Ari Atoll is 25 miles; the space between them is free from danger; from To-doo island, in the Cardiva channel, it bears S. 55° E., 30 miles distant."

CHAGOS ARCHIPELAGO.

The following description of the Chagos archipelago is by COMMANDER MORESBY, of the Indian Navy, who surveyed the islands in 1837-8. The longitudes are dependent upon Bombay Observatory, ascertained to be 72° 48′ 4″·5 E.*

"The liberal means placed at my disposal enabled us to go over a great deal of ground, and to ascertain the limits of a great bank occupying the whole space between the outer islands, which bank I have named the Great Chagos bank, the outer edge of which is dangerous for ships, having in some parts only 4 fathoms, and seldom more than 6 or 7 fathoms; when over the edge the soundings suddenly deepen to 30 and 45 fathoms, with here and there patches of 8 and 6 fathoms. As a caution to navigators, I would advise them not to pass over this bank, except in a case of necessity, and that only in the day-time. Should a ship in the vicinity of these islands be in want of stock, water, and wood, it can easily be procured, without passing over or near this bank, by visiting either Peros Banhos or Diego Garcia, both of which lie without the bank, and afford every facility for vessels touching there. Pigs and poultry may be obtained in abundance. Masters of vessels should not allow their seamen to cut down the cocoa trees for the sake of the nuts, as they can be readily procured by other means.

"**DIEGO GARCIA,** or **GREAT CHAGOS ISLAND,** extends from Lat. 7° 13½′ to 7° 26½′ S., and a meridian line through its centre, is in Long. 72° 24′ 48″ E. The variation in 1837, by theodolite, 2° 20′ W., and the dip of the magnetic needle 35°: the rise and fall of the tides from 5 to 6½ feet. The tides run into the harbour to the S.S.E., and out N.N.W. It is high water at 1h. 30m. full and change; at spring tides, in the entrance of the channel, from its being contracted, the tides run about 2 miles per hour, and unless a vessel has a fair wind, or a good slant, she would find it impossible to work in to anchorage against the tide. This is frequently the case during the S.E. trade winds, which blow generally directly out of the harbour. I would advise a vessel, wishing to touch at this island during these winds, to make the island from the east; and so time her arrival off the entrance of

* See note at foot of page 585. Refer to the charts of the Chagos Archipelago, published by the Hydrographic Office, Admiralty, Nos. 3 and 4. Also, to the plan of the islands, in the sheet of Plans of Islands in the Indian Ocean, issued by the publishers of this work.

the channel as to have the tide in her favour to enter, when she can easily work in, as the channel is a mile broad; taking care not to approach too near to the reef, which extends to the westward from Middle island, which reef is very deceptive, having some shoal patches of coral off the western extreme, not easily discernible. The western island is steep, and can be safely approached: when inside the channel, the only care required is to have a look-out at the mast-head, to avoid the coral patches, few of which are in the centre of the bay, having 3 and $2\frac{1}{2}$ fathoms on them. Care must be taken not to stand too close over to the islands bounding the eastern side of the channel, as there are several coral knolls about this part: a coral band, dry at low water, surrounds the inner part of the island, extending from 100 to 200 yards off shore—this is easily seen. The best anchorage for a ship, during the S.E. trade, is at Minni Minny establishment, which bears from the centre of Middle island S. 29° E. 7 miles. At this place a ship anchors with the houses bearing S.E. or E.S.E., distant $\frac{1}{3}$ of a mile, and $\frac{1}{4}$ of a mile off the shore reef, in 10 fathoms, sand, the water perfectly smooth, and boats able to land on the beach at low water. The fresh water in wells is close to the beach, and very excellent; firewood also is equally available, and only requires cutting. In the N.W. Monsoon, the rainy season, this anchorage is rather a lee shore, and a chopping swell renders landing at times unpleasant. Vessels ought in this season, which is from the middle or beginning of December to the beginning or end of April, to anchor on the west side of the bay, under lee of the land near to point Marianne establishment, which bears from the centre of Middle island S. by E., distant $5\frac{1}{2}$ miles. A shoal bank of sand and coral extends off point Marianne, $\frac{3}{4}$ of a mile into the bay, close to the edge of which a ship may anchor in 8 or 10 fathoms, soft sand. Point Marianne and the establishment is known by some high trees of the fir species.

"The **Great Chagos Bank,** of which Blair's bank, as mentioned by Horsburgh, is only a part, occupies the centre of the Chagos archipelago. The S.W. point of this bank is nearly north from Diego Garcia, 32 miles, and in Lat. 6° 42′ S., Long. 72° 23′ 48″ E.; it then takes a direction N. 30° E. 39 miles, to its eastern boundary, which is in Lat. 6° 8′ S., Long. 72° 44′ 48″ E. Between these two points it curves to the west 5 miles; from the eastern boundary the bank continues to the N. by W. 29 miles, in Lat. 5° 40′ S.; it then runs west 35 miles, which is the northern and eastern edge of it. On this part lies the island I have called Nelson's island, in Lat. 5° 41′ S., and Long. 72° 16′ 48″ E. The N.W. point of the Great Chagos bank is in Lat. 5° 49′ S., and Long. 71° 33′ 48″ E.; it then takes a direction to the S. by W. 18 miles, to the north Brother island; it still continues further to the west, from 16 to 17 miles, and on its western edge lie the Eagle and Danger islands, the former in Lat. 6° 11′ S., Long. 71° 17′ 48″ E., the latter in Lat. 6° 23′ S., Long. 71° 12′ 48″ E. The bank then takes a sudden turn to the E.S.E. about 70 miles, passing to the northward of the Six islands, leaving a channel of 5 miles in breadth. The soundings on the edge of this bank are from 4 to 10 fathoms, sand and coral rock; the shoal water on its edges is not very broad. I consider it very dangerous; for, though the surveying vessels never found less water than 4 and $4\frac{1}{2}$ fathoms, a ship would do wrong to proceed over it without a good look-out, or adopting some of the channels which lead in. On some parts of the verge of this bank not less than 7 and 8 fathoms is to be found: when inside the bank, the soundings deepen to 40 and 45 fathoms, soft clay. Several coral patches, with

7 and 8 fathoms on them, will be found in the interior of the bank—capital spots to anchor on. Fish, such as sharks and some red rock fish, are in abundance.

"**Pitt's Bank** is to the S.W. of the Great Chagos bank, about 17 miles; between which there is a clear channel. The Six islands are on the northern side of this channel. This bank is of an oblong shape, N.W. and S.E., near 30 miles long, by 17 broad; its southern extreme is in Lat. 7° 17′ S., and Long. 71° 24′ 48″ E., the northern extreme in Lat. 6° 49′ S., and Long. 71° 10′ 18″ E., and bears from the centre of the Six islands S. 42° W., distant 13½ miles, between which and the bank is a good channel.

"The trees on the Six islands are just discernible from the poop of a ship when on the northern end of the bank. This bank is dangerous on the north and north-eastern sides, or edges; on some parts of this boundary we found 6 and 4 fathoms—there may be less; on the centre of the bank the soundings are deeper, from 17 to 20, and 24 fathoms, soft bottom; like the Great Chagos bank, it is steep all round. Close off the south end of this bank we had no soundings at 200 fathoms, yet at two miles' distance we obtained deep soundings on another bank, extending to the S.E. about 18 miles, on which we had from 110 to 135 fathoms, sand and shells. Pitt's bank ought to be avoided by navigators, more especially at night; yet in the day-time it may be passed over, if a good look-out is kept, and the shoal patches avoided. There is good anchorage on the bank.

"**Ganges Bank** is a small bank 15 miles distant to the S.W. of the Pitt's, its centre is in Lat. 7° 22′ S., and Long. 71° 3′ 18″ E.; it is from 3 to 4 miles in extent; least water 8 fathoms, and 12 fathoms in the centre. There are no soundings near the bank at 200 fathoms.

"**Centurion's Bank,** to the S.W. of the Ganges, 18 miles; between them are no soundings; the least water on this bank is 7 fathoms, on the N.E. edge, where we observed the heavy rollers breaking at times, and where two of our boats were in danger of being swamped. We anchored on the centre of it in 14 fathoms; it is from 3 to 4 miles in extent, and in Lat. 7° 37′ S., and Long. 70° 51′ 48″ E. There are no soundings close to the bank.

"**Owen's Bank** is supposed to be in Long. 70° 6′ 48″ E., yet, as I place Diego Garcia 8′ more east, Owen's bank will be in Lat. 6° 46½′ S., and Long. 70° 14′ 48″ E. We did not explore this bank.

"**Six Islands,** bearing from Diego Garcia N. 62° W. (true), distant 69½ miles. One of the largest islands of the group, on which the proprietor has built his magazines and establishment for cocoa-nut oil, is the south-easternmost island; it is in Lat. 6° 40′ S., and Long. 71° 21′ 18″ E. From this, other five islands lie on the circular edge of a coral reef, extending to the N.W. by W. 5 miles; the northern islands have conspicuous trees on them; there are no channels between the islands, nor soundings close to the reef, which is of an oval shape, having a lagoon in its centre, and depth of water in it from 8 to 12 fathoms; it is full of coral knolls. There is a wide channel leading into this lagoon on the north side of the circle; but only small vessels can enter, as 2 fathoms is the greatest depth of water on the edge of the reef. We found no coral bank extending off to the S.W. The reef is steep close to the breakers. The current and tides sometimes wash the loose sand off the reef to leeward, discolouring the blue water for half a mile, which we took to be shoal water fit for anchorage, until we found we were deceived. These islands produce 6000

gallons of oil yearly. Pigs and poultry in abundance; also pigeons, and the fat tail land crab, which are numerous. Fresh water is also easily procured; but should a vessel be in want of these articles, Diego Garcia, or Peros Banhos, as also Eagle island, are more convenient for anchoring and landing.

"**Danger Island**, in Lat. 6° 23′ S., Long. 71° 13′ 18″ E., is to the N.W. of the Six islands, and lies on the western edge of the Great Chagos bank. The island is nearly 1½ miles in extent, low, and covered with trees; we could not land on it from the violence of the surf. It is said to be full of wild poultry, and belongs to the proprietor of Eagle island. S. by W. from the island, distant from 2 to 3 miles, a dangerous reef extends, on which the sea breaks at times. There is good anchorage to the east of the island in 17 fathoms water, which is on the Great Chagos bank.

"**Eagle Island**, to the N.N.E. of Danger island, 12 miles, is 2½ miles in extent, N.E. and S.W., by ½ to ¾ mile broad, and lies also on the western edge of the Great Chagos bank. The island is covered with cocoa-trees, and some high jungle trees on its S.W. point, off which a breaking reef extends ½ a mile. To the S.W. of Eagle island, distant 2 miles, lies a woody island, half way between which and Eagle island there is a good channel, and anchorage in 7 or 8 fathoms water, sandy and coral bottom between the two islands, taking care not to stand to the northward of the transit line between the two islands, as the bank suddenly ceases. There are no soundings or anchorage to the N.W. of Eagle island, unless a ship would run the risk of anchoring on the bank of coral reef, extending 300 yards from the island, on which there is 5 and 6 fathoms; but this is a dangerous place in case of a shift of wind. The village lies at the N.W. side of the island, near the centre, and is in Lat. 6° 11′ S. and Long. 71° 17′ 48″ E. The landing-place is opposite the village; it is bad during the N.W. winds from December to May, but good during the S.E. trade; landing should never be attempted on any other part of the island, it being dangerous. A ship requiring supplies of wood, water, and poultry, may easily obtain them at this island, and may anchor as before-mentioned between the two islands. The proprietor of this island obtains yearly about 6000 gallons of cocoa-nut oil, a small quantity of cotton, soap, and tortoise-shell. Salt fish is also exported.

"The **Three Brothers**, small islands, as before-mentioned, situated on the N.W. verge of the Chagos bank, and 12 to 14 miles to the eastward of Eagle island, are small woody islands covered with cocoa-nut trees. They are not inhabited, yet belong to the proprietor of Eagle island; the centre one is in Lat. 6° 8½′ S., and Long. 71° 30′ 48″ E.; from this, the South Brother, the largest, lies 2 miles to the S.W., and the North Brother, the smallest, 2 miles to the N.W. These islands are difficult to land upon, on account of the high surf; excepting the middle one, round which, on the east side, there is a lagoon reef, and on the north part there is a channel leading to the Middle Brother; this island does not afford water. There is anchorage to the eastward of the Brothers in various depths, from 12 to 40 fathoms—the shoaler part near the North Brother; off the South Brother a reef extends; between the South and Middle Brother there is a channel having in the centre a rocky islet, on each side of which the soundings are from 12 to 20 fathoms. Between the North and Middle Brother is a good channel, from 35 to 25 fathoms. Close to the S.W. side of the Brothers a deep channel, with 40 and 50 fathoms in it, leads on the Great Chagos bank, on the verge of which, both to the N. and S.W. of the Brothers, there are some dangerous shoal spots.

"**Nelson Island**, in Lat. 5° 40½′ S. and Long. 72° 16′ 48″ E., on the nort

and eastern verge of the Great Chagos bank, was discovered by CAPTAIN DIXON, of the *Sivera*, and by CAPTAIN BIDIN, of the *Victory*, in 1835, and severally called by them Sivera and Nelson islands; the latter name I have retained. It is a low rocky island, about 12 feet above the sea, composed of rocky cliffs of sand-stone; the east and west ends of this island are covered with long grass and a few bushes; it is nearly divided in two by a dry sand-bank, and seen from a little distance looks like two islands; from one extreme to the other, east and west, is $1\frac{1}{4}$ miles in length, by 400 or 500 yards broad; there are no soundings close off its northern side; on the east and west are several shoal spots of 4 fathoms, on the verge of the Chagos bank; yet there is a good deep channel of 25 fathoms close to the east side of this island, leading on the bank, where a vessel may anchor at any distance from the island in 16 to 17 fathoms, sand and coral. This island bears from the Victory's bank S. 31° E. distant 10 miles—between which there are no soundings; and from the S.W. island of the Salomon group S. 20° E. 21 miles.

"**Victory Bank,** in extent from 3 to 4 miles, having from 3 to 4 fathoms water on it. I consider it is a dangerous coral bank, for though we found not less than 3 fathoms, there may be less on some of the rocks. It was discovered by CAPTAIN BIDIN, in the *Victory*, in 1835, and lies south from the Salomon islands, distant 11 miles, and is in Lat. 5° 33′ S. and Long. 72° 11′ 18″ E. There are no soundings close off this bank.

"**PEROS BANHOS,** the largest group of the Chagos islands, and, excepting Diego Garcia, the most valuable in the production of cocoa-nut oil (about 34,000 gallons yearly), is the property of a gentleman at Mauritius, whose overseer and negro apprentices, about 90 in number, manufacture the oil. This group was discovered by the French in 1744; their situation is between Lat. 5° $13\frac{1}{2}$′ and 5° 27′ S., and Long. 71° 41′ 48″ and 71° 55′ 48″ E. It forms nearly a square, of 50 miles in circuit, containing 27 islands of small extent, low, and covered with cocoa trees; nearly all are on the north and west sides; two only being on the east side, four on the south side — two of which are barren rocky islands. Between all the northern islands are good channels leading in, having 8 and 10 fathoms water. The N.W. islands are connected by a barrier reef, which continues to the southward on the west side, as far as the middle of the group, where a good channel, $\frac{3}{4}$ of a mile wide, leads in, having 10 and 15 fathoms water in it. The barrier again commences on the southern side of this channel, and connects the islands on the southern and western sides; it breaks off again into several channels on the centre of the south side, close to two small rocky islands, with bushes on them, **Isle Vache Marine,** and **Coin du Mire.** Here the barrier is lost altogether above water; it can be traced under water, having 3, 5, and 7 fathoms on it. A vessel of 300 or 400 tons may pass over it, but the deeper parts ought to be chosen. A ship making Peros Banhos from the southward, or during the period of the S.E. trade winds, where a heavy swell rolls into the Atoll, would do well to enter by the southern channels, and anchor under the lee of the south westernmost island and reef, where there is an establishment of negro apprentices on **Isle du Coin;** this island is the south westernmost island of the group, about 2 miles long: $\frac{3}{4}$ of a mile from its east end lies a small island, with high forest trees on it. Still more to the east of this small island, distant 1 mile, lies another small island, larger than the former, but covered with low trees, and is called **Isle Foquet;** close to this latter island ends the barrier reef, round which a vessel may steer to enter the group; the channel here

between isle Foquet and isle Vache Marine being 2 miles wide, with 7, 8, and 10 fathoms water in it. From the channel, a west course, 3½ miles, leads to the anchorage off isle du Coin, in 13 to 15 fathoms water, with the houses bearing S.W., distant about 1 mile: wood, water, poultry, and some fruits and vegetables, may be obtained from the negroes. This is a good anchoring-place during the N.W. winds, or rainy season; but as the northern islands are then more directly to windward, and afford better shelter for a vessel getting her supplies, I would recommend **Diamond island** from December to May: it is the north-westernmost island of the group, about 2 miles long, thickly covered with cocoa trees, and contains the principal establishment, which is in Lat. 5° 15′ S., Long. 71° 42′ 48″ E.; and due north 11 miles from the southern establishment. A vessel may have the use of flat-bottomed boats to bring her water-casks off. There are abundance of poultry, fruit, vegetables, and pigs. The anchorage is ½ a mile distant from the houses, bearing N.W. in 16 to 17 fathoms. A coral reef extends from the shore, 200 to 300 yards, which is dry at low water, and is steep close to its edge. A ship departing from this anchorage, proceeding to the northward, may either proceed through any of the northern channels between the islands, or if the wind is far to the north, she can proceed through the eastern channel. In the centre of the group, on its eastern side, are two moderate-sized islands, covered with cocoa trees, and called **Petite Coquilage** and **Grande Coquilage.** Close to the northern island, Petite Coquilage, there is a good channel of 14 to 15 fathoms depth of water in it; between the two islands there is also 4 and 5 fathoms; from the north side of the channel, at Petite Coquilage, a reef, dry at low water, extends up to the N.E. island, called **Isle Yaye,** to the west of which there is a broad and safe channel. A ship making Peros Banhos from the N.W. during the N.W. winds, may either enter by the western channel, in the centre of the west side, or by Moresby's channel, which is the first channel on the north side, east of Diamond island. **Moresby's Channel** is ¾ of a mile wide, and has 7 and 8 fathoms water in it, taking care not to approach too near the spit of sand and coral reef, extending off the east end of Diamond island 1¼ miles; and which bounds the west side of the channel, as do Moresby's islands the east, which are bold and safe to approach. The soundings increase in depth to 20 and 30 fathoms, soft bottom, when a vessel has entered the group. Coral knolls are numerous in the centre, and are very easily seen; the sides of them are precipitous, none of them dry at low water, generally 2, 3, and 4 fathoms on them. Close outside the barrier reef of the group we found no bottom at 200 fathoms.

"**Benares Reef, or Shoal,** discovered by us, is a most dangerous shoal coral patch, having only 1½ to 2 fathoms on it, and lies W. ½ S. from the west side of Diamond isle, distant 4½ miles. The sea seldom breaks on it; it is about ½ a mile long N.W. and S.E., and lies outside the Peros Banhos group, consequently ought to be avoided by ships making the island from the N.W. There are no soundings near it, nor between the islands and it.

"It is high water at Peros Banhos at 1h. 30m., rise and fall from 5 to 6 feet; the ebb tide sets to the westward, flood to the eastward; the ebb runs out of all the northern channels.

"**Salomon Islands,** a circular group, containing five large and six smaller islets, is 11 miles in circumference, and has only one opening into it to the N.W.: this passage is narrow, being nearly blocked up by a shoal patch in the middle of the channel, on which there are only 1½ and 2 fathoms. On the northern side of this

patch the channel is the deepest, having 3 fathoms, and only 2 on the south side; the principal island is the S.W. island, called by Captain Blair **Boddam's island,** and is in Lat. 5° 21½′ S., Long. 72° 9′ 48″ E., and 14 miles to the east of the eastern side of the Peros Banhos. The N.E. island of the Salomon's is called **Isle de Passe,** in Lat. 5° 18′ S. and Long. 72° 12′ 18″ E., and bears from the south end of Blenheim reef (a dangerous breaking reef) S. 81° W.; and distant 12 miles from the south end of Speaker bank, between which there are no soundings.

"**Blenheim Reef** is a large lagoon reef, 6 miles in extent, north and south, by 2 miles broad; on the south end there is an opening to the lagoon, and anchorage off it in 6 or 7 fathoms; all other parts of the reef are steep, and have no soundings near. The rocks are generally covered at high water, excepting some large blocks of coral and sand-stone on its eastern side, perhaps the remains of three low sandy islands, as seen by the *Griffin*, in 1749, and also by other ships. The centre of the reef is in Lat. 5° 12½′ S., Long. 72° 24′ 48″ E., nearly south from the east verge of the Speaker's bank, distant 11 miles; the vicinity of these dangers has been well surveyed by us, and we may confidently say no other danger exists but what we have observed. Between the Blenheim reef and Speaker bank there are no soundings.

"**Speaker Bank** extends from Lat. 4° 44′ to 5° 6′ S., and between the longitudes of 72° 12′ and 72° 25′ E. It is nearly an oval shape, lying N.N.E. and S.S.W. about 24 miles, having a slight indentation on its S.E. side, like all the other banks of the Chagos; its edges are the shoalest part; the least water is 6 and 7 fathoms on its edges, excepting the south part, where we found only 4 fathoms; no doubt the sea would break here at times, when the long ocean-swell comes up with the S.E. trade. A ship ought to avoid this part; the water deepens on the centre of the bank to 15 and 22 fathoms, soft sand, and some spots of coral rock of 6 and 10 fathoms; the whole bank is sand and small coral. There are no soundings to be obtained close outside the bank.

"The currents about the Chagos are generally with the wind; four months, from the middle of December to the middle of April, to the eastward; during June, July, August, and September, to the westward, varying occasionally a little to the north or south of this direction. April and part of May the winds and currents are variable, all November and December the same: we found the greatest velocity of these currents to be 2 miles per hour on the great Chagos bank; this was when the tide and current ran in the same direction. There are regular tides on the banks and islands; the flood sets to the E.S.E., and the ebb to the W.N.W.; high water, full and change, 1h. 30m. Sometimes the tides and currents run obliquely to each other, or against each other, in which case the currents are retarded or accelerated, causing ripplings, and if there is much breeze, the swell becomes short, and confused, and on the shoaler parts of the banks heavy rollers break at times, each wave having a rise and fall (by measurement) from 15 to 18 feet: this alone ought to prevent ships crossing these banks when there is much swell, yet, as I observed before, they are easily avoided, and the islands approached with safety. Supplies are readily procured by ships in want of them."

ANDAMAN ISLANDS.

These islands extend from Lat. 10° 27′ to 14° 56′ N., and between Long. 92° 25′ and 93° 45′ E. They contain many fine harbours and anchorages capable of receiving fleets of the largest vessels, but are seldom visited, as there are no places of trade. The inhabitants bear the reputation of being extremely treacherous; hence it is necessary on landing to take all possible precautions against being attacked and cut off from the boats; but very little is really known of the natives of these islands beyond what is contained in occasional notices of shipwrecks, and these invariably represent them as irreclaimably savage, implacable, hostile, and inhospitable.* The islands are covered with dense forest, and there is abundance of fresh water. At Port Blair, in Lat. 11° 43′, a convict settlement has recently been formed by the Government of India.

The Andamans were partially surveyed by Lieutenant Blair and Captain Moorsom in 1789—1790, and in 1858 by the committee appointed by the Governor-General of India to discover a suitable place for a convict settlement. It is mainly from the reports of these surveys that the following description of the islands is derived.

PREPARIS, the northernmost of the Andamans, is 4½ miles long, in a N.N.E. and S.S.W. (*true*) direction, and very narrow, being not more than a mile wide in its broadest part. It is of moderate height, covered with wood, and slopes gradually to the sea. On its east side, at a few paces from a fine, sandy beach formed between two ledges of rock, where boats can land with safety, there is a pond of fresh water very convenient for watering; from it the highest part of the island bears N.W. This east side of the island is very steep, there being at a very short distance from it a depth of 10 fathoms, rapidly deepening to 17 and 22 fathoms. The north end of the island is in Lat. 14° 54′ 30″ N., and Long. 93° 43′ 30″ E.†

Both the east and west shores of Preparis island are bordered by a reef, which is prolonged southerly from its south end 3½ miles; upon it are some rocks above water. This reef is extremely dangerous, its edge being very steep, and the soundings near it are such that the lead gives little indication of its vicinity.

At about 1½ miles from the north end of Preparis there are some islets named Cow and Calf, connected with which is a bank of 6 to 8 fathoms extending from them nearly two miles, in a N.W. and S.E. direction. A channel, 11 to 24 fathoms deep, separates these from Preparis.

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* Captain J. H. Miller, in a communication to the *Nautical Magazine*, 1842, says:—"The islands on the west side of the Andamans are frequented during the fine season, from December to April, by a mixed and mongrel race of Malays, Chinese and Burmese fishermen for *Bêche de Mer* and edible birds'-nests, who are of very doubtful honesty; and it is necessary to take a few muskets and cutlasses, just to show them that you are prepared for mischief in case of need. These fellows are also 'fishers of men,' and to their evil deeds much of the hostility of the islanders may be attributed; they carry off children, for which they find a ready market as slaves in the neighbouring countries. I have been told that formerly they were friendly and assisted these fishermen, until a large party was invited on board a junk or prow (the Chinese got the blame of it), and after being intoxicated were carried off and sold at Acheen; and the practice is still carried on by these fellows, who land and carry them off whenever they can catch them. The Andamanians have retaliated fearfully whenever any foreigner has fallen into their power, and who can blame them?"

† This is according to the Admiralty chart, No. 152; but the observations of the Danish corvette, *Galathea*, place the north end of Preparis in Long. 93° 38′ 37″, supposing Fort Cornwallis, Penang, to be 100° 20′ 10″ E.

"On the west side of Preparis a reef with some islets upon it has its outer edge $2\frac{3}{4}$ miles from the island; in the narrow channel between this reef and the island are soundings of 9 to 15 fathoms. There is also a reef south of this one, on the same side of the island, having some rocks upon it above water, situated about 3 miles westward of the reef which extends southward from the south end of the island; this reef is seated upon a bank of 6 to 10 fathoms, and its south end is distant from the south end of Preparis about $6\frac{3}{4}$ miles in a S.W. by S.$\frac{1}{4}$S. direction, and from the extremity of the reef extending from the south end of that island S.W.$\frac{3}{4}$W. 4 miles.

The anchorage at Preparis is on its eastern side in 12 to 14 fathoms, or nearer the island at $\frac{1}{2}$ a mile from the shore in 8 or 9 fathoms; the bottom consists of sand, coral and shells. It is probable that there is anchorage also on its western side.

Although Preparis is considered to be one of the Andaman islands, it does not appear to be united to them by a bank of soundings, for in mid-channel between it and the Great Coco (the northernmost of the group) there is no bottom at 100 fathoms.

GREAT COCO.—At about 46 miles S. by W.$\frac{1}{2}$W. from the south end of Preparis is Great Coco island, which is sufficiently elevated to be visible from a distance of about 18 miles. It is or was covered with trees. It is about 7 miles long from north to south and 2 miles broad, and has a reef extending from its south end about 4 miles, upon which is an islet; two islets, named Table and Slipper, also lie off its north end. Areef is said to run off a short distance from its north-east shore. The island is seldom visited except for firewood and water.

Great Coco island has been only imperfectly examined, the above particulars are therefore uncertain. The usual anchorage is on its eastern side in 12 to 20 fathoms at about $1\frac{1}{2}$ miles from the shore; it is probable that vessels may also anchor off its west side in a similar depth.*

LITTLE COCO.—This island lies about 10 miles south-westward from Great Coco, is of moderate height, and visible from a distance of about 18 miles. Its extent from north to south is only $2\frac{1}{2}$ miles, and its breadth does not exceed $\frac{1}{2}$ a mile. It is or was covered with trees. According to LIEUTENANT BLAIR'S chart, a reef surrounds it except on its east side (which was apparently left unexamined), and extends from its north and south ends about a mile; this reef is steep, there being at a short

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* "The Great Coco has timber of a large size growing upon it, and a ship getting disabled in beating down the Bay in the South-west Monsoon may take shelter under this island, and procure sufficient spars to enable her to proceed on her voyage, or may caulk any open butts or seams. She may then, if bound across the equator, pursue her course to the southward, inside of the Andaman and Nicobar Islands, and round Acheen Head, without loss of time. This, I think, would in many cases be better than putting back, when it often happens that the expense for *necessary* repairs is but a fraction of the 'tottle.' On the 10th of October, 1839, I landed the following list of animals on the island:—One goat in kid, four pigs, eight ducks, and six fowls, and on a subsequent voyage pigeons and rabbits."—CAPTAIN J. H. MILLER.

"The Cocos are sheltered by the Andamans from the heavy south-west swell of the Bay of Bengal, and afford facilities for careening vessels in safety; of both the islands it may be said that they have a fine sandy beach all round, one or two commodious bays, and good anchorage, and that at the southern extremity of each there is a reef of rocks extending several miles into the sea. Both islands also are uninhabited. The Burmese occupy the Great Coco during the whole of the North-east Monsoon, leaving it at the commencement of the South-west Monsoon, when it is probably less healthy; they say that whatever sickness prevails among them originates at Little Coco, and that they generally improve in health on their return to Great Coco. Little Coco is a very marshy, and of course unhealthy, place; for this reason the Burmese only make short trips to it to obtain cocoa-nuts, which are very abundant."—*Report on the Andamans*, 1859.

distance from it a depth of 10 to 17 fathoms. Fresh water may possibly be obtainable on the east side of the island.

The anchorage at Little Coco island is said to be eastward of it at a moderate distance from the land; and also off its north-west end, with soundings gradually decreasing to the reef bordering the shore. It is also stated that boats may land at a sandy bay on the west side of the island.

The channel south of Little Coco island, between it and Landfall island off the north end of North Andaman, is about 20 miles wide, and from 12 to 40 fathoms deep for a distance (east and west) of about 18 miles, when bottom will be suddenly lost sounding in 100 fathoms. The ground is coral, but occasionally sand and mud. During the North-east Monsoon the current sets frequently through this channel to the North-westward; in the South-west Monsoon it flows mostly to the eastward; in fine settled weather the prevailing currents are flood N.N.E., ebb S.S.W.

When sailing between Little Coco and Landfall islands it is necessary to maintain a good look-out, it being probable that more reefs exist than are inserted in charts. In 1809 the *Daphne* (drawing 10 feet) is said to have struck on a rock at about 5 miles S. by W. from the south-east end of Little Coco; alongside it rocks were visible under water; and from the vessel's deck the surf breaking on the shore of the island could not be seen, hence the estimated distance of 5 miles may not be greatly in error.

GREAT ANDAMAN.—The three principal islands of the group are so closely connected together that for all practical purposes they may be considered as one island, which is hence called Great Andaman. The straits dividing them can only be navigated by boats at high water. The islands are named North, Middle, and South Andaman. They are surrounded by a bank of soundings which extends westward from them about 20 miles, and eastward not more than 5 to 8 miles. The outlying islands, in addition to Preparis and the Coco islets, already noticed, are Narcondam, Barren, Little Andaman, and the Sentinels. In our own description we shall follow the east coast commencing at Cape Price, and afterwards add a few remarks on the west coast.

East Coast of the Andamans.—The northern Andaman island is about 44 miles long in a north and south direction, and 14 miles broad in its widest part. Cape Price, its north point, has an islet named Pocock off its east side, which is surrounded by a reef and separated from the shore by a narrow and possibly a navigable channel. At 16 miles southward from Cape Price is Port Cornwallis, a splendid land-locked harbour, which contains excellent anchorage ground, sheltered from all winds, with good holding, and is sufficiently capacious to accommodate a fleet of the largest vessels. This appears to be the only harbour in the northern island. The surface is so densely covered with wood that it is almost impossible to penetrate into the interior, and it is related by Dr. Mouat, in 1857, that his exploring party could never proceed more than 5 or 6 miles in a day, and then it was almost always necessary to cut a path through the jungle.

At the north end of the North Andaman are some islands and reefs, the largest and most elevated of which is Landfall island; this island, and that next eastward of it, East island, are seated on a reef, and it is probable that there is no passage between them. West island is about 7 miles south-westward from Landfall island, is distant from cape Thornhill about 3 miles in a northerly direction, and is also surrounded by a reef. South-westward of West island and nearer the shore are Cliff and Reef

islands, having rocks about them. The passage between Landfall and East islands and the shore is named Pondicherry, a French ship of that name having passed through it; it should be used only with the greatest circumspection, the survey of it having been indifferently executed, and a reef named Cleugh being in mid-channel; there is also much rocky ground, many shoal spots, and numerous overfalls scattered about. In the western and middle parts of the channel the soundings vary from 18 to 10 fathoms. The flood sets eastward through it, and the ebb westward.

Union Ledge, &c.—The outermost of the known reefs off the north-east end of the North Andaman is Union ledge, a reef of 6 feet water at low tide, situated about 8 miles E. by S. from cape Price, or in Lat. 13° 32′ N. The **Jackson**, a ledge of similar depth, is distant 3 miles due east from East island; and between them is the **Ranger**, a reef of only 4 feet at a corresponding period of tide. These reefs are all so steep that the lead gives but little indication of their vicinity. The most dangerous, from its situation, is the Union, which is the more difficult to avoid, as it is only about 3 miles within the edge of the bank of soundings. At a very short distance from the eastern edge of the Union are soundings of 30 to 40 fathoms, and from the same side of the Jackson 8 fathoms, which rapidly deepens to 20 fathoms. As these shoals are extremely dangerous, and it is probable that all the reefs in this neighbourhood have not been discovered, it is strongly recommended to give this part of the Andamans a wide berth in passing, especially at night or thick weather.

Lieutenant Blair's remarks upon Union Ledge, &c. are as follows:—"Outside the opposite bearings of Table islands and Pocock island the soundings are more regular than inside those bearings, deepening to 30 and 35 fathoms at about two leagues from the land. The navigator must not be deceived by this false appearance, for immediately beyond the depth of 35 fathoms the water suddenly shoals to 20 fathoms, which depth will be found within 100 yards of Union ledge, on which there is only one fathom at low water. The greatest extent of this very dangerous ledge is about ½ a mile in the direction of the meridian; the breadth about 300 yards. The soundings are a little irregular even to eastward of this ledge, there being 20 fathoms immediately without it, and beyond that depth so little as 12 and 10 fathoms, whence it deepens to 30, 50, and 76 fathoms, and at the distance of 4 miles eastward of the ledge there is no ground with 110 fathoms. From Union ledge, Pocock island bears W. 25° N. (*true*) distant 7 miles, and the eastern Table island S. 30° W. (*true*) the same distance. Many lines of soundings have been run between Union and Jackson ledges, and as the depth is very unequal, this part should be avoided, although no dangers have been discovered in it.

"Jackson ledge is situated one league East (*true*) from the north extremity of East island; its extent, in a south-east direction, is nearly ½ a mile, and the breadth a ¼ of a mile, and the least water found on it was one fathom. North-westward from this, at the distance of a mile, is situated Ranger reef, a small circular spot of 100 yards diameter, with only 4 feet on its shoalest part; it bears from the north extremity of East island E. by N. (*true*) 2 miles. Northward of these ledges I was very particular in sounding, and found very considerable irregularities in the depth, on some spots not more than 5 fathoms; but by a very diligent look-out from the masthead, I have no reason to think that there is any less than that depth northward of Ranger ledge. The alarming inequalities of depth do not extend more than 2 miles northward of Ranger ledge, and there is a continuation of similar soundings to westward, extending the same distance round East and Landfall islands.

"There is a good and deep passage between East island and Ranger ledge, for which, however, there is no leading mark, the distance of Pocock island being so great that any bearings of it would be too indeterminate; East island should be rounded very closely to avoid the ledges eastward of it. During the South-west Monsoon I consider it would be improper to attempt this channel, for a ship rounding East island as close as it can be done with safety, would have great difficulty in weathering Jackson and Union ledges."

PORT CORNWALLIS.—At nearly 17 miles southward from cape Price is Port Cornwallis, a large land-locked bay previously mentioned. Midway, or perhaps nearer the bay, are some islets at a considerable distance from the shore, but connected thereto by a reef, named Table islands; as these islets are surrounded by a reef, the outer edge of which is probably at some distance from them, and is besides so steep as to have a depth of 17 and 20 fathoms close to it, they must be approached with the greatest precaution. Lieutenant Blair mentions a coral reef which we supposed forms part of the reef upon which the islands are seated—"They are surrounded to eastward with an extensive coral reef, and there is, besides this, a ledge of rocks, some of which just appear; they bear from the east extremity of the islands S.S.E. $1\frac{1}{2}$ miles, and there are 24 fathoms at a very small distance without the rocks."

Port Cornwallis consists of a bay extending about 6 miles in a north-westerly direction with an average breadth of $2\frac{1}{2}$ miles. It is surrounded by elevated land densely covered with vegetation to the water's edge, and abounds with shallow creeks which have not been examined; there is an abundant supply of fresh water, and oysters, besides other varieties of shell-fish, are plentiful. The entrance from shore to shore is about 2 miles wide, but the navigable channel is contracted to less than half this width by a reef which runs off from the south point towards Ross island, an islet off the north point of the bay; this islet is surrounded and connected to the north shore by a reef. In the bay there are several islets, the most considerable of which, named Chatham, is two miles long, and many years since was the seat of a settlement formed by the East India Company, but which was abandoned, the site proving unhealthy. The depth in mid-channel of the entrance is 18 fathoms, thence it decreases to 16, 14, 10, and 5 fathoms towards the head of the harbour. When within, a vessel will ride completely sheltered from all winds.*

Lieutenant Blair's remarks upon the port are as follows (1793):—"The entrance of Port Cornwallis is in Lat. 13° 17′ N., being the first opening northward of Saddle mountain—and near that mountain its situation is marked with peculiar precision. The access is easy, the entrance being 2500 yards broad; it is bounded on the north

* Port Cornwallis was visited by Dr. Mouat in 1857, who says: "The remains of the settlement on Chatham island were disentangled from the dense vegetation by which they were concealed with extreme difficulty. Fragments of the brickwork were found in excellent preservation, but all other traces of habitation were effaced. A few cocoa-nut trees alone indicated the attempt to introduce economical plants not indigenous to the soil. According to Blair's survey, the sea must have encroached on the north-eastern end of Chatham Island some 40 or 50 feet. On the south-western extremity of the same island was an extensive mud bay, uncovered at low tide, skirted by belts of mangrove, with low flat country on the opposite shore in the same direction. The only sea surge that could reach the settlement was the north-east wind, which blows over a small portion of the northern aspect. To these causes—to the pestilential nature of the mud-banks when uncovered, and to the abundance of rank, reeking, decayed vegetation in every direction—the excessive unhealthiness of the early settlement was doubtless due."

side by a reef extending from Ross island, and on the south side by South reef, a dangerous ledge separated by a narrow channel of 6 and 7 fathoms from Dundas point; from this reef an extremely narrow spit of 7 to 10 fathoms, but in one spot of only 3½ fathoms, extends nearly ½ a mile in a north-east direction. Atalanta bay, immediately round Dundas Point, has soundings of 10 to 4 fathoms, and is a good place to anchor during the S.W. Monsoon. In nearly mid-channel of the bay, at two miles from the entrance, is a very small island, named St. George, surrounded by a coral reef, and having at low water an area of about 300 yards; from this island in time of war vessels might be much annoyed in their progress up the harbour. At the extremity of the 4-fathom spit, extending 1 mile west from this island, there is a spot of coral which is almost dry at low water.

"Above St. George's island the harbour opens to the breadth of 2 miles and to the depth of 1½ miles, and contains excellent anchorage; it is bounded on the east by Hood point and the east side of Minerva bay; on the west by the east side of Chatham island and Shore point; and on the north by Minerva bay, Perseverance point, and the continuation of the harbour. The ground is soft tenacious clay, and the depth regular, decreasing from 20 fathoms in the entrance to 10 and 9 fathoms abreast of Perseverance point; here the harbour is contracted to the breadth of 1600 yards by the shoulder of Chatham island to westward, and a continuation of the land in a direction nearly North from Perseverance point, to the eastward. The harbour extends a mile north from Perseverance point, and beyond this there is a narrow and intricate channel which leads to a very secure and convenient basin adjoining the northern point of Pil island.

"The shoulder and north part of Chatham island is encompassed by a bank having a depth of 3 fathoms on the outer edge, which is about 300 yards from the inland. The continuation of this bank with a gentle curve and westerly direction joins the west point and embraces Ariel island, from the north part of which it takes a circular direction enclosing another commodious basin north of Ariel island, and then, by an easterly course, terminates at the north-west point of Wharf island. Within the margin already described, there is a very extensive mud bank, portions of which appear at low water; it occupies a space of about 4 miles. This flat, named by us Shoal bay, is situated westward of Pil, Chatham, and Ariel islands; it is of irregular form, with an extensive branch to the north-westward and several inlets to southward.

"The two basins are well situated for the accommodation of vessels under repair, and are capable of being well defended. The range of the harbour being N.W., the prevailing winds (N.E. and S.W.) are fair for either entering or quitting the port.

"At 1200 yards above Perseverance point there is a spring of fresh water which afforded in the month of February (1793) 150 tons per day, nor was there any perceptible diminution in this supply so late as the 6th of April, the latter part of the dry season. This spring is in a very convenient part of the harbour, and issues out of the ground at about 20 feet above highwater mark; adjacent are two rills.

"Near Hood point is another very productive spring.

"The land in the vicinity of the harbour abounds with timber of excellent quality, fit for all the purposes of shipping."

If bound to port Cornwallis from the north-westward, the bank of soundings between Landfall and Little Coco islands may be safely crossed in Lat. 13° 43′ N., as

this will give the former island a berth of about 4 miles, nearer than which it should not, under ordinary circumstances, be approached, it being probable that there are undiscovered reefs about it; during the S.W. Monsoon especially it should have a berth given to it of at least 3 miles. Having passed Landfall island, and steered eastward 8 or 10 miles, a course may be directed to the southward in such a manner as to pass outside or eastward of Jackson and Union ledges, for which a good look-out must be maintained; these reefs, it will be remembered, are very steep. In thick weather it is recommended, after passing Landfall island, to steer East until the bank of soundings is quite crossed, and the depth of 40 or 50 fathoms reached, and then in the course southward to keep along the edge of the bank, by which means Union ledge will be avoided.

Craggy Island.—At about 4 miles southward from port Cornwallis, following the coast, is a small island, named Craggy, connected to the shore by a reef, under or on the south side of which a vessel may anchor in 10 to 4 fathoms. Opposite this island is the Saddle mountain, the most elevated in the Andamans, estimated to be 2400 feet high. It is covered with vegetation to its summit, is of considerable extent, and its eastern side appears broken by densely wooded ravines. When viewed from eastward or westward, two peaks rise into view, giving the mountain the appearance of a saddle; hence its name. It is reported to be visible from a distance of about 60 miles. The coast hereabout is apparently well peopled.

From Craggy island to Andaman strait, a distance of 15 to 18 miles, the land is hilly nearly to the water's edge, and affords no good landing-place. In one or two places a near approach reveals some tolerably deep caves. It has not been surveyed; hence it is not known if it is clear of reefs. The soundings off it are reported to be regular to the distance of 5 miles, when the lead drops into 100 fathoms.

Sound Island.—Andaman strait is fronted by Sound island, the channel within which is named Stewart sound. Dr. Mouat says: "We steamed through Stewart sound, and right round Sound island, which is of an irregular quadrilateral shape, forming one side of a land-locked bay, accessible at all seasons to vessels of every class. The island consisted of ridges of high land traversing it in all directions, and prolonged in spurs to the point of the bay indenting its margins. It was fringed with belts of mangrove, and surrounded by coral reefs, with occasional fine sandy beaches.

"Towards its southern end is a horseshoe-shaped harbour, nearly three-quarters of a mile in depth, and rather more than half a mile in breadth. Its northern and eastern aspects are skirted by coral banks; but in the rest of its extent it has good anchorage-ground for large vessels.

"The ridge of hilly ground surrounding this bay is about 120 feet in height, and furnished an extremely grand and repeated echo on the firing of the evening and morning guns.

"The existence of a practicable passage from the east to the west coast of the Great Andaman, debouching at Interview island, had been left undetermined by Blair. The *Pluto* was next anchored off the mouth of Andaman strait, and a fast boat, with a strong picked crew, was sent to explore this strait, and ascertain how far it was navigable. After pulling through a very tortuous passage for several hours, our progress was arrested by finding that, at low tide, the mud was exposed in the main channel, and we had very great difficulty in retracing our steps. The swamps and

sunderbunds traversed for about a third of the breadth of the island in this place were extremely putrid and pestilential. Vegetation was extremely luxuriant, but confined to mangroves. There was no trace of habitation or of animal life in the dense swamps bordering the strait. The fact of the non-existence of a passage for any useful purpose was fully established."

The Archipelago.—The Middle Andaman, commencing at Andaman strait, extends southward 50 miles, and is 16 miles broad in its widest part. It is for the most part hilly to the sea-shore. At 38 miles southward from Andaman strait commences an archipelago of islands, which has not been sufficiently examined to show what harbours it may contain; but enough is known of it to enable us to state that navigation among the islands is rendered extremely dangerous by coral reefs. It was on the south-east side of the largest island that the troop-ships *Briton* and *Runnymede* were wrecked in November, 1844, when such was the hostility of the natives, that all attempts to hold amicable intercourse with them failed. These islands are represented as generally high, well wooded, and connected more or less with each other by reefs; the bank of soundings probably extends eastward of them about 12 miles. The channel between them and the shore, named Diligent strait, has soundings of 30 to 8 fathoms, the latter being in its narrowest part, where the bottom is very irregular; it is, consequently, deep enough for the largest ships, but until properly surveyed, cannot be considered safe, as coral reefs are believed to exist that are not inserted on charts.

When running through Diligent strait from southward, it is recommended to keep in mid-channel, making a frequent use of the lead; if from northward, the two islands, North and Middle Button, are an excellent guide to the north-east entrance, which is 7 miles wide, and thence decreases in width to the middle of the strait, where it is only 2 or 3 miles wide. In the northern part of the strait are some shoals, and reefs project from some of the islands and from the opposite shore. The anchorage in the middle of the strait is good, and well sheltered from easterly and westerly winds; in the shoalest part the bottom is of rock.

Lieutenant Blair, 1793, says: "Northward from Middle strait (the channel separating South from Middle Andaman) there are great inequalities in the surface of the land, some parts low and others rising very abruptly, and nearly insulated by the sea; the direction is N.E. by N., but deeply indented with bays and inlets; the soundings are regular, and there are no dangers without the depths of 10 fathoms. The distance to Strait island is 13 miles in a N.E. direction. Here the Archipelago contracts the breadth of Diligent strait to 3 leagues, and from Strait island to Round Hill (which is the narrowest part) the breadth is only one league. The number and variety of the islands, agreeably diversified with rugged cliffs and luxuriant forests, present a prospect beautiful and picturesque. On a near approach the caves appear, which are inhabited by innumerable flocks of the small swallow which make the edible bird's nest—so much valued by the Chinese as a delicacy and restorative. The principal cave is situated at the south point of Strait island, which is rocky, but not exceeding 40 feet in height. The entrance, which is washed by the tide, is an irregular aperture of about 6 feet wide, and the same height; on advancing 30 or 40 feet the height diminishes to 4 feet, and the breadth increases to 20 feet. Here, it is rather dark, and very warm, and the tops and sides of the cave are covered with nests; an astonishing number of birds, twittering and on the wing, whisk past the ears and eyes, and this, contrasted with the melancholy noise of the waves

resounding through the gloomy cavern, formed a very uncommon and interesting scene. The birds are probably induced to choose this situation from the caves' being inaccessible either to snakes or quadrupeds, and probably defensible against birds of prey. The nests in general are in form of a quarter of a sphere, of $2\frac{1}{2}$ inches diameter; of this shape, one of the sections being firmly fixed to the rock, the other section leaves the nest open above. The substance is glutinous; those most in estimation are white and semi-transparent. It has been doubtful, and various conjectures have been formed, of what the nests are composed. In smaller and more accessible caves I have observed a mucilage exuding from the rock, moistened by exhalations from the sea, which washes the lower part of these caves. This mucilage, on being lavigated and dried, had the texture, colour, and taste of the nest; but what removed all my doubts of this being the substance was seeing the birds in immense numbers resorting to a cave very productive of the mucilage in the month of January, which is the season the birds build their nests. It may now be presumed that the nests are neither of animal nor of vegetable, but of a mineral substance.

"In addition to the contraction of width of Diligent strait the soundings become very irregular, and there are many dangerous patches of coral on either side; one in particular, half a league eastward from Strait island, is very dangerous. The spit, extending about the same distance north from Round hill, the reefs connected with Middle and North Buttons, and an extensive and dangerous coral bank and reef to north-westward of those islands, should deter strangers from entering Diligent strait except in cases of necessity, when, should such a measure become necessary, strict attention to the following instruction, will lead through the strait in safety:— If entering from northward, first steer for the North Button, which is a small island rendered remarkable by several white cliffs; pass to right (or N.W.) of it not exceeding one mile distant; when abreast, steer N.E., and pass Middle Button, leaving it also to N.E., and observing the same distance; when the last is brought to bear E.N.E. it will be necessary to alter the course to South, and to steer in that direction until the North Button is just perceived to eastward of Middle Button; with this mark steer about S.W. by S., observing to keep the islands in the same position; and this will lead through the narrow part of the strait clear of the dangers on either side.

"The Archipelago appears to consist of eleven islands of various sizes. I speak with doubt, as the largest, or fourth island, may probably be intersected by narrow channels, which would increase the number. The south island, which is very small, bears from port Blair nearly E.N.E., distant 7 leagues. It is surrounded by a coral bank to south and east; the least water on it is 7 fathoms, except a small reef from the south extremity, which has 3 fathoms about half a mile distant from the island. The passage between this and the second island is clear; the ground, coral, with some spots not exceeding the depth of 5 fathoms.

"On the south extremity of the second island there are a few cocoa-nut trees; it is moderately high, the major part rocky, but covered with trees, except some cliffs, which rise abruptly from the sea at the north-east end, near the north-west extremities. From the south point there is a reef, on which the sea breaks at half a mile from the shore. A bay is formed between the two northern points, but it is too shallow for ships. The passage between the second and third island is nearly 2 miles broad, and clear of danger, with very deep water near the third island.

"The third island is of a triangular form, with a considerable projection on the north side. The south point, which is acute, is formed of high white cliffs; one in

particular, which is almost insulated, has in many situations the appearance of a sail. On the south-east side there are two small bays, and at the bottom of the northern one there are several cocoa-nut trees at a place where some natives usually reside. The water is very deep on this part of the coast, about 40 fathoms, at 2 miles from the land. From the north-west angle to the north point of the projection the soundings are very regular. Close to this point there is a narrow channel of 7 fathoms over a reef which extends from the points of the island almost 3 miles in a north-east direction; between this point of the reef and another extending from an angle of the fourth island there is another narrow channel. By the long reef and the two islands a small but commodious harbour is formed. The passage between the third and fourth islands is shut up to eastward by coral reefs. The north-east angle of the third island must not be approached nearer than 3 miles, to avoid a coral reef, which appeared to be connected with the island.

"The figure of the fourth island, as well as its surface, is very irregular, and the soundings around it correspond. On the east side, ships must not approach closer than 6 miles, as Minerva bank is situated at that distance to eastward of the island, and on some parts of the bank there is not more than $2\frac{1}{2}$ fathoms at low water. The east extreme of East island, N.N.W., leads eastward of the bank. The east side of the island is deeply indented, and some parts behind Rugged island may probably be insulated. Round Hill (which is remarkable from its regular shape, and being the highest land of the Archipelago) forms the north-east angle of this island: it is seen from a distance of 30 miles in clear weather. Eastward of this angle there are several banks, which run off a considerable distance.

"The passage between the fourth and fifth islands has deep water in the western entrance. At about the middle there is a reef from the fourth island. Across the eastern entrance there is a bar of sand and coral with only 3 fathoms on it.

"The fifth island is low, and almost bisected by the opposite bays. On the north and south sides of the island the water is deep, and the soundings are pretty regular.

"The bays and inlets formed by the three islands north of Strait island (of which Long island is the northern) are too confined and intricate to be of material use, though they might afford shelter in the event of a vessel being driven in by distress.

"Abreast of the south, opposite the middle, and towards the north extremity of Long island, there are three dangerous patches of coral about 2 miles distant from the island. To avoid these and the large coral shoal north-westward from the North Button, it will be safe not to approach that part of the coast nearer than the North Button, bearing North.

"The small inlet in lat. 12° 29′ is very remarkable, having a bold bluff point on either side. The entrance is narrow, and there is not sufficient depth within for ships. There is an extensive reef from the north point, and there is rocky ground about half a league beyond it. From this part of the coast to lat. 12° 45′ the land rises rather abruptly to a considerable height."

Middle Strait.—This narrow strait separates Middle Andaman from South Andaman island. Its eastern entrance is in lat. 12° 3′ N., or just within the southern part of Diligent strait, whence it trends in a northerly direction, and has a general depth of 6 to 9 fathoms, excepting at the eastern entrance, where there is a bar of 9 to 12 feet; it is, consequently, not navigable. From this strait to Shoal

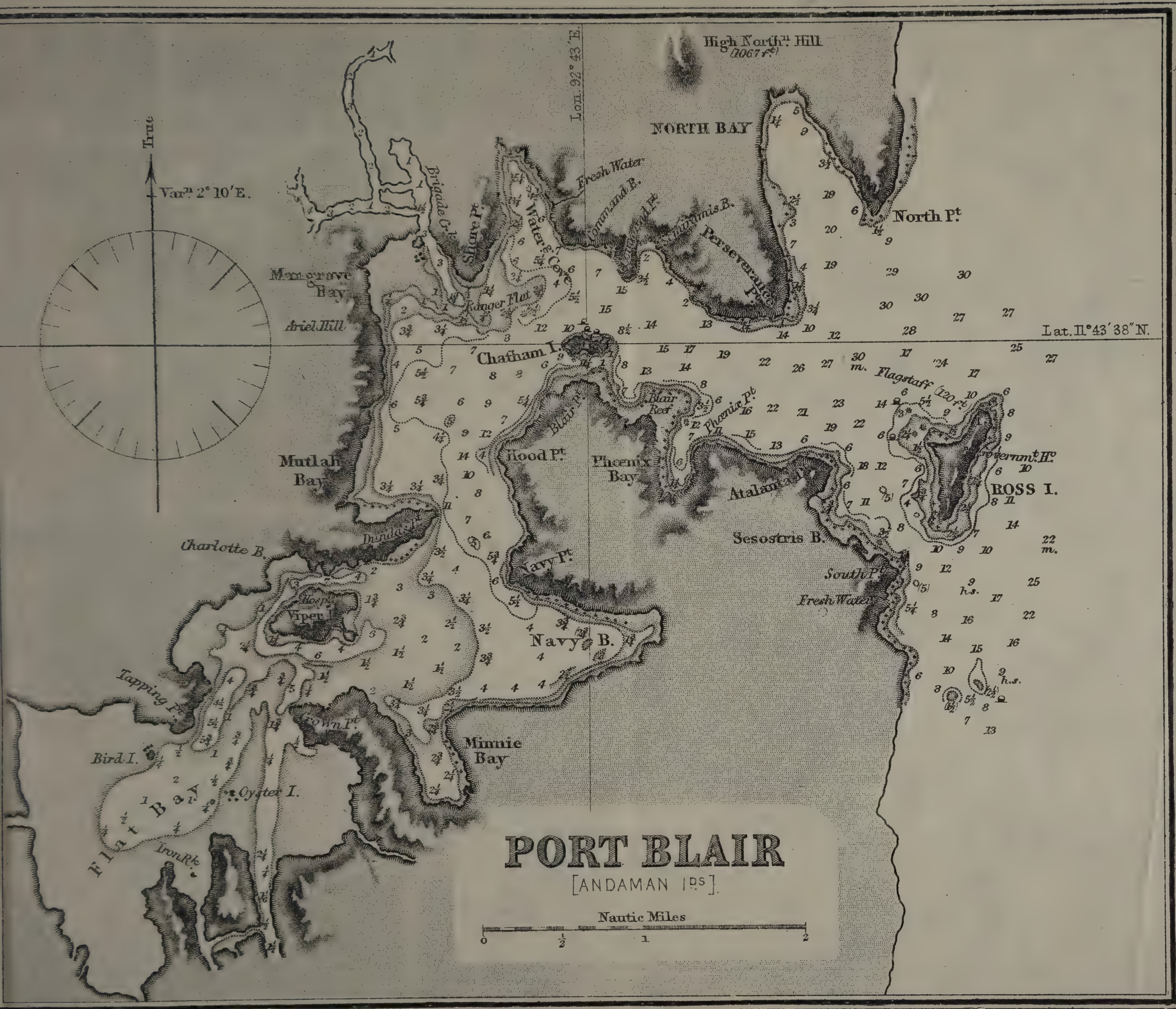
bay, 7 miles to the southward, the shore should not be approached nearer than 2 miles except with extra precaution, on account of possible off-shore dangers.

Lieutenant Heathcote, of the Indian Navy, says :—"The Middle Strait is one of peculiar formation; it is, for the most part, a narrow, deep crevice between the mountains, by which it is bounded on both sides, and which are in no part distant from it much more than 300 yards, while at places the rocks completely overhang it. The channel is thus narrowed at one or two points to about 80 yards, its general breadth being from 400 to 500 yards. Its depth varies, but it is mostly deepest where it is narrowest, 25 fathoms being found where the rocks abut immediately upon the channel, and 6 fathoms where they are more distant; a depth of from 12 to 14 fathoms is, however, very generally found throughout the narrow part of the strait; its western portion, where it runs north and south, being both broader and shallower. Its western entrance from the sea has now (1857) a depth of from 4 to 6 fathoms, it having been filled up to some extent during the last seventy years, while the interior of the strait has suffered scarcely any perceptible change. We found no variation in the depth, nor in the contour of the shore; even small islets of less than 50 yards in length appearing in precisely the same state as to size, elevation, and position, as represented by the first surveyor. But while the depths before mentioned are found in the strait itself, its eastern mouth is almost closed by a bank of sand and mud, which has only from 6 to 10 feet water on it; and this, I believe, may be looked upon as the effect of the current of the S.W. Monsoon, which being driven upon the west coast of the island, finds its way through this narrow strait, and deposits at its exit the sediment which it had taken up or set in motion on its passage. The area of drainage of this strait, though small, is sufficient to throw into it a considerable quantity of silt and sand; and the very form of this bank indicates that it has come out *from* the strait, and not that it has been thrown *into* it by any effort of the winds and currents of the N.E. Monsoon; and moreover, were this latter the case, some corresponding efforts would surely be observable at some of the other openings on the same side of the island, such as port Cornwallis, the entrances north and south of Sound island, and port Blair, at all which places instead of shoals we find deep water."

Port Meadows, &c.—Along the coast immediately south from Diligent strait are three islets, named port Meadows, Oyster and Shoal bays, of which the first-named is the northernmost. Port Meadows is a small, but convenient harbour, with an island at the entrance, inside of which the depth is probably 10 to 7 fathoms. The channel on the north side of the island is unsafe, vessels therefore always use the south channel, although it is less than a quarter of a mile wide, and has two rocky patches of 24 to 27 feet in the fairway. The shores of the harbour have coral reefs off them. The surrounding land is generally low with extensive tracts of mangrove jungle, intersected by creeks, and forming several islands.

Oyster Bay, two miles southward of Port Meadows, has soundings of 10 to 5 fathoms. Shoal bay, two miles further southward, has a depth of only 18 to 4 feet; it is separated from Oyster bay by an island.

PORT BLAIR.—This is a large inlet or bay near the south end of South Andaman, the entrance to which is in Lat. 11° 44′ N. It has soundings from 30 fathoms at the entrance gradually decreasing to 3 fathoms nearly at the head of the bay, where the mud flats become dry at low tide. Facing the inlet there is a small


PORT BLAIR
[ANDAMAN IDS].
Nautic Miles
High North[n] Hill (1067 f[t])
NORTH BAY
North P[t]
Lon. 92° 43' E.
Lat. 11° 43' 38" N.
True
Var[n] 2° 10' E.
Fresh Water
Command B.
Perseverance P[t]
Mangrove Bay
Ariel Hill
Brigade C[k]
Water Cove
Ranger Flat
Chatham I.
Blair Reef
Phœnix P[t]
Flagstaff (120 f[t])
Governm[t] H[o]
ROSS I.
Mutlah Bay
Hood P[t]
Blair P[t]
Phœnix Bay
Atalanta P[t]
Sesostris B.
South P[t]
Fresh Water
Charlotte B.
Dundas P[t]
Navy P[t]
Navy B.
Viper I.
Hosp[l]
Tapping P[t]
Crown P[t]
Minnie Bay
Bird I.
Oyster I.
Flat Bay
Iron R[k]

islet named Ross, the western side of which has a reef extending from it some distance; upon this reef the depth is 2 to 4 fathoms. Within the bay is an island called Chatham. The country surrounding the inlet is extremely fertile, and there is much less of mangrove and swampy land than at Port Cornwallis. Everywhere there is an abundance of wood and water, and the rocks abound in shell-fish.*

When running into Port Blair, Ross island may be passed on either side, but the north side is the better channel, being wider than that south-west of the island, and also deeper, as it has a depth of 30 to 20 fathoms, while the south-west channel has only $5\frac{1}{2}$ fathoms in its shoalest part. The anchorage is 2 miles within the entrance, near Chatham island, in 9 to 6 fathoms. Water can be obtained on the north shore of the harbour opposite Chatham island.†

At about a mile S. by E. $\frac{1}{2}$ E. from the south end of Ross island, and half a mile from the shore, is the easternmost of two reefs of 9 and 15 feet respectively, the latter being the furthest from shore. As these reefs are steep, with soundings of 6 fathoms at a very short distance from them, extra precaution is necessary when sailing in their vicinity. It is probable that between them and the land is a channel of 8 and 9 fathoms. It will be prudent not to approach them nearer than the extremity of Atalanta point well open of South point, bearing N.W. $\frac{1}{4}$ N., or the south point of Ross island, N.N.W.

From Port Blair to the south point of the South Andaman the distance is about 14 miles, and the coast is bold throughout its whole extent. The bank of soundings is supposed to extend from it not more than $1\frac{1}{2}$ mile.

Rutland Island.—At the south end of the South Andaman there is a large island, named Rutland, separated from it by Macpherson's Strait, a narrow and intricate channel of 13 to 6 fathoms. The island is 10 miles long and 6 miles across in its widest part, well wooded, and abundantly supplied with water. The

* "When making Port Blair, the land from its north point will be observed to rise rather abruptly to a height which may be seen from a distance of more than 30 miles: a continuation of this for about 9 miles, in a broken ridge, in the direction of North, very pointedly marks the situation of Port Blair. At the northern extremity of the ridge the descent is more gentle, terminating where Shoal bay is formed,—it retreats to southward behind the high land, and to northward round an island where a second mouth is formed, which abounds with oysters. This extensive double inlet is too shallow for vessels."—Lieut. Blair, 1793.

† Port Blair is a fine harbour of refuge, in which a vessel in the Bay of Bengal caught by a gale of wind and unable to keep the sea can find complete shelter. A correspondent of the "Nautical Magazine," 1861, who writes under the signature of "North," says, in reference to it, "On leaving the Sandheads in May, June, or July, and the weather has set in stormy, which is very likely to be the case (I do not mean an actual gale, but blowing hard), and the wind hanging to the southward, so that you cannot weather the Andamans without tacking to the westward, I consider that these boards to the westward are mere waste of time, with unnecessary tear and wear to the ship and crew. It is better in such cases, and they often happen, to pass through the Preparis channel, and proceed to the settlement under the lee of the Andamans in smooth water, than to contend against the heavy swell of the Bay with a deeply-laden ship, at the risk of damage and putting back, or even foundering, as many ships have done within my recollection. I speak in earnest and as a practical sailor, when I state that most, if not all, of these crippled and foundered ships might have pursued their voyage with ease and safety by the course above recommended. A ship crippled in the matter of spars will find all that she requires for the cutting on the Andamans, and good spars they are, as I have reason to know. She might also caulk leaky and strained butts, and, in short, put herself sufficiently to rights to proceed on her voyage, instead of putting back to Calcutta at a ruinous loss to all parties.

"After passing inside of the Andamans, let her stand on to the southward close-hauled on the starboard tack, and it will be very unusual if she cannot weather the Seyer Islands; but if she cannot weather them the passage is safe inside of them, if they are not approached under four miles, so that she will soon afterwards be able to make over to the coast of Pediar, and get round Acheen Head with facility by attending to Horsburgh's directions, and find little difficulty in reaching the Trade-wind, which at this season blows right home to the equator."

dense forest covering its south side exhibits marks of exposure to the full force of the south-west Monsoon, the trees in many places being uprooted and for a considerable extent beaten down by the violence of the wind. The shores are difficult of access, and except in Macpherson's strait, it contains no good harbour. It is probably well peopled.

Macpherson's Strait is about $1\frac{1}{2}$ miles wide at the eastern entrance and 13 fathoms deep; in almost mid-channel there is a rock,—thence it trends north-westward towards a number of islands and reefs named the Labyrinth islands, when the navigation becomes extremely intricate by numerous reefs of coral. This part of the Andamans is very imperfectly represented in charts.

Off the west end of Rutland island are two islets named the Twins, or Sisters.* They are about a mile from the shore, and the soundings between are 15 and 10 fathoms. It is prudent to give them a good berth, as a reef is said to project from them about a mile in a south-westerly direction, near which the depth is 9 to 13 fathoms.

From Rutland island a bank of soundings extends 10 miles to the south-westward, upon which the depths are 7 to 10 fathoms. There are reasons for believing that some parts of this bank may be dangerous.

Cinque Islands.—This is a group of islands off the south-east side of Rutland island, from which they are separated by Manners strait, a channel 2 miles wide and 19 to 35 fathoms deep. They are moderately high, and joined together by a reef; a reef also extends about a mile from their southern end, and has upon it from 3 to 6 fathoms,—close to the outer edge of this reef are soundings of 27 to 25 fathoms.

Passage Island, &c.—At $3\frac{1}{4}$ miles southward from Cinque islands is an island named Passage island, having a rocky islet at a short distance north-westward from it. And at about $3\frac{1}{2}$ miles south-eastward from these are two rocky islets named the Sisters; these are close together and connected by a reef.

WEST COAST OF THE ANDAMANS.—At about 7 miles westward from Cape Price is West island, a small low islet surrounded by a coral reef, some parts of which extend probably half a mile beyond high water mark; in other respects the island is bold. From this island, westward, to the edge of the bank of soundings, the depths are regular, increasing from 12 to 16 fathoms in the first 6 miles, and thence gradually deepening to 40 fathoms close to the edge of the bank. Cape Thornhill southward of West island, and 7 miles south-westward from Cape Price, is a round hill of a regular form, having the appearance of being isolated by a narrow channel. At a short distance westward from cape Thornhill is Cliff island, a steep rocky islet apparently bold on its west side, and 2 miles southward of this islet is another of slight elevation surrounded by a reef, the channel between these is believed to be shallow. In a south-westerly direction from cape Thornhill, about 6 miles, is another promontory apparently isolated, and especially when viewed from the south-westward, there being on its south side an islet; this promontory is low and flat,—in the entrance to the inlet are an islet and several coral reefs.

On this part of the coast of the Andamans the ground is generally of coral, with

* The correct longitude of the Sisters, according to Mr. Bradley, of H.M.S. *Fox*, 1818, is 92° 44′ 49″ E. (Madras Observatory, 80° 14′ 19″ E.)

very great overfalls. In a S.W. direction, 6 miles from the last-mentioned inlet, there is a dry rock at about 3 miles from the coast; and 6 miles further in the same direction, at the same distance (3 miles) from the land, is a small flat island. North Reef island, 7 miles S.S.W. from the small flat island, has a reef jutting out from its south side, 2 or 3 miles in a southerly direction; on the east side of this island there is a deep water passage to Port Andaman, but at about 2 miles from it in a south-easterly direction is a patch of rocky ground, over which are violent overfalls.

Of the west coast of the Andamans but little is known, it being seldom visited, and perhaps less is known of the part between cape Price and Interview island than of the coast southward of that island. A bank of 20 to 30 fathoms, but having upon it numerous overfalls of 7 to 10 fathoms, and probably of 4 fathoms or even less, fronts it at the distance of 15 to 20 miles; the south end of this bank is in Lat. 13° 2′ N., and is believed to be dangerous,—the north end is in Lat. 13° 25′ N. Lieutenant Wales, I.N., of the *Ranger*, in his examination of the bank did not find a less depth than 7 fathoms, but supposed from the irregularity of the soundings and nature of the bottom, that there might be less. A Captain Nimmo has reported as little as 4½ fathoms near the north end; for which reason Lieutenant Blair says the bank should certainly be avoided by large vessels. Horsburgh says: "A country ship from Masulipatam bound to Pegu, at daylight, saw the Great Andaman bearing East, and observed at noon in Lat. 13° 0′ N., then distant from the island 9 or 10 leagues. Hence she steered 3 or 4 miles eastward with a light breeze, and at 2 P.M. coral rocks were perceived under her, covered *apparently* with so little water that the rudder seemed nearly to touch them, hauled instantly to the westward, and soon got into deep water. The India ship *Pitt*, bound from Bengal to England, had the Saddle mountain bearing East 9 or 10 leagues, and the extremes of Great Andaman from N.E. by E. to S.E. by S.; she then tacked in 14 fathoms, and when in stays had 8 fathoms, coral rocks. Standing northward with a light breeze, she had 11, 7½, 14, 16, 24, 18, 12 to 9 fathoms, in the first part of the night, then tacked and stood S.W. by S., deepening gradually till daylight. At sunrise the mountain bore E.N.E., and the extremes of the land from N.E. by N. to S.E. by S., distant 9 or 10 leagues, then in 60 fathoms. Between the shoal bank and the coast the soundings vary from 40 to 20 fathoms, and 15 fathoms near the land." *

PORT ANDAMAN.—Interview island on the western side of this harbour is 13 miles long, and is everywhere surrounded by a broad belt of mangrove, except near its southern end, where the land is higher and more healthy-looking. It has but moderate elevation, probably furnishes an abundance of fresh water, and is

* Captain William Richardson (1816) says:—"My chief officer ran due West on this bank for two leagues in 6 to 4½ fathoms. He supposed that to be its breadth, and that it runs lengthways north and south as the islands do."

Minns Bank.—In an old chart of the Andaman Islands a bank of 35 to 4 fathoms is represented as extending from Lat. 13° 12′ to 13° 36′ N., at about 42 miles westward of Great Andaman;—the depth, 35 fathoms, being at the south end, and that of 4 fathoms at the north end of the bank. The existence of this bank is not credited, and it is probably the bank above alluded to, as it is between nearly the same latitudes, but differs considerably in longitude.

Another bank, the existence of which is also doubted, is inserted in the same old chart at about 20 miles north-eastward of Minns Bank, in Lat. 31° 50′ N., and between Longitudes 92° 16′ and 92° 32′ E. The soundings given are 52 to 20 fathoms, the latter being the westernmost. We suspect that this is only the western edge of the bank of soundings surrounding the Andamans, reported by some shipmaster in error as to his position.

covered with dense vegetation, which shows evidence of exposure to the violence of the south-west Monsoon. At some distance from its south end is an islet, named South reef, which is surrounded by and connected to the island by a reef. Between the island and the coast are several islets and reefs. All this part of the Andamans has been very imperfectly examined.*

Flat Island, &c.—At 18 miles southward from Port Andaman is a small island close to the shore, and surrounded by a reef, named Flat island; between are some reefs at various distances from the land. Hence southward to the north-western entrance of Middle strait the distance is about 16 miles; this strait has already been mentioned; it need only be observed, therefore, that when visited by Dr. Mouat in 1857, it was found to be for the greater part bounded by deep patches of stunted mangrove, the growth of which was evidently checked by the quantity of fresh water that falls into the strait during the Monsoons.

Coral Banks.—These are two extensive banks of 4 to 20 fathoms, or *less*, water, situated about 16 miles off the west coast of the Andamans. The shoalest spot discovered (4 fathoms) is in Lat. 12° 34′ N., and is only 4 miles within the edge of the bank of soundings.

PORT CAMPBELL.—Port Campbell, the entrance to which is in Lat. 11° 59′ N., is an extremely fine harbour, and contains excellent anchorage in depths varying from 6 to 13 fathoms. Its extent is about 6 miles in a south-easterly direction. At the entrance are two islets, one on each side, of which that off the west point is named Montgomery; from these, banks extend and contract the channel to a width of about half a mile. The channel being so narrow renders the harbour difficult of ingress and egress; but within, the shelter is perfect, being almost land-locked. Near Montgomery island is a native village. Wood and water are abundant.

PORT MOUAT is a harbour within the Labyrinth islands at the south-west end of South Andaman, and nearly opposite Port Blair on the eastern coast, from the head of which it is distant about two miles. It is of considerable extent, well sheltered, and bordered by low hills covered with lofty trees. It is accessible only from the south through the passage between the Labyrinth islands, a navigation far too difficult and dangerous to be used by vessels in distress during the S.W. Monsoon. Dr. Mouat, who discovered it in 1857, says:—"On attempting to run parallel to the coast in steaming northward, the coral reefs, which are here very extensive, were found to be far too near the surface to admit of the passage of a vessel even of so light a draught as the *Pluto*, the water shoaling rapidly, from 8 to 1½ fathoms. An attempt to stand to sea in the direction of the largest island outlying to the westward, the North Sentinel, failed from the same cause."

North Sentinel.—This is an island of about 4 miles in extent, situated 15 miles westward from the Labyrinth islands, and in or near Lat. 11° 34′ N., Long. 92° 27′ E.†

* "A large and easily-accessible harbour is formed between the eastern canal of Interview island and the adjoining western aspect of North and Middle Andaman. We steamed round Interview island, and at its southern extremity, near South reef island, came into violent collision with the natives in an attempt made to enter into amicable intercourse with them."—Dr. Mouat, 1857.

† This is according to the Admiralty chart, No. 825, edition 1856; but the observations of Mr. Bradley, of H.M.S. *Fox*, 1848, tend to show that the whole of the southern islands of the Andamans are placed in that chart 12 miles too far eastward, hence the correct longitude of this island is probably 92° 15′ E. (Madras Observatory being in Long. 80° 14′ 19″ E.)

It is of sufficient elevation to be seen from a distance of 18 or 20 miles, and is said to have a level summit and to be well wooded. Around it shoal water with reefs extends out about a mile. At its south end are two islets, and there is also one off its north-west side. It is probable that fresh water may be obtained from the island. Landing is represented as difficult.

The bank of soundings on the west side of the Andamans does not extend out from the west side of the North Sentinel more than 3 or 4 miles, where there is no bottom with 100 fathoms. The soundings are 20 or 30 to 50 fathoms, with sand and coral towards the shore; in 40 to 50 fathoms it is generally oaze.

LITTLE ANDAMAN.—This island is about 27 miles long from north to south, and 13 miles across in its broadest part, which is in the middle. Its north end is 30 miles southward from Rutland island, or in Lat. 10° 53′ N.; and its south end in Lat. 10° 26′ N.* It is not very lofty, being visible only from a distance of about 20 miles, and when first seen has a level appearance; it is described as rising with an easy swell towards the middle, or rather nearer the south end, and the whole is well wooded. The west and east coasts are believed to be clear of sunken dangers, except what are close to the shore; the soundings are mostly from 10 to 18 fathoms at one or two miles off, thence (in a distance of 5 or 6 miles) deepening to 50 or 55 fathoms, after which bottom is lost at 100 fathoms. The south side is more steep, there being at a little eastward of its south-west point 38 to 40 fathoms within one or two miles of it, and no bottom at 3 or 4 miles from shore.† On the north-west side of the island there is a small bay, where vessels may anchor in 5 fathoms.

At 5 or 6 miles W. by S. from the south-west point of Little Andaman is a bank of coral rocks, upon which the depth is said to be 6 and 7 fathoms; *but it may be less.* Between it and the island are soundings of 12 to 20 fathoms.

South Sentinel.—This is a small island situated 17 miles north-westward from the north-west side of Little Andaman, in about Lat. 10° 58′ N. It is only a mile in extent east and west, is well wooded, and has a reef projecting some distance from each end, over which the sea breaks heavily during the S.W. Monsoon. At about a quarter of a mile from its east end there is no bottom at 40 fathoms; at nearly midway between it and Little Andaman, but nearer the latter, the depth is 45 and 50 fathoms, and thence gradually decreases eastward, until at 1 or 2 miles from that island it is 13 and 10 fathoms.

Brothers.—The Brothers are two small islets covered with trees, whereof those on the southern islet are described as rugged in appearance, and those on the northern islet as perfectly flat, hence the latter is sometimes called Flat island. Their position is 5 to 8 miles north-eastward from the north end of Little Andaman, and they are distant from each other about $3\frac{1}{2}$ miles. A reef surrounds the North Brother, and projects from its northern and south-western sides nearly a mile; the South Brother is also surrounded by a reef. Between the Brothers there is a ledge of rocks named Leeboard, the position of which (not well ascertained) is believed to be 2 miles N.E. from the southern islet; there is also a reef, Ariel ledge, at about

* The south-east point of Little Andaman, by the observations of the Danish corvette *Galathea*, is in Long. 92° 30′ 17″ E., dependent upon Fort Cornwallis, Penang, being 100° 20′ 10″ E. The latitude was not stated.

† This does not agree with the Admiralty chart No. 825.

$1\frac{1}{4}$ miles south-westward from the same islet. The channel between the Brothers and Little Andaman, although 5 miles wide from shore to shore, and 6 to 10 fathoms deep, is so narrowed by Ariel ledge and the reef running out from the latter island, that it cannot be recommended and should be considered unsafe; this remark applies equally to the channel between the Brothers.

Duncan Passage.—The channel north of Little Andaman, between it and Rutland island, derives its name from CAPTAIN DUNCAN, of the *Ganges*, who sailed through it in 1760, and was probably the first European voyager who traversed it. It is 27 to 30 miles wide from shore to shore; but only 13 miles wide, if the Brothers and Sisters islets are considered the southern and northern limits. The soundings are 11 to 20 fathoms, and the navigation is believed to be safe, there being no known danger besides what is represented on the chart.* If necessary, a vessel may anchor in the channel in 12 to 17 fathoms on sand, and proceed at convenience. A good look-out should be maintained, the channel not having been surveyed.

HORSBURGH says:—"In light breezes and fine weather, a kind of tide sets through the channels among these islands to the eastward and westward; but at times currents prevail, which are generally governed by the wind. In the N.E. Monsoon, on both sides of the islands, the current sets mostly to the S.W. or southward; a ship running for Duncan passage should, therefore, endeavour to keep a little to the northward in this season, and to the southward in the opposite Monsoon, according to the prevailing wind, that she may preserve a leading breeze to pass through the channel."

NARCONDAM.—This is a small island, an extinct volcano, 2150 feet high, situated in Lat. 13°·28′ N., and Long. 94° 17′ 22″ E. (fort Cornwallis, Penang, being in 100° 20′ 10″ E.). When viewed from a distance, it appears like a cone, or pyramid, with its summit broken off. Close to its east side there is an islet, or rock, and off its south point another. It is not known if a bank of soundings surrounds it.

Barren Island is a small island in Lat. 12° 16′ N., and Long. 93° 55′ 26″ E., according to the observations of the Danish corvette *Galathea*.† It is only 2970 yards in diameter, in shape nearly circular, and about 975 feet high. The sea around it is believed to be very deep, because at a short distance from it there is no bottom at 100 fathoms, except on its south-west side, where within the distance of a $\frac{1}{4}$ of a mile are soundings of $4\frac{1}{2}$ to 14 fathoms. Landing is difficult. When visited in 1857 the island was covered with trees, and the sea in its immediate vicinity was quite hot. The volcano is in an active state at intervals.‡

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* See the Admiralty chart, No. 825.

† Dependent upon Fort Cornwallis, Penang, being 100° 20′ 10″ E. MR. BRADLEY, of H.M.S. *Fox*, 1848, made the island in Long. 93° 53′ 45″ E.

‡ See a very interesting description of Barren Island in the "Nautical Magazine," 1860. Although we say that the sea around Barren Island is believed to be very deep, it is possible that there may be banks of soundings in its vicinity that have not been discovered.

CAPTAIN SHARRINGTON of the *Bahar*, country ship, was reported to have struck bottom in 4 fathoms at 5 or 6 leagues S.S.E. from the island. No further particulars are given, nor have any attempts been made to examine this bank, that we are aware of.

"Looking to the interior of the island it is well called 'Barren Island,' for it is truly a valley of desolation, dark and gloomy; but, as viewed from the sea, it is extremely fertile, all the slopes seaward being clothed with thick vegetation, though of what kind I had no opportunity of seeing. There is no anchorage, and landing, except in very calm weather, is not possible, as there is but one spot where a landing can be effected, and the water must be very still to make it practicable even there. The sea becomes hot as you approach the landing-place, till, near the shore, it

Invisible Bank.—An extensive bank of 17 to 50 fathoms is situated between Latitudes 11° and 11° 28′ N., and Longitudes 93° 31½′ and 93° 45′ E. The ground near its outer edges consists frequently of oaze or sand, but well in upon the bank it is occasionally foul and rocky, especially in the vicinity of the Flat rock. The name "Invisible" was given to it by LIEUTENANT BLAIR, in 1790, because the water upon it did not appear to him to be discoloured, and showed little, if any, indication of the existence of the bank.

Flat Rock.—This very dangerous rock, situated in Lat. 11° 8′ N., and Long. 93° 40′ E.,* is only 20 to 30 feet above the water, and not more than 100 feet in diameter; it is, therefore, difficult to avoid in very calm weather, when the breakers do not show much, and at night; hence the greatest care and vigilance must be exercised when in the vicinity. Rocky ground extends from it about twice its length, upon which the sea breaks in bad weather. At a short distance from it the depths are from 13 to 20 fathoms, coral and sand, which increase as you stand away from it on all sides to 30 and 40 fathoms towards the edge of the bank.

When in the neighbourhood of the Flat Rock the lead should be kept going, especially as its position has not been well ascertained. The soundings about it are not always regular. It is recommended when soundings are obtained to tack at once, and haul out into deep water.

NICOBAR ISLANDS.

The **Nicobars**—or SAMBILANGS (NINE ISLANDS) in Malay—are a cluster of islands southward of the Andamans, between those islands and Sumatra. Some are of considerable size, and all are covered with trees and a dense vegetation. They are reported to be extremely unhealthy. Some of the islands contain good harbours, and to most of them a vessel may with care stand pretty close in, as the coasts are remarkably free from detached sunken dangers. The principal and only moderately civilized island, that most frequented by country vessels, is Car Nicobar, the northernmost one. The natives of this island have obtained the character of being very honest, kind, and hospitable, and many of them speak a little broken English.

The Nicobars have not been surveyed; the description we have of them is, consequently, imperfect. A partial examination of the islands has been made by the Danes, and a chart, the result of this examination, was published in 1846. Another reconnaissance was made by the officers of the Austrian frigate *Novara*, in 1858; and a chart of the islands was subsequently issued at Vienna. It is remarkable that the geographical positions in these two charts do not by any means agree, but differ in some instances so much as 8′ to 20′ in longitude.

The channels among the islands are safe to navigate, although at times there are very great ripplings and overfalls, which are alarming to strangers; the currents

becomes *scalding* hot—a circumstance which occasioned a little merriment; for some of our men, not expecting anything of the kind, jumped out of the boat as usual into the water, and of course began dancing about very actively till they could either get in again or on shore."—REV. CHARLES PARISH, Bengal Service, 1862.

* So inserted in the Admiralty chart No. 825, where also another position is given for it on the authority of CAPTAIN W. OWEN, R.N., of H.M.S. *Seaflower*, 1806—namely, Lat. 11° 17′ N., Long. 93° 29′ E., which nearly agrees with what MR. BRADLEY, of H.M.S. *Fox*, supposes to be its correct position—namely, 93° 26′ E.

generally set East and West through them. The shores are in general lined with coral reefs, and most of the projecting points have a reef jutting out from them; hence a good look-out is always necessary, and a free use must be made of the lead.

CAR NICOBAR has an extent of about 7 miles from N.E. to S.W., and is nearly 6 miles broad. It is of moderate height except on its western side, and towards its south-east point, where the land rises into hills. There are villages all round the coast, the inhabitants of which are fond of barter, being always ready to exchange produce for cloth and other goods. The position of the village of Saoui, at the north side of the island, according to the *Novara's* observations (taken on the reef) is Lat. 9° 14′ 8″ N., and Long. 92° 44′ 53″ E.*

The soundings around Car Nicobar, at a mile from the shore, average 20 fathoms on sand, or sand and coral, which rapidly increase seawards to 100 fathoms; the edge of the bank is steep. Anchorage can be obtained almost anywhere, but the coral bottom makes it indifferent; the most eligible place is off the village of Saoui in 10 or 12 fathoms.

The north-west point of Car Nicobar has a reef extending from it; hence it should have a good berth, especially as broken water is said to lie off it as much as 1½ miles. Captain Hay, of the *Inglis*, says that "a large ship should not approach it nearer than the depth of 14 or 12 fathoms, as I did, for the convenience of getting refreshment quickly on board, having anchored abreast the village in 9½ fathoms at 1 mile distance, the north point bearing N.E. ½ N., the south point W. by S., with 30 fathoms of cable out—a rock was seen under the ship, having only 7½ fathoms on it. A ship ought to anchor at about half-way between the north-west point of the island and the village in 12 or 14 fathoms, sand, but never so near the village as did the *Inglis*."†

BATTI MALVE.—This small island is distant from Car Nicobar about 18 miles in a S. by E. direction, its centre being in Lat. 8° 49′ N., Long. 92° 51′ 30″ E.‡ Its height is 150 to 200 feet; in shape it is nearly quadrangular, and it is not more than 1½ miles across. Its highest part is its west side, whence it slopes eastward, causing the island to resemble a wedge at a distance. The surface consists of bare rock so thinly covered with soil that only shrubs and a few scraggy trees will grow on it. There is no fresh water, and there are no inhabitants.

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* Assuming the observatory at Madras to be 80° 14′ 19″ E.; —all the *Novara's* longitudes of the Nicobar Islands are dependent upon this meridian. The *Novara* anchored in 14½ fathoms, coral sand, at about two miles from the shore, between the villages of Mosse and Saoui. An approach to the shore to about three or four cables' length can be made, as the depth at that distance is about ten fathoms, clay. From the offing, Car Nicobar appears level, with a low eminence rising towards its centre; the coast is overgrown with cocoa-nut palm.

The Danish corvette *Galathea* made the village of Saoui in Lat. 9° 12′ 43″ N., Long. 92° 43′ 20″ E., dependent upon Fort Cornwallis, Penang being 100° 20′ 10″ E.

† "There are a number of villages around the island of Car Nicobar. You can approach within 10 or 11 fathoms, hoist all your colours, and you will soon have the natives off to show you the best place to anchor. Tell them what you have come for, and after you have got your ship comfortably at an anchor, and decks cleared, show them your barter; you will soon get familiar with them. They are very forward in their manners, and take many liberties, but do not mean any harm. It is only for the want of knowing better, being only half civilized; therefore on no account get angry with them—they will do anything for kindness."—Mr. Major, Agent for Lloyd's, Maulmain.

‡ The Danish corvette *Galathea* made its south point in Lat. 8° 50′ 4″ N., Long. 92° 49′ 55″ E.

Batti Malve is seated on a bank of soundings, the extent of which is unknown. At 4 miles S.S.E. from the island the depth is 22 to 25 fathoms; at 1½ miles westward from it 47 fathoms, and at a mile eastward from it 7½ to 10 fathoms.

TSCHAURA is distant 24 miles S.S.E. ¼ E. from Batti Malve, its east end (according to the observations of the *Galathea*) being in Lat. 8° 25′ N., Long. 93° 3′ 37″ E. It is only 1½ miles in extent, and not more than 6 feet above the surface of the water, excepting at its south-east corner, where it rises as an immense rock of great height perpendicular to the sea, far above the trees on the island; this rock is said to give the island the appearance of the crown of an old-fashioned hat, with the flaps let down; the low land then resembling the flaps, and the rock the crown of the hat; hence the Portuguese gave it the name of Sombreiro (*hat*). The village is on its north-east side. The produce of the island is chiefly hogs and poultry; all kinds of tropical fruits may also be obtained. The natives are reported to be friendly to strangers.

The north-west, west, and south-west sides of Tschaura are bordered by a reef which extends out from ½ to ¾ of a mile; the edge of this is steep. Anchorage may be obtained all round the island, but the usual place is off the village in 20 to 30 fathoms, sand.

Tschaura is seated on a bank of soundings, the extent of which is unknown. At 2 miles eastward from the perpendicular rock the depth is 50 fathoms; at a mile north-eastward from the village it is 45 fathoms; and at the same distance seaward from the south-west point of the island, it is 93 fathoms. According to the Danish chart of 1846, a coral bank of 8 to 17 fathoms lies 2½ miles north-westward from the island; it may possibly be a part of the bank of soundings, as the chart represents soundings of 16 to 8 fathoms between it and the shore.*

TERESSA is the island next southward of Tschaura; its west point according to the observations of the *Galathea* is in Lat. 8° 18′ 45″ N., Long. 93° 5′ 29″ E. It is about 10 miles long N.W. and S.E., and 2 to 3 miles broad, and when viewed from a considerable distance appears like two islands, the land towards each end, particularly the north part, being much higher than in the middle. Its productions are similar to those of Car Nicobar; it is, however, said to be less populous. Ships generally avoid the island as much as possible during the south-west Monsoon, as it is considered an awkward place to visit at that season.

The west, north and south-east sides of Teressa are foul to some distance off, especially at the latter part, where the reef runs out about a mile. The island and Bompoka, eastward of it, are both seated on a bank of soundings, the extent of which has not been ascertained. There is anchorage all round the island, but the depth is considerable, there being 30 to 40 fathoms at a quarter to half a mile from the west shore, and 30 fathoms (coarse sand) almost immediately outside the reef extending from the south-east point; the usual place of anchorage is off the eastern shore in about 20 fathoms.

BOMPOKA, an island on the south-east side of Teressa, is not more than two

* This bank on the Austrian chart is inserted as uncertain, and the soundings are 9, 8½, and 17 *feet*, not fathoms. The authority for its insertion is apparently the Danish chart.

miles long N.N.E. and S.S.W., and one mile broad. It is two miles from the shore of Teressa, being separated from it by a channel 30 to 50 fathoms deep. It consists of a mountain, partly covered with wood. Its summit is a sharp ridge, extending north and south about half the length of the island, from which the declivity on all sides is regular to the water's edge. The inhabitants are very few, and the women are considered to be fairer and handsomer than those of the neighbouring islands.

At a short distance from the east shore of Bompoka are soundings of 18 to 29 fathoms. The anchorage is on its western side in 15 to 20 fathoms.

TILLANGSCHONG is an island 30 miles north-eastward from Bompoka, the anchorage on its west side, at two miles from its north point, being in Lat. 8° 32′ 29″ N., Long. 93° 34′ 14″ E.* It is about 8 miles long, and with the islets off its south and north points, occupies an extent of nearly 11 miles. It is very narrow, and consists of a high rugged mountain 450 feet high, which may be seen from a distance of 12 to 14 miles, and when first seen has the appearance of a cockscomb. The greater part of the island is covered with trees, and it is said to be inhabited only by exiles from the other islands. The outermost rocky islet off the south end of Tillangschong is named Laouk.

The east side of Tillangschong is steep, and has at a short distance from it a depth of 13 to 34 fathoms.† The west side is perhaps equally steep, there being almost close to it, and to the islets and rocks off the south end of the island, soundings of 30 to 75 fathoms. The extent of the bank of soundings east, west, and north of the island is unknown.

CAMORTA is the island most southward of Tillangschong. Between are soundings of 17 to 65 and 57 fathoms, the first being off the north end of Camorta, and the last at a short distance southward from Laouk, the rocky islet off the south end of Tillangschong; in mid-channel the depth is 40 to 65 fathoms. The extent of this bank in an east and west direction is unknown.

Camorta, Trinkut and Nangcovri together occupy an extent of 19 miles in a N.N.W. and S.S.E. direction, and of about 7 miles east and west. Camorta, the principal island, is 15 miles long, and its north point is in Lat. 8° 14′ 5″ N., Long. 93° 31′ 11″ E., according to the *Galathea*. The northern and middle parts of the island are flat, and have only a moderate elevation, but the land in its west part is high, especially near Nangcovri harbour; it is here that the principal village of the island is situated, at the base of a perpendicular ridge. The island has been described as "irregular broken land, mostly covered with trees and underwood; the trees are three or four sorts of the poon, very fit for masts and to build houses. There are several plains of pasturage three or four miles round; the soil is rich, as sugar-canes grow without cultivation, and it produces the finest yams in India—there are besides fine flavoured pine-apples, plantains, guavas, &c. Water is obtained from wells, but

* So determined by the *Norara*, but the chart of the Nicobars from the observations of the surveying officers of that ship has it in Long. 93° 36′ E. The *Norara* stood in for the north shore of the island to within 100 feet of the steep octagonal-shaped cliff which forms its north point, and afterwards skirted the north-west coast for about 2½ miles at the distance of 150 to 200 feet. The highest part of the island did not apparently exceed 300 feet. At its south-east side there is a well-sheltered anchorage.

† Mr. Ritchie says: "At 10 fathoms' distance eastward from Tillangschong there is no ground with a line of ordinary length."

is not plentiful in the dry season, owing to the small number of wells sunk by the natives. There are no tigers nor other dangerous beasts; but many snakes, though few of them are venomous." The inhabitants are not numerous. Its western side abounds with bays and fine harbours; there are good places at the north-east and north-west parts for cocoa-nuts; the village is named Kakana.

At about 2½ miles northward from the south-west point of Camorta, on the west coast, is the entrance to a large bay named Ulala, which is three-quarters of a mile wide at the entrance, and probably within is deep enough to receive vessels of considerable size.

The depths along the west shore of Camorta are 28 to 30 fathoms at about a mile from the land, and it is not known how far westward the bank of soundings extends. A reef is reported to run out about 3 miles from the north-west point of the island.

Trinkut, on the south-west side of Camorta, is 5½ miles long, and very narrow. It is low and level and covered with betel and cocoa-nut trees. The channel between it and Camorta is about a mile wide in its narrowest part, and excepting at its southern end is shallow, too shallow we believe for vessels of even moderate draught. From its north-east point a reef runs out about ¼ of a mile.

The soundings at a short distance from the east shore of Trinkut are 4 to 7 fathoms, which rapidly increase to 17 and 20 fathoms, the latter being at about two miles from the land; it is not known how far eastward the bank extends. Between the north-east end of the island and Camorta vessels anchor in 8 or 9 fathoms, coral; and also, at a short distance westward of its south point, in 6 to 8 fathoms, soft ground.

Nangcovri is about 5 miles in extent, of triangular shape, having its apex to the south, rugged, uneven, and almost covered with wood. It is very thinly inhabited.

At 1¾ miles eastward from the south point of Nangcovri the depth is about 32 fathoms, and at 3 miles southward from the same point 74 fathoms. It is believed that the last-mentioned sounding is on the southern edge of the bank upon which the three islands, Camorta, Trinkut, and Nangcovri are seated.

Nangcovri Harbour, the narrow channel separating Nangcovri island from Camorta, is considered the finest harbour in the Nicobars. It is deep enough for the largest vessels, the anchorage is nearly land-locked, and access to it is either from eastward or westward. A few Moravian missionaries from Tranquebar were stationed some years ago in Cross Harbour (one of the bights) to convert the natives to Christianity: their settlement was called Hermann, and we believe it has been abandoned. Very few refreshments can be obtained here, the land being hilly and not cultivated, although on the north side of the harbour the soil is good.

The western entrance of Nangcovri harbour is about ⅛ of a mile wide, and 27 to 33 fathoms deep; the points of land on each side are high, and from that on the north side (the south-west point of Camorta) a bank of 6 to 12 fathoms on irregular rocky bottom runs out a short distance in a south-westerly direction.* The eastern entrance is a little wider than the western, being contracted by rocky banks which line the shore on each side, having 12 and 14 fathoms close to them, and from 18 to 20 fathoms

* "The western entrance to Nangcovri harbour is scarcely 100 fathoms wide by 14 in depth, and is marked by two rocky pinnacles. Directly opposite lies the island of Katschal, thickly wooded to the water's edge, and stretching out long and low, without any marked elevation above the sea level."—*Narrative of the Novara's Voyage.*

in mid-channel. There is less water outside or eastward of this narrow part of the eastern entrance, but it is nowhere less than 6 to 11 fathoms deep; generally the soundings close to the rocky banks off the shores are 5 fathoms. The navigation of the eastern entrance is considered easier than that of the western entrance on account of its greater width.

The harbour is divided into two parts by a point of land jutting out on each side. The easternmost, named Cross harbour, from its form, is the smaller, and contains several shelves of rock in its southern arm, with 5 or 6 fathoms close to them. The western, or larger part of the harbour, is a great basin of an oblong form, about 2 miles long and 1 broad, with a cove on the west side, and another at the south end. In its north-west part there is a rocky bank of 5 and 6 fathoms, sand and patches of rock, distant from $\frac{1}{2}$ to $\frac{2}{3}$ of a mile from the shore. The depths throughout the harbour are generally 10 or 12 fathoms near the shore, and 18 or 20 fathoms in the middle, except near the western entrance, where there are 27 to 34 fathoms; the bottom all over is soft, and good for holding. The tide runs strongly with eddies through the western entrance. The flood runs eastward, and sets out of the eastern entrance with some strength, although in the harbour it is scarcely perceptible.

When running into Nangcovri harbour by either the eastern or western entrance it is recommended to keep in mid-channel, and as an extra precaution, to have a man at the fore or fore topsail-yard, to look out for the edges of the rocky banks that line the shores.

KATSCHAL.—At about 4 miles westward from Nangcovri island is the island of Katschal, which is 10 miles in extent N.W. and S.E., and of very irregular form, its eastern and western sides being each indented by an extensive bay. Its north and west parts are moderately elevated and level; the other parts of the island are much higher, and sufficiently lofty to be visible from a distance of about 25 miles. The island is covered with wood, and furnishes abundance of cocoa-nuts.

Along the north-west, south-west, and east sides of Katschal, there is anchorage; on the south-west side of the island the best position is in about 11 fathoms off the entrance of the bay. The north-east coast is so steep that, at half a mile from it, the depth is *said* to be 50 to 100 fathoms. The extent of the bank of soundings westward of the island is unknown.

At about a mile from the south coast of Katschal there is a rock 12 feet under water, and at 5 miles southward from the island there is said to be a coral bank of 9 to 17 fathoms,* having soundings of 70 to 80 fathoms close to it.

LITTLE NICOBAR.—This island is about 12 miles long and 8 miles broad; it is moderately elevated, hilly, and like most of the islands of the Nicobars, covered with wood. Its north point is surrounded by a reef. At about 10 miles north-westward from its north point is a small low island, named Meroe, and midway between are two others, named Treis and Track, of which the former is the larger in

* It is so represented in the Danish chart of 1846, but in the Austrian chart (the voyage of the *Novara*) the same soundings are given as *feet*, not fathoms. In both charts its existence is stated to be uncertain. This may be the coral bank reported by CAPT. MACKAY of the *Albion*, in 1770; it was stated to be in Lat. 7° 43′ N., 9 miles S. of Katschal; on it 9 to 18 fathoms water were found, and no bottom with 60 fathoms close to.

size; these two islets have sunken rocks about them. At nearly midway between Treis and the north point of the island there is a small bank of 6 fathoms, having close to it a depth of 25 fathoms.

At nearly 3 miles from the east shore of Little Nicobar island there is a small islet named Montschal. In the channel between are soundings of 19½ to 30 fathoms.

The anchorage at the Little Nicobar is on its north-west side, under protection of a little islet named Milu. The depth is 9 to 12 and 14 fathoms, sand and coral, and the approach is from westward or northward; in either case care is required to avoid the coral reefs that line the shore. Mr. Major says of this anchorage: "It is a beautiful little harbour, only open from N. ½ W. to N.W. by N.; the entrance is directly opposite Track island, in the Sombrero channel, and a ship can lie within 100 fathoms of the shore in 9 fathoms water, on the starboard side of the harbour, under the small island of Milu (or Buseh island, as it is called by the Danes). The natives here are very inoffensive, and willing to trade, but they are very poor. This harbour is perfectly safe at all seasons of the year, and poon spars are procurable in abundance in the jungle, for disabled ships, without any expense—only the trouble of cutting them by the ship's crew, and bringing them to the ship, which would not be much labour. Of the islands Treis and Meroe, the former must not be closely approached,—the latter can, and a great number of cocoa-nuts can be got there, but it is not safe in the S.W. Monsoon."

GREAT NICOBAR.—This island is about 30 miles long N.N.E. and S.S.W., and 14 miles wide in its broadest part, which is in the middle, whence it diminishes to a point at its south end, ceasing in low level land, covered with trees, and fronted by a sandy beach. The highest parts (probably 1900 feet) are in about its centre and towards its north side, where the hills run across the island in an E.N.E. direction. The soil is of great fertility, and in many parts densely covered with timber. The sugar-cane in great abundance is to be met with growing wild; coffee also, and numerous tropical fruits. The natives of the interior are believed to be of different race to those on the coast, and are supposed to be savages. There is no place for trading for cocoa-nuts. Quantities of tortoise-shell can at times be picked up. According to the observations of the *Novara*, the little sandy beach at the south end of Condul island, off the north shore of the island in St. George's channel, is in Lat. 7° 12′ 17″ N., Long. 93° 39′ 55″ E.; and the east side of Galathea bay, at the south end of the island (at the landing-place near the extremity of the point) in Lat. 6° 48′ 26″ N., Long. 93° 49′ 45″ E.*

Galathea bay, at the south end of Great Nicobar island, has an extent of 2 or 3 miles; it affords excellent anchorage in 5 to 9 fathoms, sand and clay, and shelter from the Monsoons. At the head of the bay there is a barred river, a pistol-shot wide, which runs up the centre of the island. A reef jutting out from the west point of the bay (the south point of the island) requires some caution to clear.

At about 2 miles from the east shore of Great Nicobar island, and 13 miles from

* The *Galathea* made the middle of the west side of Condul, about a mile N.W. (*true*) from the sandy beach where the observations of the *Novara* were made, in Lat. 7° 12′ 50″ N., Long. 93° 43′ 31″ E.; and the south point of Great Nicobar Island, the west side of Galathea Bay (3′ south, and 2′ of longitude west from the landing-place alluded to by the *Novara*), in Lat. 6° 45′ 49″ N., Long. 93° 50′ 40″ E.

Galathea bay, there is an isolated rock, named Boat Rock. In the channel between it and the shore are soundings of 20 and 18 fathoms.

Around Great Nicobar island there is a bank of soundings, the extent of which is unknown. At 2 or 3 miles from its west shore the depth is 17 to 24 fathoms; at 5 or 6 miles from its south-west side 25 to 30 fathoms; and at 6 miles from its south-east side 40 to 50 fathoms.

St. George's Channel.—The wide and deep passage between the Great and Little Nicobar islands is named St. George. Although a very convenient channel, it is seldom used except by vessels trading with the islands, the masters of which may be supposed to have some local knowledge. The bottom is said to be foul, and strong tides and currents running in eddies prevail to a considerable extent, rendering the anchorage generally unsafe. At the eastern entrance is the little islet, Cabra, 2 miles from the shore of Great Nicobar, and with soundings between of 20 to 40 fathoms; and at the western entrance is the larger island of Condul, from the north and south ends of which a reef projects; the passage through the channel is northward of this island. Vessels sometimes anchor in Ganges harbour, a small bay on the south shore just within the eastern entrance of the channel in 9 to 16 fathoms, coarse sand and clay. Care is required to avoid a reef in front of the bay, and another just off its east side.

Examination of the Nicobars by the Austrian Frigate "Novara."—The following is a general summary of the results of the examination of the islands by the Austrian frigate *Novara*:—

"With but few exceptions the shores of the whole group of the Nicobars consist of coral sand, or are fringed with coral banks, which latter extend seaward to a depth of 30 fathoms. In like manner almost all the bays seem to be edged with coral reefs—if, indeed, they are not actually studded with them. The promontories frequently present cliffs both above and below the level of the ocean, extending a couple of miles into the sea, which, what with the occasional rapid currents and light breezes, are not always very easily weathered. The prevailing winds are the two Monsoons: the north-east in the months of November, December, January, February, and March; the south-west in May, June, July, August, and September. During the months of April and October there are variable winds and calms, extending more or less into the adjoining months. The currents vary in direction with the passages between the islands, and depend upon the ebb and flow of the tide, varying in force and direction with the tidal phenomena. Ordinarily these make themselves felt during the making of the tide from S.W. to N.E., and in a contrary direction during the ebb.

"Due south of Car Nicobar we found, while lying at anchor, a current running $3\frac{1}{2}$ miles an hour, two days after the full moon. North of Little Nicobar, near the small island of Treis, where the current compelled us to anchor, its velocity, as we experienced two days after new moon, is as high as $4\frac{1}{2}$ miles an hour. These observations refer to a period when the velocity of the current was as its maximum. In light winds, and when near the coast, one must always let go the anchor, or at least lay out a kedge, the latter, however, being barely sufficient at several spots immediately after the full or new moon. According to observations made during five days about the period of full moon, the time of H. W. at Car Nicobar may be assumed at 9h. 40m., and the difference in height between ebb and flood at 5 feet.

"In these waters, and in a still more marked degree in the latitude of Sumatra,

occurs a belt, within which the wave-currents form what is known to English navigators as 'Ripples.' The sea here is ranged zone-fashion, so to speak, as though in fact in a state of ebullition, and makes a considerable noise, yet without there being anything to indicate an increased strength of current; since, on the contrary, we found, when reaching these tracts, that the velocity of the current was, if anything, rather diminished. We conceive this phenomenon may be attributed to the agitation caused by partial tidal currents crossing each other's course, and occasionally even running counter to each other, as also to certain special conditions of ocean temperature at varying depths. The changes of the tides at points of the coast, proportionally speaking so near each other, are so widely different in point of time, and the height reached by the waves is so little uniform, that any such phenomenon as the above must naturally make itself perceptible at the surface in the open sea.

"While the change of tide at Car Nicobar takes place every 9h. 40m., that of cape Diamond, in Sumatra, is laid down in the English chart at 12h., and on the sandbanks in the strait of Malacca at only 5h. 30m. The difference in elevation assigned exhibits a similar discrepancy in the estimates; that for Car Nicobar being stated at 5 feet, that for cape Diamond at 10 feet, and on the sandbanks already mentioned at 15 feet. The hurricanes of the bay of Bengal rarely visit the Nicobars; they seem to originate near or about the Andaman islands, or on the west coast of Sumatra, proceeding in the former case towards the northern portion of the bay, and in the latter towards the Coromandel coast and Ceylon.

"During the South-west Monsoon, in which occurs the rainy reason, frequent thunder-storms, and even gales of wind occur, especially in the vicinity of Great Nicobar. The dry North-east Monsoon again brings fine weather, but sometimes blows with considerable strength.

"Car Nicobar has no regular harbour, but presents on its north side a spacious land-locked bay, nearly rectangular, the holding ground of which is a coral sand of from 10 to 16 fathoms, and is thoroughly sheltered to the S.W. and N.E. During the North-east Monsoon it is advisable to lie somewhat closer in with the northern promontory of the island. At this season it is difficult to find any spot at which small boats can disembark. However, near the northern point it is possible to reach the shore in a small cove, the western boundary of which presents an open space of coral sand, where it is possible to lie-to in deep water with even a good-sized boat. The village of Saoui, which gives its name to the roadstead, is not readily accessible during the North-east Monsoon, in consequence of the surf; but the very next indentation of the coast facing eastwards, which is protected seaward by a coral reef, offers a well-sheltered point of disembarkation, where the boats can be beached on the smooth coral sand, and thereafter drawn up high and dry.

"During the North-east Monsoon it is also practicable to avail oneself of the bay on the south side of Car Nicobar, or to anchor anywhere along the west side of the island; but such anchorages possess no other protection than is afforded by long points of land projecting far into the ocean, and usually protracted by coral reefs.

"Both in the bay of Saoui, and on the south side of Car Nicobar, are found small brooks, which run with water, even during the dry season. It is difficult, however, to water hereabout, because these rivulets are blocked up with sand-bars, not to speak of the obstacles interposed to the landing of boats, by the tremendous surf, and

the low swampy shore at most periods of the year. In cases of extreme necessity, however, the little rivulet called the Areca might with some difficulty be made available.

"Tschaura, Camorta, and Bompoka, have no regular anchorages; a vessel must be content to ride to leeward of that coast, which will serve as a shelter against whichever Monsoon happens to be blowing. Disembarkation by means of boats is extremely difficult, and it is much better to make use of a native canoe, which, after transporting the visitor through the surf to the land, can be more easily drawn up on the beach.

"Tillangschong possesses a beautiful harbour on the south side, which, however, is open to the S.E., but during the greater part of the year affords an excellent anchorage. The most southerly point has numerous cliffs and needles of rock where it projects into the sea, but it is possible to approach within a few fathoms of the southernmost of these with vessels of any size. On the west side of the island, at the spot where its two halves may be said to blend, the northernmost rugged, the more southerly flat, a pretty good anchorage will be found, which seems to be sheltered toward the S.W. by several solitary projecting rocks. Generally speaking, but more especially to the N. and E., this island presents a steep, precipitous shore, so that, with the exception here and there of a few solitary rocks close into the shore, there is nothing but clear, deep water around almost the entire island to within about 10 fathoms of the land.

"The harbour of Nangcovri is rather roomy, but of very unequal, though for the most part considerable, depth; the soundings in its midst giving between 20 and 30 fathoms. The promontories are all more or less low-lying and thickly beset with coral reefs, and caution is the more necessary, since it is far from unusual, after working in from 20 to 16 fathoms, to find the water shoal suddenly to 4 or even 3 fathoms. The anchorage formed by the two islands of Camorta and Nangcovri has an entrance from the east, and also from the west, the navigation of which by large ships demands the utmost vigilance. The western entrance is barely a cable's length in width, while the island of Nangcovri has hardly any fairway for vessels along its exterior coast-line. In consequence of the two islands trending towards each other at that point, the harbour near its middle is greatly narrowed, so that there may almost be said to be two harbours. In either of them a vessel is quite safe, being, in fact, so thoroughly sheltered from all winds that the heat is occasionally overpowering.

"On the west side of Camorta, 6 or 7 miles north of the western entrance of the harbour, will be found a large sheet of water, called Ulàla bay, in the first half of which there is excellent anchorage; but the vapours emanating from the abundant mangrove swamps render residence here extremely unhealthy. As Ulàla cove runs for the most part parallel with Nangcovri harbour, and is separated from the latter only by a range of low eminences, the near proximity of these mangrove swamps likewise imparts their baneful influence to the air of Nangcovri harbour. There is absolutely no water here fit for drinking.

"Katschal has large bays both on its east and its west sides, but they are almost entirely silted up with coral sand. The channel between Katschal and Camorta is clear. Here we made short tacks in passing through, approaching the shores on either side within half a mile.

"Little Nicobar has a good harbour on the north side, formed by the island of

Milù and the north coast of Little Nicobar, which is bent almost at a right angle. This anchorage is accessible in all winds, and is well sheltered, but a considerable portion adjoining the shore of Litttle Nicobar is rendered useless by banks of coral. Notwithstanding the most careful examination of this part of the coast, we could not discover the spot which in the Danish charts is marked as furnishing water fit for drinking, but perceived nothing save mangrove swamps, with numerous water-courses filled with brackish water, the two largest of which we navigated in our gondola as far as practicable.

"The island of Condul, in St. George's channel, forms another very fair anchorage; and similarly on the north side of Great Nicobar, one finds several suitable bays, the most easterly of which, called Ganges harbour, is fringed with coral banks, rendering it proportionately difficult of access. The anchorage of Condul may be selected for one reason, namely, that it is landlocked towards both N.E. and S.W., besides having the additional advantage of being airy and distant from the mangrove swamps, whereas in the bays on the north coast of Great Nicobar these are of immense extent. One of these mangrove swamps in the central cove was traversed by one of the naturalists, the result of which was that he found a river debouching into the sea through the very heart of the swamp, which, however, so long as the sea-water could find entrance, was not of course drinkable.

"On the west side of Great Nicobar, along the whole length of which we sailed, but which we could not visit more carefully, owing to want of time and the heavy S.W. swell of the ocean, several other promontories and coves are apparently available as harbours, and moreover may be supposed to be the embouchures of rivers. At the south point of Great Nicobar there is a large bay, which, however, being quite exposed from S.W. to S.E., must be anything but a safe anchorage during the South-west Monsoon. During the prevalence of the North-east Monsoon it seems tolerably well suited for an anchorage, if the eastern promontory be kept S.E. by S., and the anchor be cast in soundings of from 10 to 13 fathoms. Landing, however, is at all times a matter of difficulty, as the surf is very boisterous and the swell of the sea pretty heavy. Its most remote point is the mouth of the river Galathea, which, however, is closed by a sand-bar, and for that reason cannot be easily reached. This bay, owing to its configuration, is excessively hot and sweltering, and with reference to its salubrity cannot be recommended as a suitable abode.

"The climate of the Archipelago, though tropical, is not nevertheless to be ranked among the hottest, in consequence of its insular position, and of the whole of the islands being thickly clothed with forest. Hence the quantity of rain is sufficient to keep the rivers full, even in the dry season. According to the meteorological observations made on these islands by various observers at different periods of the year, the average temperature does not exceed 77° Fahr., much about the temperature of the fluid found in the fresh unripe cocoa-nut. But during the months of April and October respectively, at which period calms prevail in these islands, the maximum temperature of 86° to 88° Fahr. is reached.

"Considering the violence with which rain falls, and that the dry season of the North-east Monsoon from November to March, and the damp season of the South-west Monsoon from April to October, are by no means so sharply defined on these islands as on the adjoining coasts of the mainland, the quantity of annual rainfall must be enormous. At certain times it is not much less than 100 or even 150 inches, and yet it probably is not so high as that presented by other localities, which

experience the regular changes of the monsoons, as, for instance, in the strait of Malacca, where the annual rainfall is 208 inches, or Mahableshwur, south of Bombay, where it amounts to no less than 254 inches. March is the driest month in the year. During the whole of the month which we spent on the islands, or in their immediate vicinity, we only had three sharp thunderstorms. These become more frequent and severe during April, until about May or June the South-west Monsoon sets in and envelopes the islands in rain-clouds."

AUSTRALIA.

WEST AND N.W. COAST:—CAPE LEEUWIN TO DAMPIER'S ARCHIPELAGO.

CAPE LEEUWIN, the S.W. extremity of Australia, in Lat. 34° 21′ S., Long. 115° 6′ E., is a prominent barren headland, visible in fine weather at a distance of 30 miles; it is fronted by low rocky ground, and several detached islets and breakers extend S.W. and S.E. from the land to the distance of 5 or 6 miles; the cape itself appears like a small, low, rocky island close to the mainland, with low land to the north, and the Remarkable Bare sand-patch to the N.W.-ward of it. The approach to cape Leeuwin is not marked by the usual indications of the proximity of land; there is no change of colour in the water, nor seaweed at the surface; nor do sea-birds become more numerous. The **soundings** off the cape are not regular, nor do they extend far off shore; there are 85 fathoms at 28 to 30 miles in a S. by W. direction, and 40 to 60 fathoms at 18 miles south of the cape.

The **coast** from cape Leeuwin to cape Hamelin trends N.W. 12 miles, thence to cape Mentelle N.$\frac{1}{2}$W. 18 miles, and then to cape Naturaliste N. by E. 25 miles.

Geographe reef with 3 feet water on it, lies S.W. by S. 6 miles from cape Hamelin, and is the westernmost (*known*) danger of this coast; the sea does not always break here; and soundings give little warning, there being 24 fathoms at 1$\frac{1}{2}$ cables to the N.W. and S. W.; approximate position, Lat. 34° 20′ S., Long. 114° 54′ E.; other reefs extend between this and the mainland.

Off cape Hamelin there are several small islets, and 3 miles from it is the Remarkable Bare sand-patch (so called from its general aspect) forming the north side of cape Leeuwin bay; here there is good anchorage for small ships, and shelter from westerly winds; an island, connected with the mainland to the northward by a reef, fronts the bay; and the channel ($\frac{1}{2}$ a mile wide) is on its south side; there may be dangers here, at present unknown. At the back of the bay is a lake of fresh water.

Cape Naturaliste, in Lat. 33° 32′ S., Long. 114° 55′ E., is a sloping headland, low at its extremity, but rising to an elevation of 500 or 600 feet; the summits are well wooded. Off the cape, at a short distance, are many rocks.

Naturaliste reef, extending 1$\frac{1}{4}$ miles N.E. by E. and S.W. by W., lies 17 miles N. by E. from cape Naturaliste: it consists of three distinct patches, on which the sea does not always break; nor do soundings give certain warning, there being 13 fathoms at 1 mile to the northward and 25 to 30 fathoms at 5 or 6 miles to the westward of it; approximate position, Lat. 33° 15′ S., Long. 114° 58′ E.

Between this reef and the cape two other dangers have been reported by American

whalers. **Pioneer reef,** with heavy breakers, (seen in a light breeze after a heavy gale,) was said to lie 4 miles northward of cape Naturaliste; and **Wright bank,** a rocky patch with 5 or 6 fathoms over it, was stated to have been sailed over, when $1\frac{1}{2}$ miles to the northward of the same cape. H.M.S. *Beagle* passed close to both spots, having regular sounding of 25 to 27 fathoms, and without seeing broken or shoal water: the appearance of breakers may have been caused by the long swell of the Great Southern Ocean meeting a strong southerly current sweeping out of Geographe bay.

GEOGRAPHE BAY.—From cape Naturaliste to point Casuarina the distance is 36 miles in an E. by N.-ly direction; between the two points is Geographe bay, which is 12 miles deep, with soundings of 18 fathoms in the centre, decreasing to 3 fathoms at 1 mile from the southern shore; here whalers and vessels engaged in the timber trade find good anchorage during the greater part of the year, but it is exposed to the prevalent N.W. winds of winter.

The principal anchorage is in 3 to 5 fathoms off the mouth of **Vasse inlet** and near the small town of **Busselton;** a *white cask beacon* on the beach $3\frac{1}{2}$ miles N.E.-ward of the inlet leading in. Northward of the beacon ($\frac{1}{2}$ a mile and more) are narrow patches of weeds, with only 9 feet of water on one of them.

Supplies of firewood, fresh provisions, water, &c., may always be obtained at Busselton.

The S.W. shore of the bay—immediately round cape Naturaliste—has several rocky projecting points, with small sandy bights between them, and fronted by sandy shoals for the distance of $\frac{1}{2}$ a mile or more.

CASUARINA POINT, in Lat. 33° 19′ S., Long. 115° 37′ E. (*approximate*), consists of sand hills covered with scrubby vegetation; the two highest are—Signal hill (162 feet high) $\frac{1}{4}$ of a mile, and Eliott hill (190 feet high) one mile southward of the point. A bold **reef,** breaking with even a moderate sea, projects N.E. by N. $\frac{1}{2}$ a mile from the extremity of the point; on its west side there are 8 to 9 fathoms at a $\frac{1}{4}$ of a mile, and on its north and east sides 4 to 5 fathoms at $\frac{1}{3}$ of a mile distance.

To the eastward, protected by Casuarina point and reef, lies **Koombanah bay,** $1\frac{1}{2}$ miles wide, and 1 mile deep, where large vessels may anchor in $4\frac{1}{2}$ fathoms (mud), and small vessels in $2\frac{1}{2}$ to 3 fathoms, but the limited space always necessitates mooring.

Here also is **Leschenault inlet** with the town of **Bunbury** on the west side of entrance and southward of Signal hill; and **Australind** on the east side of the inlet 6 miles N.E.-ward of Bunbury.

Supplies in abundance may be procured at Bunbury, and good water from wells within Casuarina point.

A rocky patch—position doubtful—lies near the shore, 4 miles northward of the bay.

From Koombanah bay to cape **Bouvard,** the low sandy coast extends N. $\frac{1}{4}$ E. 45 miles; inland there is a range of hills, and mount William (1630 feet high) lies S.S.E. 28 miles from cape Bouvard, and 12 miles from the coast. This cape is the most westerly of several small rocky points, and has 6 to 7 fathoms water within $\frac{1}{2}$ a mile of the shore, but a **rocky bank** 10 to 12 miles long, *of which little is known,*

is said to trend N. and S., at about 3 to 5 miles westward of it. **Butcher reef,** nearly a-wash and $\frac{1}{3}$ of a mile long, is about $1\frac{1}{4}$ miles off the nearest shore and S. by W. $\frac{1}{4}$ W. $2\frac{1}{4}$ miles from the extremity of cape Bouvard. Also S.W.-ward of the cape, at the distance of about 6 miles, there is a 3 fathom patch, with 9 fathoms water between it and the shore; but generally for a distance of 20 miles southward of the cape there is a depth of 6 to 9 fathoms close to the shore.

From cape Bouvard to **Robert point** (the west side of a small shallow bay called Peel inlet, into which flows the river Murray) the coast trends N-E. $\frac{1}{2}$ N. 8 miles; thence to **Beecher point,** which is low and wooded, it extends northward for 7 miles, forming a sandy bight fronted by **Murray reef,** which lies from 3 to 4 miles off the coast, and consists of straggling reefs, with here and there dangerous sunken rocks; the deep water (6 to 7 fathoms) between the reef and the shore is frequented by coasters working against adverse winds.

Warnbro' Sound.—From Beecher point, in Lat. 32° 21′ 26″ S., Long. 115° 44′ 22″ E., to Mersey point, the distance is 4 miles N. $\frac{3}{4}$ W.; between them is Warnbro' sound, the shore of which is low and sandy, with sandhills here and there covered with bushes. Off Mersey point (to the westward) is **Penguin** island, $\frac{1}{2}$ a mile long north and south, and connected with the point by a sandy bar having only 4 to 5 feet water on it where deepest. Warnbro' sound is well defended, on the west, from any dangerous sea by a chain of islets, rocks, and reefs extending from Penguin island to the Sisters rocks, a distance of $2\frac{1}{2}$ miles in a S. $\frac{1}{4}$ W. direction. The entrance into the sound is $\frac{1}{3}$ of a mile wide, between Passage rock and the north end of the reef on which is the Sisters, but this is fronted by a *bar,* or cluster of rocky patches, having in three places not more than 8 or 9 feet water; and outside of all is an *outer bar,* with $3\frac{1}{2}$ to 6 fathoms water on it, where a heavy sea breaks in bad weather. Passage rock is the most elevated of a small cluster of rocks 16 feet high; and the Sisters, S. $\frac{1}{2}$ W. $1\frac{1}{2}$ miles from Passage rock, form a group of six bare rocks, 20 feet high, whence the Sisters reef extends N. by W. nearly $1\frac{1}{4}$ miles. Directions cannot be safely given for this channel, but reference must be made to the chart.* The soundings in the middle of the harbour are 9 to 10 fathoms. Within the sound (in its S. part) is port **Kennedy,** $\frac{1}{2}$ a mile N.E.-ward of point Beecher; here vessels lie in 5 to 6 fathoms, to ship the timber cut in the neighbourhood.

Coventry reef or rock, stated to be in Lat. 32° 19′ 24″ S., Long. 115° 39′ 22″ E., is small and sometimes uncovers; it lies S.W. $\frac{1}{4}$ S. $4\frac{1}{2}$ miles from cape Peron summit and $2\frac{3}{4}$ miles westward of Passage rock. There is a clear channel 2 miles wide between Coventry reef and the islets and reefs fronting the entrance to Warnbro' sound; close to it (at $1\frac{1}{2}$ cables') are 10 fathoms water, and there are regular soundings of 10 to 12 fathoms in the channel.

Cape Peron, in Lat. 32° 15′ 48″ S., Long. 115° 42$\frac{1}{2}$′ E., and $1\frac{2}{3}$ miles north of the north point of Penguin island, is the S.W. extreme of a conspicuous rocky and bare headland whose conical summits rise to the height of 120 feet. The curve in the sandy coast between the island and the cape is known as **Shoalwater bay,** but having only 3 fathoms (greatest depth) it is only used by boats and small craft. **John point** is the N.W. extremity of the headland, and off it a reef of sunken rocks

* See Admiralty Chart, No. 1700—Swan River and Rottnest Island, on which is a plan of Warnbro' Sound.

extends (to the northward and westward) $\frac{1}{2}$ a mile; also between Peron and John points an uneven ledge partly dry at low water extends westward for half a mile or more; and **West rock** (with 12 feet or less water on it) lies to the S.W.-ward of Peron point: these dangers should not be approached by a stranger within a mile, nor in less than 7 to 8 fathoms water. A low sandy neck of land separates the northern part of Shoalwater bay from Mangles bay in the southern part of Cockburn sound.

GARDEN ISLAND, the western boundary of Cockburn sound, is $5\frac{1}{2}$ miles long N. by W. and S. by E., and its seaward side is fringed by continuous reefs, extending from a $\frac{1}{4}$ to a $\frac{1}{3}$ of a mile off the shore; its southern point is **Collie head,** consisting of low rocky cliffs fronted by many detached sunken rocks on a ledge extending $\frac{1}{3}$ of a mile. The distance between John point (already mentioned) and Collie head is rather more than a mile, and here is the southern channel into Cockburn sound; but the width of the channel being greatly contracted on the north and south by the reefs and foul ground stretching from the head and point, and having only $3\frac{1}{2}$ to $4\frac{1}{2}$ fathoms water in it, small vessels engaged in the country trade and drawing not more than 12 feet can alone use it. The most conspicuous object on Garden island is **Signal hill,** situated 2 miles from the north end of the island, and visible 15 to 18 miles; the Haycock, rather more than half a mile from the north end, is visible 12 miles. The N.W. point of Garden island is in Lat. 32° 9′ S., Long. 115° 40$\frac{1}{2}$′ E.

From the north end of Garden island (where there is a remarkable *white patch*) to **Direction island** off the S.E side of **Rottnest island** the distance is nearly 10 miles N.N.W. $\frac{1}{2}$ W.; between them are numerous chains of reefs and many rocks exceedingly dangerous to navigation, and the channels are few and narrow; behind these reefs is **Swan river,** the chief port of Western Australia.

The **soundings** in the offing along the lines of coast already described, from cape Naturaliste to 20 miles westward of Rottnest island, a distance of 100 miles in a N.N.E. direction, range from 70 to 25 fathoms, decreasing gradually towards the shore, and serve to show a vessel's distance from the coast.

The **tides** are irregular, and the rise rarely exceeds 2 feet: gales from seaward tend to raise the water along the coast, while land winds depress it.

SWAN RIVER AND ITS HARBOURS.

SWAN RIVER has its entrance between **Rous head** on the north and **Arthur head** on the south; it is barred, and the deepest channel (50 yards wide) seldom has more than 6 feet water, while rollers are frequent on the outer ledge.

The river has a general N.E.-ly trend, and at a distance of 4 miles from its mouth enters a lake called **Melville water,** on the north side of which is **Perth**—the capital. The chief shipping port of Western Australia is **Freemantle** on the south side of entrance to Swan river, on a low sandy flat connecting Arthur's head with the mainland. N.N.E.-ward $2\frac{1}{2}$ miles from Arthur head is **Buckland hill,** one of the leading marks for the passages.

The **anchorages** for Swan river are **Gage road, Owen anchorage,** and **Cockburn sound,** which are more or less sheltered from seaward by Rottnest and Garden

islands, and the chain of reefs between them; these are again fronted by the Five-fathom bank, a ridge of sunken patches and banks, with occasional breakers, and intervals of deep water, extending from about 4 miles S.E.-ward of Rottnest light (and nearly parallel with the reefs for about 15 miles southward) to a Four-fathom patch lying $3\frac{1}{4}$ miles S.W. by W. $\frac{3}{4}$ W. from cape Peron: there is a clear space from $1\frac{1}{2}$ to 3 miles wide, with 8 to 11 fathoms water, between the Five-fathom bank and the chain of islands and reefs.

To describe all these dangers minutely would be a work at once useless and unnecessary; they are so numerous that without the chart* the description would be a perplexity rather than a guide, while, with the chart before him, the navigator only requires to have the channels and passages indicated, and to use them as circumstances compel him; but pilots are always to be procured, and *no stranger should under any circumstances neglect to make use of their services.*

The only **pilot stations** for Swan river are Thompson bay (in Rottnest island) and Freemantle; the boats and crews are provided by Government.

The **principal meridian** for the surveys of the coast of Western Australia is Scott's jetty, $\frac{1}{3}$ of a mile to the westward of Swan river lighthouse,—Lat. 32° 3′ 18″ S., Long. 115° 45′ 30″ E.

Supplies of every kind, as well as water, can be procured here; ships can also be repaired, but the heaving down establishment is at Garden island.

ROTTNEST ISLAND is a prominent object when making Swan river from N.W. or westward, as it lies nearly W. by N. $\frac{1}{3}$ N. 12 miles from the entrance of Swan river, and may be readily distinguished from Garden island, to the southward of it, by the white stone lighthouse, 197 feet high, built near the centre of the island, which has a hummocky and scantily wooded surface.

The **lighthouse** stands on a hill bearing West $2\frac{3}{4}$ miles from Phillip point, the east extreme,—and E. by N. $\frac{1}{4}$ N. 3 miles from cape Vlaming, the west point of Rottnest island; and in Lat. 32° 0′ 21″ S., Long. 115° 31′ 12″ E. The tower is 53 feet high, and is surmounted by a lantern 11 feet high, showing a *white revolving* light, visible 20 miles. It *flashes for* 5 *seconds in every minute, the remaining interval of* 55 *seconds appearing dark,* except to a vessel within a few miles of the island.

On the approach of a vessel by day, the light-keeper makes a signal to the pilot, stationed at the north-east extreme of the island, showing whether the vessel is about to enter the channel north or south of Rottnest island; the pilot will then proceed on board.

A vessel arriving off Rottnest island at night, and requiring a pilot, should show her position by lights, blue-lights, or rockets, or by firing guns, when the light-keeper will give notice to the pilot, who will board the vessel as quickly as possible.

The north-west side of Rottnest island, from cape Vlaming, trends nearly N.E. by E. $\frac{1}{2}$ E. 4 miles to North point, and is fronted by rocks and shoals extending from half a mile to nearly a mile from the shore.

Soundings.—There are soundings in about 70 fathoms at 18 or 20 miles westward of Rottnest island, from whence the depth decreases to 30 fathoms at 3 miles off the west end, and irregularly to 25 and 22 fathoms at the same distance from the

* See Admiralty Chart, No. 1700—"Swan River and Rottnest;" also No. 1058—Cockburn Sound, Gage Road, and Swan River.

south side of the island. To the northward of Rottnest island, the soundings are more regular after passing cape Vlaming.

At 5 miles off North point the depth is 22 and 21 fathoms, fine grey sand, shoaling very gradually to the mainland. The bottom is rocky off the west end of Rottnest island; but consists of rock and coarse white sand on the north-west and south-west sides of the island.

Horse-shoe rock, which is covered, lies N.E. $\frac{1}{2}$ N. $2\frac{1}{4}$ miles from cape Vlaming, and has 9 and 10 fathoms close to it.

From North point the northern coast of Rottnest island trends E. $\frac{3}{4}$ S. $1\frac{1}{2}$ miles to Bathurst point, and is bordered by rocks and foul ground extending from a quarter to half a mile from the shore, with a rocky $2\frac{1}{4}$ fathoms patch lying N.N.W. $\frac{1}{2}$ W. half a mile from Bathurst point.

Duck rock.—Roe reef.—Duck rock, which lies about half a cable's length off Bathurst point, is a small rocky islet, distinguished by a cask beacon on it, from which Roe reef—a rocky patch, with $2\frac{1}{2}$ fathoms on it—bears N. by W. $\frac{1}{4}$ W. three-quarters of a mile. Roe reef may be cleared to the northward by keeping the north extreme of cape Vlaming open to the north-westward of North point until Duck rock bears South.

Thompson bay, one of the pilot stations, is an indentation of the north-east side of Rottnest island, about 1 mile wide, N.W. and S.E. between Bathurst and Phillip points; but it is only fit for boats, it being full of the shoal patches and rocks which form Kingston reefs.

Phillip rock, which lies N.E. 2 cables' lengths from Phillip point, is a small rocky islet distinguished by a cask beacon.

Kingston reefs, which front Thompson bay, extend East nearly 2 miles from Duck rock, and N.E. by E., $1\frac{1}{4}$ miles from Phillip rock to Kingston spit. There is a depth of 7 fathoms near the north and east edges, increasing to 9 and 10 fathoms at half a mile to the northward of these reefs. To clear Kingston reefs to the northward, Bare hill, a peak 140 feet high, near the north coast of Rottnest island, should be kept a little open north of Duck rock. Should this hill not be distinguished, North point must be kept a little to the southward of W. $\frac{1}{2}$ S.

To clear Kingston reefs on the south side, keep Parker point, the south extreme of Rottnest island, open south of Bickley point, which lies S.W. by S. half a mile from Phillip point.

Wallace islet.—Twin rocks.—Wallace islet, 1 cable's length off Bickley point, is a rugged grey rock, at a quarter of a mile to the north-eastward of which lie the Twin rocks, which are bold-to, and bound Beagle road to the south-westward.

Beagle road, off the east end of Rottnest island, between Phillip and Bickley points, affords good shelter from the usual north-west and south-west winter gales, between the months of March and October. The best berth is in 4 fathoms, sand, nearly South half a mile from Phillip rock, and N.E. a quarter of a mile from Twin rocks, with Parker point a little open to the south-eastward of Bickley point. A vessel remaining here should moor, on account of the limited space.

Porpoise bay, and **Direction islet.** — Porpoise bay, which extends S.W. by W. $\frac{1}{2}$ W. $1\frac{1}{2}$ miles from Bickley to Parker point, is full of rocks and shoals, terminating south-eastward at Direction islet, a low rocky mass lying S.W. $\frac{3}{4}$ S. half a mile from Wallace islet, with deep water at a cable's length from its south-eastern side.

A small, rocky, 2-fathoms patch, lying nearly half a mile to the north-eastward of Direction islet, may be avoided in hauling up for Beagle bay, by keeping Parker point in line with Direction islet, until Phillip rock bears North.

Parker point, S.E. ¼ S. 1¾ miles from Rottnest light, being connected with the island by a low narrow neck of land, appears when seen at a distance, as an islet. It is bordered by a rocky reef projecting nearly a cable's length from the point.

Salmon bay, and another bight to the westward of it, extending W. ½ N. nearly 4 miles from Parker point to cape Vlaming, are foul and rocky.

Rottnest island having a penal establishment for the aborigines of the colony, boats are not allowed to land there without written permission from the Colonial Secretary. The native prisoners on the island collect salt from the lagoons on it, cut wood, grow grain, and perform much useful work.

Middle ground is a 3-fathoms patch of sand and weeds, lying nearly midway between Phillip point and Champion rock, with Phillip rock its own breadth open north-eastward of Duck rock, and the north extreme of Direction islet in line with Tree hill, which rises half a mile North of Parker point.

Middle ground may be avoided by borrowing towards the rocky islets off the east end of Rottnest island, from which no dangers extend beyond a cable's length. It may be cleared on the north-east side by keeping Phillip rock in line with Duck rock.

Jackson rocks, a patch with 12 feet water on them, have lately been discovered in the southern passage, at about South half a mile from Middle ground, with Phillip point and Duck rock nearly in line, and a little North of a line from cape Vlaming through Parker point.

Champion rock lies nearly in line with the west extreme of Phillip rock and Duck rock, distant from the former about three miles. It is nearly 2 cables in extent, with only 9 feet water on its shoalest part; but there are 4 and 5 fathoms close round it. This rock may be cleared to the northward by cape Vlaming being shut in by Parker point; and to the eastward by keeping Duck rock in line with the north-east extreme of Phillip rock.

Stragglers reef.—Champion rock is situated at the north-west extreme of Stragglers reef, a collection of covered rocks and foul ground, without any well-known channel between them, extending to the Stragglers rocks, which lie between 2 and 3 miles to the south-eastward of Champion rock.

From a patch with 3¾ fathoms on it, lying S.W. by W. one-third of a mile from Champion rock, the western 5-fathoms edge of the Stragglers reef extends nearly S.S.E. 3 miles to Hügel pass. And from a 3-fathoms patch lying S.E. ½ E. half a mile from Champion rock, the eastern 5-fathoms edge of the foul ground of Stragglers reef trends nearly S.E. 2¼ miles to Stragglers channel. The sea breaks upon all the foul ground between these 5-fathoms lines in bad weather.

The Stragglers form a cluster of small, pointed rocks, the largest and highest of which bears nearly S.E. by E. 7½ miles from Rottnest light. These, together with the sunken rocks about them, are nearly 1 mile in extent.

Swan River lighthouse stands on Arthur head, on the south side of the entrance of Swan river, and nearly E. by S. ¾ S. 12 miles from Rottnest light. It is of white stone, surmounted by a lantern, showing a *fixed white* light of inferior magnitude; but being 92 feet above the sea level, it is visible 14 miles.

From Rous head, which forms the north side of the entrance of Swan river, and

lies north one-third of a mile from the lighthouse, a sandy beach extends northward to a rocky shore near the Winding Sheet, a bare sand patch, N. by E. ½ E. 3½ miles from the entrance of Swan river.

A Sand-bank, with 5 fathoms or less water on it, lies 2 or 3 miles to the north-westward of the Winding Sheet, and should be avoided in bad weather, as its exact position, extent, and least depth of water, have not yet been ascertained.

Hall bank, which lies N.W. ¾ N. 2 miles from Swan river lighthouse, and 1¾ miles from the beach, is a rocky patch about 1 cable in extent, with 3¼ to 4 fathoms water on it, rising abruptly from a depth of 8 and 9 fathoms. This bank, on which the sea breaks in bad weather, is marked by a painted *black* and *white* buoy on its western side.

For about half way between Hall bank and the shore the soundings are regular in about 8 and 9 fathoms, when they decrease gradually to 3 fathoms within a few yards of the beach.

Elenor rocks form a 12-feet patch, not exceeding 120 yards in extent, lying N.W. ½ N. 1¼ miles from the Swan river light, and are marked by a *chequered* buoy, moored in 5 fathoms, at 50 yards from their western side.

A Rocky patch, with 3¼ fathoms on it, lies N.W. by W. ½ W. half a mile from the light-house, with 5 and 6 fathoms close outside, and 4 and 5 fathoms within it; but the space between this danger and the shore is narrow, and is unmarked.

Beagle rock, W. by S. ¼ S. three-quarters of a mile from Swan river light, has 16 feet water on its shoalest part, and is distinguished by a *black* buoy. There are rocky patches of 3 fathoms at E. by S. 2 cables' lengths, and at West a quarter of a mile from Beagle rock, with 4½ fathoms between and close around them.

Minden reef is a small 13-feet patch, marked by a *black* buoy with a white vane, lying S.W. ½ W. a little more than a mile from Swan river light-house, with 4 fathoms close around it, except on its south-east side, which is separated by only a cable's length, from a projection of the 3 fathoms bank, which here extends a mile from the shore.

GAGE ROAD, which has generally been considered unsafe in winter, is the nearest, but most exposed, anchorage to Swan river; it is open to the northward, but is in some measure protected by Rottnest island and the Stragglers reef from the vast body of water rolling in from the N.W., and is sheltered to the southward by Success bank, which separates Gage road from Owen anchorage.

At about half way over from Rottnest island (in an E.S.E. direction) to Swan river, the water deepens from 4½, 5, and 6, to 9 and 10 fathoms, gradually increasing to 12 fathoms between 2 and 3 miles from the mainland, where there is the deepest water and best holding ground in Gage road.

Directions.—In the summer, from October to April, the safest season for vessels to anchor in Gage road, a stranger—after making the best of the sea and land breezes and occasional strong south-west winds, which prevail as far as 30 miles from the land—should, on making Rottnest island, continue the passage then decided upon, either north or south of the island, as any change in the route after once commenced, would tend to embarrass the pilot, and delay his boarding the vessel until too near the land.

Northern Passage.—A vessel bound for Gage road by the passage north of Rottnest island, should not approach it nearer than 1 mile, in order to avoid Horseshoe rock and Roe reef. A vessel will be clear to the northward of the former,

while Duck rock beacon is kept open of North point; and the latter may be cleared on the north side by keeping the north extreme of cape Vlaming open of North point until Duck rock bears south.

An E. by S. $\frac{1}{4}$ S. course may then be shaped for the Winding Sheet, the remarkable white sand-patch, already described, at $3\frac{1}{2}$ miles to the northward of Swan river. When Wallace and Direction islets are in line, and open to the eastward of Phillip rock—at which time Swan river light-house will be easily seen and the vessel will be boarded by a pilot—a S.E. $\frac{3}{4}$ E. course, for about 7 miles, will conduct the vessel to the outer anchorage in Gage road, when a berth may be taken up as most convenient.

The Southern Passage is $2\frac{1}{2}$ miles wide between the islets off the east end of Rottnest and Champion rock. In proceeding for Gage road from the westward by the southern passage, Rottnest island should not be approached nearer than half a mile, to avoid the reefs and foul ground fronting cape Vlaming and the bays between it and Parker point.

Having cleared the reef which projects from Parker point, keep the south extreme of cape Vlaming in view south of Parker point, which will lead about $1\frac{1}{2}$ cables' lengths south of Jackson rocks.

When Bathurst point opens east of Phillip point, steer E.N.E through the 5-channels channel north-westward of Champion rock until Duck rock beacon opens east of Phillip beacon, when an E. by S. course may be steered for the outer anchorage in Gage road, as before directed.

In working through the southern passage against a northerly wind, Champion rock and the dangers of the Stragglers reef may be avoided by keeping the Mewstone—a lump of rock bearing nearly W. by S. $\frac{1}{2}$ S. $4\frac{1}{2}$ miles from Swan river light-house—open to the S.W. of the largest and highest of the Stragglers rocks, until the south extreme of cape Vlaming is just open south of Parker point; then steer eastward for Gage road as before directed.

Should the Mewstone and Stragglers not be satisfactorily distinguished for that purpose, the beacon on Phillip rock should not be brought to bear to the westward of N.N.W. $\frac{3}{4}$ W.

In beating up towards Rottnest island against a strong northerly or southerly wind, much ground will be gained by working in the stream of the island, in order to avoid the strength of the lee current, which is found on such occasions to run at the rate of 1 and $1\frac{1}{2}$ knots.

Anchorage.—In the summer season, from October till April, safe and convenient anchorage will be found in Gage road, in somewhat more than 6 fathoms, at about W. by S. 1 mile from Swan river light-house, with the south extreme of Rous head in a line with a low sandy point projecting from the south, or Fremantle side of the river; and Anglesea point on the south side of Fremantle, in line with Scott's jetty, bearing east.

Vessels discharging cargo often lie much nearer to the shore, in about 3 fathoms; but the ground is not so good, and is also strewed with the Beagle, and other rocky patches, already described.

The wrecks which have occurred in this anchorage may be traced to the desire of finding a berth near the shore, when vessels get into rocky ground; a gale probably comes on in the midst of discharging or receiving cargo, and in some cases, before a second anchor can be let go, the vessel is driven on shore.

But the shoals in Gage road being *now marked by buoys*, and the holding ground better known to the pilots, together with the generally improved condition of vessels' ground tackle, ship-masters have of late felt more confidence in the security of Gage road. And where the anchorage was formerly considered unsafe in winter, it is now resorted to at all seasons, to avoid the delay and inconvenience of discharging cargo in the more secure, but distant, Owen anchorage or Cockburn sound.

Tides.—It is high water in Gage road, full and change, at 8h. 50m.; and in Thompson bay, Rottnest island, at 7h. 50m.; rise not exceeding 32 inches; the tide ebbing 10 hours, and flowing 14 hours.

The **Mewstone,** one of the conspicuous marks for the passes into the several anchorages, is a rocky lump, close to and around which are several shoal spots.

The **Seal and Row-boat rocks** are three rocks (above water) on a ledge 4 cables' lengths to the eastward of the Mewstone.

The low rocky island of **Carnac,** $\frac{1}{3}$ of a mile in extent, lies 2 miles northward of the north end of Garden island; on the east side of it are two buildings; near and around it are ledges of rocks, with several rocky islets; and on its west side at the distance of about 2 cables is **West rock,** which is used as one of the leading marks of the channels.

Challenger rock, with 3 or 4 feet water on it, is small, of a bright colour, and easily seen, if the *buoy* with a vane has been washed away; hereabout the shoal rocky patches lie in great numbers.

The **Five Fathom bank** (its northern part $2\frac{1}{3}$ miles southward of the east extreme of Rottnest island) extends S. by E. $\frac{1}{2}$ E. $3\frac{1}{4}$ miles until the Mewstone is in line with Buckland hill bearing N.E. by E.; its breadth varies from $\frac{1}{2}$ to $\frac{3}{4}$ of a mile. The south extreme of the northern portion of the Five-fathom bank is known as the **Seaward reef;** there are many dangers on it, the positions of some of them not being accurately known, but all may be cleared to the southward by keeping the Mewstone *its own breadth open to the northward* of Buckland hill; and the whole of the Five-fathom bank may be cleared to the westward by keeping Rottnest light-house to the northward of N. by W. $\frac{1}{2}$ W.

Casuarina shoal, on the Five-fathom bank, is a small rocky patch W. $\frac{3}{4}$ N. $2\frac{5}{4}$ miles from the N.W. point of Garden island; the least water on it is about 15 feet; the channel between Seaward reef and Casuarina shoal is nearly 2 miles wide, with 4 to 12 fathoms water in it, the deepest part being towards the reef. The southern-most shoal spot (at present known) is a small rocky patch S. $\frac{1}{2}$ E. $8\frac{1}{2}$ miles from Casuarina shoal, and nearly S.W. by W. $\frac{3}{4}$ W. $3\frac{1}{2}$ miles from cape Peron.

On the northern part of the Five-fathom bank the general depth, except near the shoal patches, is from 6 to 7 fathoms; but the sea occasionally breaks on all parts of it after heavy gales. Outside the bank the water deepens rapidly to 20 and 25 fathoms; between it and Garden island there is a clear space of $2\frac{1}{2}$ to 3 miles wide, in 8 to 11 fathoms.

OWEN ANCHORAGE is separated from Gage road by Success bank, and from Cockburn sound by Parmelia bank; and being sheltered from seaward by the reefs extending from the Stragglers rocks to Carnac isle, offers a secure retreat from Gage road during the stormy months of winter. The best berth is in Beagle anchorage, at about $\frac{3}{4}$ of a mile to the southward of Fish rocks.

The Soundings in Owen anchorage vary from 4 to 9 fathoms; the least depth

of water in the fairway being 4 fathoms, between $\frac{3}{4}$ of a mile and 1 mile to the southward of the Mewstone; a four-fathoms bank extending from the S.W. extreme of Success bank nearly to the west end of Parmelia bank; and 4 fathoms near the entrance of Beagle anchorage, between the south-east extreme of Success bank and Owen patch.

Huegel pass, leading from the sea into Owen anchorage or Gage road, although it has from 4 to 6 fathoms water in it, is narrow and little known, and consequently it may be considered unsafe.

Lambert pass, another narrow channel from the sea into Owen anchorage, with 4 to 6 fathoms water in it, is encumbered with several small sunken rocks, and ought not to be attempted without a pilot.

The deepest channel through Lambert pass is close on the north side of **Passage rock,** which is small and nearly awash, lying about 2 cables' lengths northward of the Roarers reefs, and S.W. $\frac{1}{2}$ W. 1 mile from the Mewstone.

A good *leading mark* for the mid-channel of Lambert pass is the Mewstone, its own breadth open to the N.W. of Buckland hill, the summit of the coast land N.E. by N. $2\frac{1}{2}$ miles from Swan river lighthouse. But as this course would lead close upon several patches of $2\frac{1}{4}$ and $3\frac{1}{2}$ fathoms within a $\frac{1}{4}$ of a mile of, and in, the channel, a boat should lie at Passage rock before it is approached by a stranger, within $\frac{1}{2}$ a mile.

Buckland hill open a very little to the northward of a boat so placed, or of any beacon which may hereafter be fixed on Passage rock, would lead clear of all the dangers, and close on the north side of Passage rock in 4 to 7 fathoms; after which an easterly course may be steered for Owen anchorage; or the Mewstone may be left to the eastward by a vessel bound to Gage road through Stragglers channel.

Carnac pass also leads into Owen anchorage from the sea, passing near the N.W. side of Carnac, but although nearly a mile wide, with 4 to 5 fathoms, it is crowded with sunken dangers.

FROM GAGE ROAD TO OWEN ANCHORAGE.—A vessel under 18 feet draught may, in the event of threatening weather from the northward or N.W., *shift her berth* from Gage road to Owen anchorage by crossing Success bank, the deepest water being at E.N.E. $\frac{3}{4}$ of a mile from the Mewstone, and in Stragglers channel.

In crossing Success bank by the former passage, make a W.S.W. course for the Mewstone, passing between Scott's ledge and the patch of $2\frac{3}{4}$ fathoms to the northwestward of it. When the low flat rock off the south point of Carnac isle comes on with the east end and highest part of a white sand-patch on the north end of Garden island, bearing nearly S. by W., steer this course, which will lead through the passage, at about $1\frac{1}{2}$ cables' length to the eastward of Seal rock ledge.

When the south end of the low cliffs northward of Woodman point bears E. $\frac{3}{4}$ S., steer directly for it, until Fish rocks beacon comes in line with Swan river lighthouse, then haul up N.E., and pass between the two buoys on the south-east extreme of Success bank and Owen patch, with the two beacons on the sand-hills in line; and anchor in 9 fathoms in **Beagle anchorage,** with Swan river lighthouse bearing N. by E., and the Mewstone W. by N. $\frac{1}{4}$ N.

Stragglers channel.—Vessels of less than 18 feet draught proceeding from Gage road into Owen anchorage by the Stragglers, or Western channel, should steer west for the highest Straggler rock, and when West rock, off the north-west point

of Carnac isle, is its own breadth open east of the white sand-patch on the north end of Garden island bearing S. $\frac{1}{4}$ E., keep southward on this line until the highest Straggler is in line with Rottnest lighthouse and the Mewstone bears S.S.E.; then steer for the Mewstone on this bearing, which will lead through the channel between Success bank and the $2\frac{1}{2}$-fathoms shoal to the eastward of it.

Pass to the westward of the ledge projecting from the Mewstone, and continue southward until the south extreme of the low white cliffs bears E. $\frac{3}{4}$ S., and then proceed for Beagle anchorage, as before directed.

A vessel drawing more than 18 feet, in shifting her berth from Gage road to Owen anchorage, should pass out north or south of Rottnest island, and then into Owen anchorage by Lambert pass.

Lambert pass.—In adopting the route by the Southern channel and Lambert pass, steer westward from Gage road, so as to bring the south extreme of cape Vlaming in line with the low neck connecting Parker point with Rottnest island, which will lead through the Five-fathoms channel, and at a $\frac{1}{4}$ of a mile north of Champion rock.

Whilst Bathurst point is just in view north-eastward of Phillip point, alter course southward, to avoid Jackson rocks, and then steer S.S.E., between the Stragglers reef and the Five-fathoms bank, until the Mewstone is its own breadth open north of Buckland hill; and then proceed through Lambert pass, as directed on the preceding page.

If preferred, a vessel may reach a perfectly secure anchorage in Cockburn sound, between Garden island and the mainland, by using Challenger pass, between Carnac and Garden islands. But for either passage a pilot may always be obtained by making the usual signal.

COCKBURN SOUND is a spacious harbour, formed between Garden island and the mainland, and separated from Owen anchorage by Parmelia bank. It is 8 miles long North and South, and 5 miles wide, affording secure anchorage nearly throughout, in 5 to 12 fathoms, well protected from all winds, especially on the western side near Garden island. Vessels of any size may be hove down in Port Royal (or Careening cove) to the southward of Colpoys point.

Challenger pass, leading into Cockburn sound between Carnac and Garden islands from seaward, has many channels between the numerous sunken rocks and reefs, but cannot be considered perfectly safe for vessels of great draught, without a pilot.

Approaching Cockburn sound by Challenger pass from the westward, the outer dangers to be avoided are Seaward reef and Casuarina shoal. The best passage, at about mid-way between these dangers, being found by keeping Brown hill—on the eastern side of Cockburn sound—open of the north end of Garden island one quarter of the space, from thence towards Carnac isle, bearing E. by S. $\frac{3}{4}$ S., until the buoys on Challenger and the Stags rocks are made out.

Should these buoys be adrift, and a vessel bound into Cockburn sound be unable to procure a pilot, a boat or cask must be anchored near Challenger rock. Marks for finding this rock are the south point of Carnac isle in line with Fremantle gaol—which stands about a cable's length to the eastward of Swan river lighthouse—and the Haycock, near the north end of Garden island, appearing a little to the eastward of Signal hill, the summit of Garden island, bearing S. by E. $\frac{3}{4}$ E.

Having made out the chequered vane buoy on Challenger rock, and the white cask

buoy on the Stags rocks, steer for the former, and bring it in line with the Stags buoy and Brown hill, bearing E.S.E., easterly. Pass 30 to 50 yards northward of both buoys, and North of the intermediate 3-fathoms patch; at the same time keeping South of the black cask buoy on Flat ledge, and the *chequered* cask buoy on the Three-fathoms bank.

After passing the Stags buoy, keep it in line with the Challenger buoy astern, until the Mewstone is seen round the east side of Carnac isle, when the vessel will be clear of Challenger pass, and after passing North of the North-east spit *white* buoy, may steer south-eastward into Cockburn sound. Or if bound into Owen anchorage or Gage road, haul up on the west side of the *black* cask buoy on Inside reef, and cross the deepest part of Parmelia bank, at about half a mile to the eastward of Carnac isle.

In approaching Challenger pass from the *southward*, it is advisable to bring the Haycock to bear N.E. ½ N. until within 1½ miles of the island, when the Five-fathoms bank will have been passed over, and the depth will be 9 to 11 fathoms. Steer North for 3 miles, and Challenger rock will then be half a mile to the eastward. As this is the westernmost danger of Challenger pass, its position should be correctly ascertained before entering the channel. The summit of cape Peron, to the southward, must therefore be kept open to the westward of Garden island until Challenger pass is satisfactorily made out, or until the vessel is boarded by a pilot.

For Owen Anchorage across Parmelia bank.—To cross Parmelia bank over its narrowest and deepest part, keep the Haycock over the stern, bearing S. by W. ½ W.; this will lead across the bank at half a mile eastward of Carnac isle, in 14 feet water; and when it deepens to 3½ or 4 fathoms, steer eastward for Beagle anchorage, as directed at page 662; or if bound for Gage road, steer northward, and follow inversely the directions given at page 662 for crossing Success bank.

In going out by Challenger pass, the foregoing directions must be reversed, and a W. by N. course be made good for 3 miles beyond Challenger rock, when the soundings will quickly increase from 5 to 10 and 15 fathoms, and the vessel will be seaward of all dangers.

Coast.—From Rottnest island to **Shark bay (Kok's islet)**, in Lat. 24° 43′ S., Long. 113° 9′ E., the distance is 455 miles; the coast is fronted more or less by islets, and by rocks and reefs above and under water, extending seaward in places, but especially towards the southern part, to the distance of 2 or 3 miles. The **Beagle** islets, just south of the parallel of 29° 45′ S., are about 9 or 10 miles from the beach. The Houtman rocks also extend (North and South) a considerable distance from the coast between the parallels of 28° 10′ and 29° S.

HOUTMAN ROCKS consist of three groups of small coral islets, reefs, and rocks extending N.N.W., and S.S.E. a distance of 49 miles, and 10 to 13 miles across.

The northernmost group, called Wallabi, is separated from the middle, or Easter group, by Middle channel, from 6 to 9 miles wide, with regular soundings varying from 20 to 28 fathoms, sand.

Easter group is separated from the southernmost, or Pelsart group, by Zeewyk channel, 4 miles wide in its narrowest (western) part, where the deepest soundings are 37 fathoms, decreasing eastward to 20 fathoms, sand and coral.

North islet (Wallabi group) is in Lat. 28° 18′ 5″ S., Long. 113° 36′ 33″ E. The north extreme of Rat island (Easter group), in Lat. 28° 42′ 49″ S., Long. 113° 47′ 41″ E. And the S.E. extreme of Pelsart isle in Lat. 28° 59′ 14″ S., Long. 113° 58′ 10″ E.

Snapper bank, the most distant detached shoal from the Houtman rocks, lies S.E. by E. 7½ miles from the dead coral islet N.E. of Easter group, and N. by W. 6½ miles from the north-easternmost of the Pelsart group; this is a 6-fathom coral bank, 1¾ miles long north and south, by ¾ of a mile wide.

Soundings.—The vicinity of Houtman rocks has not been carefully sounded, but from the heavy breakers on the reefs, and the long ocean swell rolling into the channels, it is presumed there are no outlying dangers. At nearly 6 miles outside North islet reef the soundings are 42 fathoms, coral; whilst no bottom was reached with 166 fathoms at 4 miles off the N.W. extreme of Pelsart group.

Snapper and rock-fish may be caught in abundance near these islets; but it is doubtful whether water could be procured, except during the rainy season.

Turtle Dove shoal, marked on old charts at about 13 miles S.S.E.-ward of the south end of Pelsart island, has recently been reported by several whalers and coasters, who agree in placing it S. by E. ¾ E., 26 miles from that island. The sea does not always break on it, and there are 30 to 40 fathoms close to it.

Another reported **shoal,** 8 miles S.E.-ward of the last assigned position of the Turtle Dove, may possibly be the same danger, but until the vicinity has been examined great caution is requisite in navigating this part of the coast.

GEELVINK CHANNEL separates Houtman rocks from the mainland; it is from 24 to 30 miles wide, with 25 to 30 fathoms water in it over an uneven sandy bottom, deepening gradually to the southward.

The only known danger in the channel is **Mid-reef,** in a direct line between Moore point* and the south extreme of the Houtman rocks, or nearly W. by S. ½ S. 18 miles from Moore point; it is covered, and does not always break: the depths around it are from 29 to 32 fathoms.

SHARK BAY extends south 144 miles, and is from 30 to 50 miles wide. It is formed between Bernier, Dorre, and Dirk Hartog islands, to the west, and the low mainland coast to the east, south, and south-west.

Naturaliste channel, the southern entrance into Shark bay, between Dorre and Dirk Hartog islands, extends S.W. by S. 12 miles from the reef which projects from the south extreme of the former, to cape Inscription, the north point of the latter island. The soundings in the channel vary from 9 to 35 fathoms, with no other known dangers in it than Dampier reef, on which the sea always breaks. This reef, 2 miles long east and west, and 1 mile broad, with 2½ fathoms on it, lies N.E.-ward 7 or 8 miles from cape Inscription, and in the fairway of the channel.

Geographe channel, the northern passage into Shark bay, is 30 miles wide between cape Cuvier (of the French) and Kok's islet, and has generally regular soundings in 20 to 30 fathoms, except at about 5 miles to the north-eastward of Kok's islet, where there appears to be a 6-fathom shoal.

Coast.—From cape Cuvier (Lat. 24° S., Long. 113° 22′ E.), which is high and rocky, a low sandy coast trends to cape Farquhar, N.N.E. ½ E. 28 miles; thence to point Cloates the distance is 62 miles, nearly north, the coast between forming in two

* Moore point (Champion bay) is in Lat. 28° 47′ 8″ S., Long. 114° 36′ 20″ E.

open bays. From point Cloates to the North-West cape of Australia the distance is 52 miles N.N.E. ½ E.

The **North-west cape** is a low sandy point in Lat. 21° 47′ 40″ S., Long. 114° 2′ 15″ E., projecting E.N.E. 2 miles from Vlaming head, the northern fall of the ridge extending along the west side of Exmouth gulf: this gulf is 34 miles wide at its entrance, from cape Locker to North-West cape, and was traced nearly 50 miles in a S.S.W. direction. Several small islands, rocks, and sunken reefs lie scattered about the entrance.

Rowley shoals consist of extensive coral reefs lying between the parallels of 17° and 17° 40′ S., and the meridians of 118° 50′ and 119° 40′ E. As the sea breaks heavily on them, they may be easily seen in the day-time, and the noise of the breakers may be heard at some distance from them at night.

Soundings on the N.W. Coast of Australia.—The outer edge of the 100-fathoms bank of soundings off the western part of the North-west coast extends from about 45 miles eastward of the Rowley shoals in a W.S.W. direction to about 30 miles north of the Monte Bello isles, and from thence closes towards North-West cape. From the outer edge to the land, the depth of water decreases with some regularity.

Squaw rock, a dangerous 10-foot patch, discovered in 1860, lies nearly N. by E. 70 miles from North-west cape, or in Lat. 20° 41′ S., Long. 114° 17′ E.

A **coral reef,** on which the ship *Lively* was lost, is said to lie in Lat. 16° 30′ S., Long. 119° 36′ E.

The following remarks on the N.W. coast of Australia and Dampier Archipelago, with directions for the new port of **Tien-Tsin,** are by Captain J. T. Jarman:—

"From April to November inclusive, during which I passed alternately northward and southward of the N.W. cape, I invariably found, at a moderate distance from the land, fresh steady breezes from S.S.E.: at about 35 miles N.E.-ward of the cape the wind was more easterly,—sometimes E.N.E. I never found the vessel within the influence of regular tides until eastward of Monte Bello isles; these I rounded very close in five out of seven passages, and from the N.W. cape to Ritchie reef the current invariably set with the prevailing wind at about ¾ of a mile per hour.

"If bound to the eastward during the period mentioned above, a berth of 7 or 8 miles will be sufficient to give the N.W. cape; from thence, if the wind admit, steer direct for Ritchie reef, which is very accurately laid down on the 'Admiralty chart, —Sheet, No. vii. N.W. coast of Australia, additions by Captain Stokes, R.N.'

"No vessel should at present attempt to pass to the S.E.-ward of the Monte Bello group, as there are many scattered reefs extending in that direction; and when working in their vicinity with a contrary wind, a good look-out must be kept. I passed over several discoloured patches and saw many others in the day-time; at night, it would be very imprudent to stand nearer than 10 miles toward the islands.

"Ritchie reef should be rounded on its west side (especially in light winds), on account of the prevailing westerly set which sweeps strongly round the north end of Monte Bello. I twice passed along this reef at the distance of about ½ a mile, and from aloft saw no appearance of any other danger in its vicinity; in a moderate breeze the sea breaks heavily on the reef, and in a calm may be heard several miles off; the reef is 2 miles N.E. and S.W., and divided into nearly two equal parts by an apparently deep water passage of about ⅓ of a mile in, trending S.E. and N.W.; the southern portion is a sand bank above high water mark: the centre lies in Lat. 20° 16′ 30″ S., Long. 115° 8′ 30″ E.

"Working to the eastward from the reef, I never stood to the northward of 20° S., and when far enough to the eastward to weather Monte Bello, by keeping well to the southward I obtained the advantage of regular tides. I was once becalmed when Rosemary isle bore due south, distance 6 miles, and observed the tide commence running E.N.E. at 5h. P.M. at the rate of 2 miles per hour, it continued in the same direction until 10h. P.M.: there was no slack water, but it suddenly changed to S.S.W. at the same rate; this was on the day of full moon.

"It appears to be safe to work along the northern side of the Dampier Archipelago, but I always kept the lead going and found a regular decrease of water towards them. Enderby island is the highest of the group in this locality, and wherever the soundings are marked on the Admiralty chart they are very accurate.

"Rosemary isle may be easily known by its steep and rounded appearance, and is safe to approach; but be careful to give Legendre isle a good berth, for a tide race sweeps round its north end—off which I found overfalls of 35 fathoms, with the north end of Legendre bearing S.W. distant 4 miles.

"Delambre isle is of moderate height and visible 10 miles from the deck; it is only safe to approach on its north side, which is steep to; on the west side it dries out for about $1\frac{1}{2}$ miles; and has on its east side at about $\frac{1}{2}$ a mile from the north extremity, a reef of rocks projecting from the shore fully $2\frac{1}{2}$ miles (covering about 10 feet at high water springs), and leading to seaward in an E.S.E. direction; the great rise of twenty feet hereabout, makes this reef very dangerous at high water. The first voyage, I anchored in the night in 10 fathoms sandy bottom, Delambre island bearing S. by W. distant 5 miles: the vessel remained at anchor for twenty-eight hours during my absence at Nicol bay, and in the interval the tides were carefully observed and noted as follows, viz.:—the first of the set out *from* Nicol bay N.E. by N. gradually backing round by the north and ended with a N.W. set: the first of the flood set *down* to S.E. backing round by the south and ended with a W.S.W. set: no slack water, and the ebb immediately followed at the rate of $2\frac{1}{2}$ miles per hour. High water at F. and C. at Delambre, 10h. 45m. On nearing the mainland in this season regular land and sea breezes prevail. I should not recommend any vessel to stand to the westward between Delambre and Bezout islands.

"If bound to Tien-Tsin harbour, after rounding Ritchie reef, should the wind hang far easterly, do not go to the northward of 19° 50′ S.; when to the eastward of Monte Bello islands, work along well down to southward and you will have smooth water,—with the assistance of regular tides, which are lost when far in the offing. I believe the space between Monte Bello and Rosemary isles to be free from danger: in three passages, in beating over the whole of this space, and down in the bight near cape Preston, I saw no indication of any hidden danger. Standing to the southward you will gradually decrease your water to 14 and 12 fathoms, sand and mud; should it fall calm, you may anchor (with a stream) for the tide. In this season—April to October—the wind usually draws off the coast at night, but does not extend far to seaward.

"Be careful to give the north end of Legendre island a good berth, for the flood tide sweeps right into Mermaid strait: if ebb tide, after rounding Legendre, and with a land wind, steer direct for Delambre isle, the north face of which is about 50 feet in height and nearly perpendicular—with a slight rise towards the centre of the island. You will have 7 fathoms within $\frac{1}{2}$ a mile of the north end of Delambre,

but do not approach the east side nearer than 3 or 4 miles—especially in the night, with a flood tide; nor bring the N.E. end to northward of N.W. ½ N. until Bezout island is plainly visible, for between Delambre and Bezout the flood sets strongly to the W.S.W., and there are reefs and rocky patches in the vicinity of the latter island on all but its north side.

"In coming from the northward give Bezout isle a berth of 2 miles on account of a rock about a mile to the S.E. of the isle, which covers at half tide. From Bezout steer S.S.E. until cape Lambert bears northward of west; the cape is low land, and will not be perceived until Bezout bears W.S.W. Between the island and the cape there is a passage of 2 miles in breadth, but twice in passing through in my boat at *low water* I saw several scattered rocks. If required, shelter may be found under Bezout isle, but it would not be prudent to seek it during a dark night, bearing in mind the great rise of tide whereby many of the dangers are hidden at high water.

Bezout isle, ⅓ of a mile in extent, is flat-topped, of moderate height, with a sort of natural terrace on its south side; in working down to southward from it you may stretch boldly to the S.E. until near the Hat rocks, which are above water; the lead will give you timely warning when to tack, according to the state of the tide. At about ⅔ of a mile to the southward of cape Lambert, stretching out from the main in an E. by N. direction, is a very extensive reef of coral, drying about 8 feet at *low water*, and its outer extremity is about 2½ miles from the shore, with no passage between it and the mainland.

"Running down to the southward, do not bring the east end of Bezout isle to the northward of N.W. until well southward of cape Lambert, when you may edge in shore towards Samson point—the N.E. point of Tien-Tsin harbour; this is requisite, or in the night a stranger might mistake Picard isle for Jarman isle, which latter forms the southern point of the harbour, and has a small rocky islet lying about 1½ miles from it in a N.E. direction. Do not come within a mile of Samson's point until it bears northward of west; projecting from it is a similar (but smaller) reef to the one off cape Lambert; it also covers at half tide and extends one mile seaward; in working down, I found no other danger. You can stand in shore, by the lead, close to the pitch of the reef off Samson point, when the deep bight, or harbour, will be plainly visible, and Jarman isle will bear about south. Jarman island is an abrupt precipitous mass, safe to approach on its north side: on its west side it shelves down to a flat sandy beach, with a few scattered rocks along shore; landing here is easy, and safe at all times of tide and in any weather; as seen from the northward it is similar in appearance to Picard isle, which lies about 3 miles to the S.E. of it; but in the vicinity of Picard isle the water is very shallow.

"When abreast of the reef off Samson point, you may steer boldly into the bay and anchor in any convenient depth; you will have 17 feet at low water with Samson's point bearing north, and Jarman isle on any point between E.S.E. and S.S.E.; the bay is only open between E. by S. and N.N.E.—fine weather points; the holding ground is a sort of stiff sand; I rode out a strong breeze from E. by N., in July, with 35 fathoms of chain: until you have seen the beach at *low water mark*, with a large vessel, you had better not approach within the above-mentioned bearings, although you will have the same water ⅓ of a mile nearer in. With the sea breeze in the Easterly Monsoon you can easily shift your position as convenient: in the West Monsoon you are perfectly sheltered and can chose your berth anywhere. At

the head of the harbour the flat extends out about ⅓ of a mile, dry from high water mark.

"At low water spring tides, Jarman isle is nearly connected with the southern shore of the inner harbour—or Butcher inlet—the channel into which has about 6 feet at low water, and 25 feet at high water, but is very narrow at the entrance; once inside it is much broader, and is a perfectly land-locked lagoon, with an average depth of 23 feet at high water, neap tides, and a soft muddy bottom: owing to the rather contracted entrance a stranger should not attempt it without having previously ascertained the dangers—which are all visible at low water; you must have a fair wind to enter, for with a long vessel there is barely room to lay athwart; going in, with a flood tide, be careful not to have too much canvas on your vessel, and be certain also of the exact spot (by previous marks) where you intend to anchor, for if not in fair mid-channel, and the vessel runs away with a lot of chain, you will be certain, in swinging, to tail on the shore. I moored my vessel head and stern, and when leaving, slipped my stern moorings—running out with the land wind at midnight; she was 140 feet in length, and at low water spring tides had always 6 or 7 feet alongside, and nearly the same depth of mud. I lay about 60 yards from the beach, which at high water forms almost a natural wharf; at low water I buoyed the channel in—from Jarman isle to my anchorage; a small vessel may pass close to the island: bring the north side to bear about N.N.E., and by keeping this bearing you will carry the best water—taking care to avoid the rocks that line both sides of the narrow entrance; they generally cover about three-quarters flood. High water, F. and C. at 10h. 30m.; mean rise and fall from spring to neap, 16½ feet; two tides in twenty-four hours. Flood tide sets fair into the inlet. Mean height of the barometer from April to August, 30·02 inches. Thermometer, night 79°; day 83°.

"I made Samson point by many observations to be in Lat. 20° 37′ 15″ S., and Long. 117° 9′ 45″ E.—assuming Arthur head, West Australia, to be 115° 45½′ E. Variation 1° 30′ W. The outer harbour can conveniently shelter fifty vessels; in light winds and calms there is anchorage in moderate depths anywhere after passing Legendre island, but doubtless there are many undiscovered dangers in the whole neighbourhood—great care and vigilant look out are therefore indispensable. I made six passages between Swan river and Tien-Tsin harbour (both ways) between the end of April and the end of August, 1863;—average from Swan river 9 days, return 11 days."

AUSTRALIA—SOUTH COAST.

Coast.—From **cape Leeuwin** (described p. 652), in Lat. 34° 21′ S., Long. 115° 6′ E., to **point D'Entrecasteaux,** in Lat. 34° 52′ S., Long. 116° 1′ S., the distance is 60 miles. The steep, rocky cape of D'Entrecasteaux is one of the most remarkable projections on this coast, and is visible from 28 to 30 miles; there is a low islet 2 or 3 miles south of the point, and breakers extend nearly the same distance still further, having 30 fathoms water 2 miles to the westward of them.

Cape Chatham, with an island off it in Lat. 35° 2½′ S., Long. 116° 29′ E., is the next headland; here there are soundings of 60 to 65 fathoms, at the distance of 18 to 20 miles from the cape, and 40 fathoms at 8 to 10 miles, within which distance they are irregular.

The **White-topped rocks** which, when made out, show a ship's position, are two

small, but rather high rocks, lying 10 miles from the nearest land; W. ½ N. 13 miles from Chatham island, and S.E. ½ S., 15 miles from point D'Entrecasteaux. The soundings at 18 to 20 miles southward of these rocks are 65 fathoms, white sand.

Nuyts point, a cliffy headland projecting 3 miles beyond the line of coast, lies E. by S. 7 miles from Chatham island. Thence to the sharp, cliffy cape, **West Cape Howe,** in Lat. 35° 8½′ S., Long. 117° 40′ E., the coast trends irregularly to the eastward. The next prominent point is **Peak head,** 4 miles E.N.E. ½ E. of which is **Bald head** (in Lat. 35° 6¼′ S., Long. 118° 0¾′ E.) the eastern extremity of a peninsula 10 miles in length, forming King George sound. Bald head is visible 35 miles; it is high, rounded, and of a sterile aspect, and near its extremity (on the south side) is a rock awash, but it is otherwise safe to approach, having 10 to 12 fathoms close to the shore.

Vancouver reef, of small extent, and with a rock awash in its centre, lies nearly 3 miles S.W. ½ S. from Bald head, and S.E. by E. ½ E. 2½ miles from Peak head; it is steep on every side, and the soundings give no warning.

Maude reef (¼ of a mile in diameter) is outside of Vancouver reef, and nearly in a line with it and Bald head, at the distance of 6½ miles from the latter; it is also 4 miles S. ¼ E. from Peak head; soundings do not indicate its vicinity, since there are 45 to 47 fathoms at 2 to 3 miles S. and S.E. of it, bottom of coarse sand, coral, and stones.

Eclipse islands are a rocky cluster 4 miles S.W.-ward from Peak head; the largest island is about 1½ miles long, E.N.E. and W.S.W., by ½ a mile wide, rising in several green hummocks, and visible 20 to 25 miles; it bears from the extremity of Bald head S.W. by W. 8¼ miles, and from West Cape Howe E.S.E. ¼ E. The rest of the group are three small, barren, rocky islets off the S.W. end of the largest island, and which are surrounded by breakers. This is the southernmost land on the coast. To the N.W.-ward of Eclipse island, at the distance of ¾ of a mile, there is a patch of sunken rocks and breakers.

There is a good clear channel *inside of all the dangers* just described by borrowing towards Peak head; also, passing outside the Eclipse islands, both Maude and Vancouver reefs may be avoided by keeping the southernmost island to the northward of west, until the west end of Breaksea island (in King George Sound) opens of Bald head N. by E. ¾ E. Working to the westward, these islands should be avoided, as the current runs strong to the eastward during the prevalence of westerly winds. It is believed there is no bottom with 30 fathoms at about a mile from the islands.

KING GEORGE SOUND, between Bald head and cape Vancouver, is a convenient and safe anchorage for refitting, wooding, and watering; its entrance is protected from easterly winds by Breaksea and Michaelmas islands; within the sound is Seal island and several small rocks; all the known dangers are marked on the charts.* There are also two land-locked harbours—the Princess Royal on the west, and Oyster harbour on the N.W.

Light.—Breaksea island, an elevated mass 1½ miles east and west, with a small high islet close to its east end, is 3 miles N.E. by N. from Bald head. On the island, 1200 yards within its east extremity, a *fixed white* light is exhibited at an elevation

* See Admiralty Charts, Nos. 2619 and 1059.

of 384 feet above the sea, visible 24 miles seaward, between Bald head and cape Vancouver, the foot of Mount Gardner, or between the bearings of E. by N. and S.W. $\frac{1}{4}$ W. The light-tower is of iron, rising from the centre of the keeper's dwelling, and the whole 43 feet high; it stands on the summit of the island in Lat. 35° 4′ 18″ S., Long. 118° 3′ 20″ E.

Caution.—When approaching King George sound from the westward, the mariner is cautioned that although this light may be occasionally seen, it does not become fairly open until bearing N.E. $\frac{1}{4}$ N.; and it should not be steered for until bearing N.N.E. $\frac{3}{4}$ E., when the vessel will be to the eastward of the Maude and Vancouver reefs; the light will also be hidden to a vessel passing north of Michaelmas island.

The channel between Bald head and Breaksea island is good and deep, but a sunken rock, said to be in it, must be guarded against.

A channel, $\frac{1}{2}$ a mile wide, separates Breaksea and Michaelmas islands; there is also a channel between Michaelmas island and the mainland to the north, but $\frac{1}{2}$ a mile to the north of the west end of this island there is a shoal patch, with deep water close to it.

There is **anchorage** between Seal island and the first sandy beach westward of Bald head, with a low rocky islet bearing W.S.W. $\frac{1}{2}$ W., in 6 to 7 fathoms, sand and weed; also, west of Seal island, in 5$\frac{1}{2}$ fathoms, $\frac{1}{2}$ a mile from the shore.

Princess Royal harbour is an excellent place for a large ship, but the entrance is narrow (only $\frac{1}{4}$ of a mile wide); the shoals in it are *buoyed*, but nevertheless should not be attempted by a stranger without a chart or a pilot.

A *fixed white* **light,** 37 feet above high water, and visible (through the approaches to the harbour) from a distance of 10 miles, is exhibited from point King, the northern bluff of the narrow entrance to Princess Royal harbour. The lighthouse is a small wooden square tower, 17 feet high, with the keeper's dwelling attached, and presents the appearance of a cottage. It stands on the edge of the point, W. by N. $\frac{3}{4}$ N. 7$\frac{1}{4}$ miles from Breaksea island lighthouse, and its position is Lat. 35° 2′ 35″ S., Long. 117° 55′ 12″ E.

Oyster harbour is barred, and only fit for vessels drawing less than 11 feet water.

The town of **Albany** is well situated on the N.W. side of Princess Royal harbour, and *supplies* of all kinds may be procured there.

An *outlying* (reported) *danger*, called **Sealer's ledge,** position doubtful, is marked on the charts; it is 24 miles to the eastward of Bald head, and 12 miles southward of Bald island, the southern extremity of which is in Lat. 34° 55′ S.

Coast.—From cape Vancouver, the irregular outlined coast trends first N.E.-ward to Long. 120° E., and then eastward as far as capes Arid and Pasley; a large part of this coast, from Long. 121° 35′ E. to Long. 124° 4′ E., is fronted by a dangerous labyrinth of islands and reefs, called the **Recherche Archipelago.**

Termination island, in Lat. 34° 30′ S., Long. 121° 58′ E., is the southernmost of the Recherche archipelago; it is a smooth rock rising to a peaked summit, visible 28 to 30 miles; off its north end is a rock with breakers; on its S.W. side, at the distance of 6 to 7 miles, there are soundings in 62 fathoms, white sand, but further south they are quickly lost.

Pollock reef.—Cape Pasley is in Lat. 33° 55′ S., Long. 123° 28′ E.; to the south

of it, at the distance of 24 miles, is Middle island, the largest of the South-east isles of the Recherche archipelago; more southerly still is the dangerous Pollock reef, discovered in 1834 by Capt. Pollock, of the *Merope*, who described it as extending 8 or 10 miles east and west, by 100 yards wide, with about 2 feet water on it; the west end, on which alone the sea broke, was stated to be in Lat. 34° 35′ S., Long. 123° 26′ E., or 14 miles S. ¼ W. from the largest of the South-east isles. Capt. Bethune, of H.M.S. *Conway*, in 1838, made it in Lat. 34° 34′ S., Long. 123° 25′ E.; the sea broke heavily over a space of about a ¼ of a mile, and at 2 miles north from it, 40 fathoms, sand, were found.

Between Pollock reef and the west side of Kangaroo island the Great Australian Bight curves deeply towards the north; there are no known dangers on the line between the reef and the island.

Light on Cape Borda.—On cape Borda, the N.W. point of Kangaroo island, a *revolving* light is exhibited, showing alternately *red* and *white* every *half minute*, visible between S.W. by S. and N.E. by E. ½ E., by the westward. The *white* light may be seen 30 miles, but the *red* light not more than about half that distance; when the *red* light is not visible, the *white* light will appear at *intervals of one minute*. The lighthouse is a square stone tower, and stands about 500 yards from the edge of the cliff, in Lat. 35° 45½′ S., Long. 136° 38′ E.

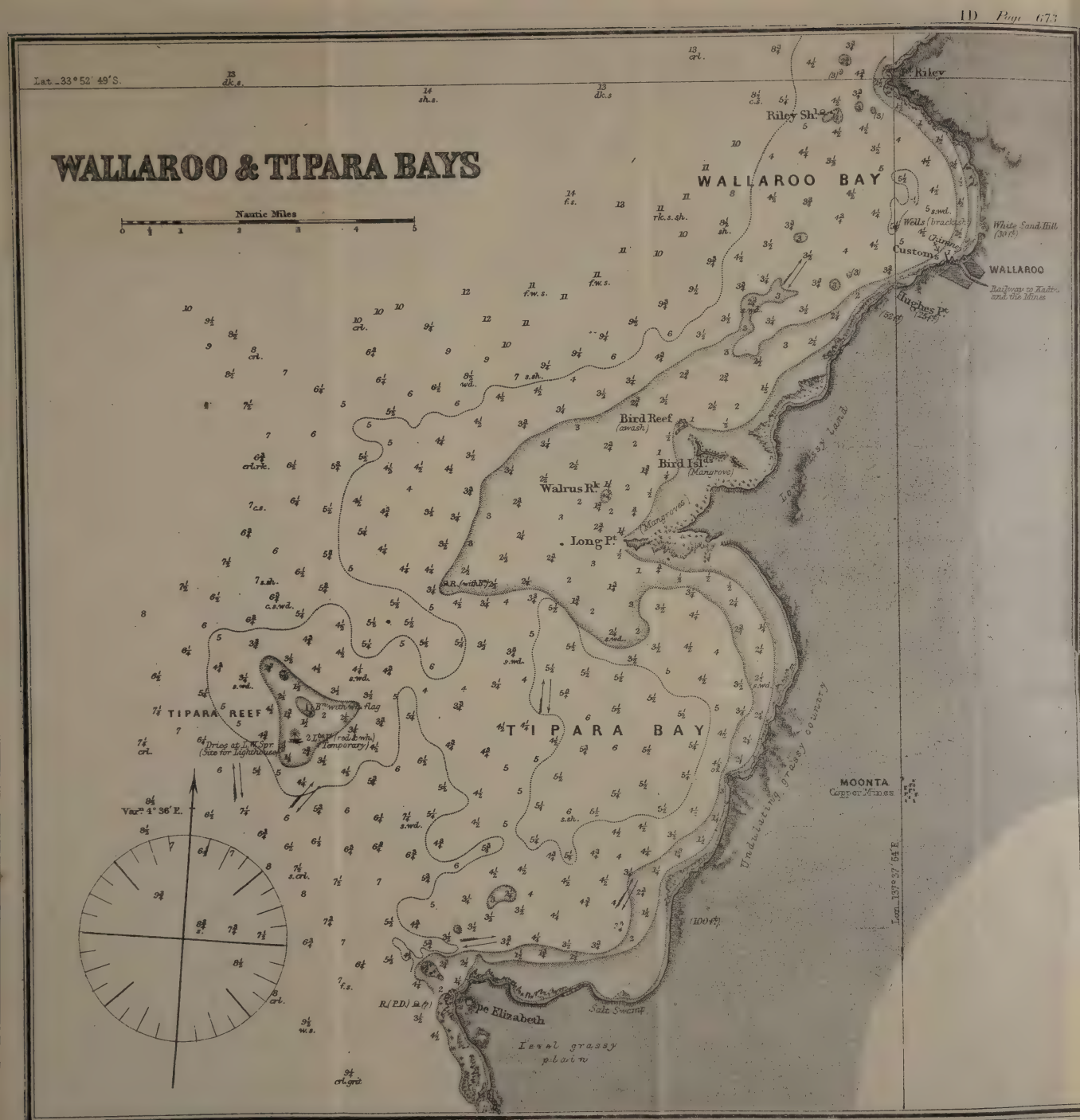
Caution.—Vessels approaching cape Borda from the south-west should keep the light well open of the high land to the southward of the cape, to avoid the reef off cape Bedout, the western extremity of the island, and if bound up Investigator strait, after having rounded cape Borda, they should keep the light quite clear of the high land to the eastward of it on a S.W. by W. bearing until cape Forbin is passed, when it may be shut in. In proceeding down Investigator strait, the light should not be brought to bear to the westward of S.W. by W.

SPENCER GULF.—The prominent cliffs of cape Catastrophe, in Lat. 35° 1′ S., Long. 135° 54′ E., form the west point of entrance to Spencer gulf: the east point of entrance is cape Spencer, composed of three cliffy points, the southernmost being in Lat. 35° 18′ S., Long. 136° 55′ E. The two capes bear from each other W.N.W. and E.S.E. distant 46 miles.

William's island lies 2 to 3 miles S.E. from the western extremity of cape Catastrophe, having a channel nearly 1½ miles wide between it and the cape; there are 12 fathoms in mid-channel, but the soundings are much deeper on each side, bottom of fine sand. A small **sunken rock,** on which the sea breaks only at times, bears E.N.E. 2½ miles from the N.E. end of William's island, and nearly 2 miles S.E. ⅔ S. from the S.E. end of cape Catastrophe.

Thistle island is 15 miles long N.W. by N. and S.E. by S., by ½ a mile to 2 miles wide; the south point, off which is a small islet surrounded by breakers, is in Lat. 35° 6′ S., Long. 136° 11½′ E.

Neptune isles lie between the the parallels of 35° 12′ and 35° 22′ S., and between the meridians of 136° 1′ and 136° 9′ E.; they are rocky and surrounded by breakers, with some detached reefs among the low northern islets constituting the group; these should be avoided during the night. Capt. J. L. Stokes places the southernmost isle in Lat. 35° 22′ 15″ S., Long. 136° 7′ 45″ E.


WALLAROO & TIPARA BAYS
Nautic Miles
0 ½ 1 2 3 4 5
Lat. -33° 52' 49" S.
WALLAROO BAY
Riley
Riley Shoal
Wells (bracketed)
White Sand Hill (30 ft)
Customs
WALLAROO
Railway to Kadina and the Mines
Hughes Pt
Bird Reef (awash.)
Bird Isl (Mangrove)
Walrus Rk
Long Pt
Mangroves
Low grassy Land
TIPARA REEF
Beacon with red flag
Dries at L.W.Spr. (Size for Lighthouse)
TIPARA BAY
Undulating grassy country
MOONTA
Copper Mines
Var. 4° 36' E.
Lon. 137° 27' 64" E.
(100 ft)
Cape Elizabeth
Salt Swamp
Level grassy plain

The channel of **Thorny passage,** formed between the N.W. part of Thistle island and the land of cape Catastrophe, is from 4 to 6 miles wide; in it are several small islands and islets, which so much contract the southern entrance, that $1\frac{1}{2}$ miles of its breadth (between Smith islet and the mainland) is alone safe for ships; there the depth is 20 to 22 fathoms.

The **Althorpe isles,** with several rocks and a reef, lie 5 miles to the southward of cape Spencer; the largest, about a mile in extent, has 35 to 45 fathoms at 8 or 9 miles to the westward and southward of it, and 22 fathoms at 6 miles to the eastward.

Gambier islands, four in number, lie near the middle of the entrance to Spencer gulf. Wedge island, the largest and southernmost of the group, in Lat. 35° 11′ S., Long. 136° 29′ E., is 3 miles long, and has two peaked rocks near its south side; there are 20 to 30 fathoms in mid-channel between it and cape Spencer. The westernmost island is 6 miles W. by N. from Wedge island, and about the same distance E.S.E. from the S.E. end of Thistle island. From the north side of the northernmost island of the group a reef, on which the sea breaks, extends 4 miles in a northerly direction.

Sir Joseph Banks islands, 13 in number, are a short distance up the gulf, on the western side; they are low, rocky, and sandy islets with several rocks (some above and others under water) near them.

The eastern part of the entrance of the gulf* being nearly 18 miles wide between Gambier islands and cape Spencer, with depths of 20 to 30 fathoms nearly the whole distance across, and 16 to 25 fathoms at 3 miles to the eastward of the cape,—hence, with a leading wind, this side is to be preferred by a ship sailing into the gulf. Beyond Corny point, in Lat. 34° 52′ S., Long. 137° 3′ E., 9 miles within the entrance on the eastern side, the gulf widens to upwards of 60 miles, and there is good anchorage either in **port Lincoln** on the west side, or in **Hardwicke bay** on the east side of the gulf.

Pearce point, in Lat. 34° $28\frac{1}{2}$′ S., Long. 137° 21′ E., a long narrow strip of land projecting 7 or 8 miles from the line of coast, forms the northern boundary of Hardwicke bay.

WALLAROO AND TIPARA BAYS.—Beyond Pearce point is Elizabeth point, a projection of white sandy cliffs, in Lat. 34° 10′ S., Long. 137° 27′ E. Northward of Elizabeth point are Tipara and Wallaroo bays.

Light.—In April, 1865, a temporary light-vessel was moored close under the rocky patch near the southern extremity of the Tipara reef, with the following bearings:—Elizabeth point, S.E. $\frac{3}{4}$ S.; Long point, N.E. by E. It exhibits a *white* light from the mainmast 24 feet above the sea-level, visible from all points of the compass at a distance of 7 miles in clear weather; a *red* light from the foremast 12 feet above the sea-level, visible from N. to S. round by W., at a distance of 3 miles in clear weather. The light-ship has two masts, is painted *red*, and exhibits during the day a red ball at the mainmast head.

Vessels making the light from the N.N.W. should not stand towards the northern extremity of the reef, whilst the *red* light is visible; by observing this direction a ship will be well clear of the reef.

* For the navigation of Spencer Gulf it is indispensable to have Admiralty Charts No. 2389 and 1061.

Should the weather be hazy, and the *red* or less intense light be obscured, no vessel should approach the reef with the *white* light bearing S.S.E., under 7 fathoms.

The following description of the Tipara reef, and **sailing directions** for Wallaroo or Tipara bays, were issued in 1865 by CAPTAIN B. DOUGLAS, port-officer of Adelaide :—

"The Tipara reef is an extensive shoal, the southern extremity being 4½ miles N.W. from Elizabeth point. It consists principally of sand, but there is a rocky patch of small extent near the southern extremity, which dries at low water; it is under the shelter of this patch where the light-ship is moored. From the rocky patch the reef extends in a northerly direction, about 2 miles, the outer edge trending to the N.N.W.; whilst the S.E. part takes a N.E. ½ E. direction; the extreme breadth from east to west nearly 2 miles.

"The soundings on the reef vary:—in some places there being 1½ fathoms; whilst in others—particularly to the N.N.E. part of the shoal—there are only 2 or 3 feet. From the northern extremity of the reef, the buoy off Long point bears N.E. by E. ¾ E.

"A *red* nun buoy has been placed off Long point in 3 fathoms, with the following bearings:—Elizabeth point, S. ½ E.; Long point, E. by N. ½ N.

"Vessels rounding the south part of the reef should not bring Elizabeth point to bear to the southward of S.E. by E. ½ E.; whilst those intending to pass to the northward of the danger, into or out of Tipara bay, should not bring the buoy off Long point to bear to the eastward of E. by N. ½ N.

"To pass outside or to the westward of the Tipara reef, do not approach the light-ship from the westward under 6 fathoms, or come within a mile of the same; from this position, when to the westward of the reef, steer a N.N.W. course, in which the same soundings will be maintained.

"When the buoy of Long point bears East, a course of N.E. may be shaped, taking care as the Long point buoy is brought to bear S.E. not to come under 4½ fathoms.

"When Long point bears South, a course of E. by N. may be shaped, when the Pilot and Harbour-master will come off, and conduct the vessel to the anchorage or jetty.

"At night no vessel in the vicinity of Tipara reef should come under 7 fathoms, or attempt to enter the bay until the lights from the Smelting Works are clearly defined bearing E. by N., when that course may be shaped for the anchorage; taking care not to come under 6 fathoms, unless the commander is sufficiently well acquainted with the bay to take the ship in, or the pilot has taken charge.

"The tides in the vicinity of the reef, and Long and Elizabeth points, are irregular and rapid; care must therefore be exercised to guard against the influence of the tides when in the stream of the reef, or near the points referred to.

"It is high water at port Wallaroo at 5h. 45m. F. and C.; rise and fall 4 feet 8 inches at ordinary springs.

"To pass inside Tipara reef give Elizabeth point a berth of 1½ miles, to avoid the shoal rocky patch which extends nearly 1 mile from the point in a north-westerly direction. With the point bearing S.E., distant 1½ miles, steer due N., which course will lead through the inner passage in not less than 4 fathoms.

"In beating through, keep the lead going, and do not, in a vessel drawing more

than 17 feet, when standing in shore, bring Long point buoy to bear to the westward of W.N.W.

"In standing off, when to the southward of the north end of the reef, do not bring the Long point buoy to bear to the eastward of N.N.E., by which the eastern part of the reef will be avoided.

"Small vessels may pass inside the Long point buoy, taking care not to bring Elizabeth point to bear to the westward of S. by W., so as to avoid the Walrus rock. With the above bearing a vessel will be in 2 fathoms at low water, spring tides, with the Walrus rock distant about ½ a mile.

"The Walrus rock lies nearly a mile off Long point, when bearing S.E. by S., and is nearly dry at low water.—N.E. 1½ miles from the Walrus rock lies the Bird reef, which is awash at low water; coasters should give this danger a wide berth, not bringing the Long point buoy to bear to the westward of S.W.; with this bearing a vessel will be in 2 fathoms at low water.

"**Anchorage.**—In the bay there is excellent anchorage in 4 fathoms, with the jetty end bearing E.S.E., distant about 2 cables' lengths. Small vessels can anchor in 3 fathoms, with the end of the jetty bearing S.S.E. to S.

"Alongside the jetty will be found good berths, from 8 to 14 feet, shoaling towards the shore."

Fresh water is scarce at Wallaroo.

Riley Point, to the northward of Wallaroo, is a cliffy projection, in Lat. 33° 53′ S., Long. 137° 38′ E., and with cape Condillac to the N.W. by W. contracts the breadth of the gulf to 20 miles; thence to Lowly point the eastern shore is encumbered with shoals, extending 5 to 12 miles from the beach and connected with it; on which account, when proceeding upwards, keep 5 or 6 miles off the western shore. Middle shoal is 10 miles off the land, and is always covered. For the navigation northward of Wallaroo, the chart will be the best guide.

PORT AUGUSTA, near the head of the navigation of Spencer gulf, is important from being the only shipping port for the northern copper mines and pastoral districts of South Australia.

The northern part of Spencer gulf, leading to the port, is an estuary about 40 miles long at point Lowly, and 8 miles broad—gradually contracting to a quarter of a mile above the port.

The high range of mountains on the east side of the estuary, called Flinders range, has several conspicuous peaks—mount Brown and mount Remarkable being over 3000 feet in height.

Vessels running for port Lowly, from the S.W., have sometimes mistaken a gap, to the westward of point Lowly, for the entrance to port Augusta estuary, which does not show till close up to point Lowly; but mount Brown can almost always be seen, and when it bears N. by E. ½ E., point Lowly is directly in line.

The following directions were issued in 1862, the result of the survey by Commander Hutchinson and Mr. F. Howard, R.N.:—

Point Lowly is a long low point, and makes out with a high sandy beach on its southern side—the land gradually rising about half a mile to the westward. Although the point is steep-to, a berth of not less than half a mile should be given to it, by a large vessel, to avoid a bank of hard sand and rock N.N.E. ½ E., $\frac{7}{10}$ of a mile from

the point. Point Lowly shoal is 2 cables in length north and south, and 1 cable east and west; the least water on it being $2\frac{1}{4}$ fathoms at low water springs.

A cairn of stones 9 feet high has been erected on point Lowly, the base being 15 feet above high water; it stands in Lat. 33° S., Long. not yet determined. From the cairn, mount Brown bears N. 21° 10′ E. (true), and is $31\frac{1}{2}$ miles distant.

Point Ward, on the east side of the estuary, is 8 miles from point Lowly, and is low and fringed with mangrove. A long sand-spit runs out from point Ward to within $3\frac{1}{2}$ miles of point Lowly, leaving a channel with 13 fathoms water on the west side of the estuary.

The deep water channel is confined to the vicinity of the west coast the whole way to port Augusta—the east coast being low and fronted with extensive sand flats.

Backy Bay.—The coast is nearly straight from point Lowly to the N.N.W. for 6 miles, being the head of Backy bay, formed of low whitish cliffs and stony beaches, with mangroves after the first 3 miles. From the head of the bay, E. $\frac{1}{2}$ S. 2 miles, is Backy point—bold, black, and rocky—approachable in 8 fathoms to a cable's length. The coast line is broken and rocky to Crag point, which is $1\frac{1}{4}$ miles (N. by E. $\frac{1}{2}$ E.) beyond.

Douglas Point is N. $\frac{3}{4}$ E., $2\frac{1}{3}$ miles from Crag point, and is rocky, with a low black cliff. The coast between Crag and Douglas points forms two bays, with sand flats at low water drying out to the line of points, whilst the 3-fathom line is half a mile farther out.

Douglas hills are a group of detached grassy hills, some having deep rocky ravines between them. There is a sheep station among the hills (which are covered with grass and a few stunted bushes) carrying about 2500 sheep. The shepherd's stone hut and well can be seen from the sea about two-thirds of a mile in shore, and 1 mile to the northward of Douglas point. The well is 120 feet deep, and supplies about 240 gallons of very brackish water per day. The well is conspicuous, having a heap of white limestone round it, thrown up during its excavation. A cairn of stones has been erected on the hill, about half a mile N.W. of the hut, which is 645 feet above high-water mark.

Douglas Bank lies N. by E. $2\frac{3}{4}$ miles from Douglas point, with only 11 feet on it at low water. It is about half a mile long north and south, and 1 cable east and west. The shallowest water is on the west side, which deepens suddenly to 6 and 8 fathoms, whilst the east side gradually deepens to 6 fathoms half a mile off.

Mount Gullet, the low flat hill on the east coast, bearing E. by N., clears the bank, the ship passing 2 cables to the southward in 5 fathoms—and the same hill E. $\frac{1}{2}$ S. clears it to the northward in 6 fathoms. Crag point and Douglas point in line S. $\frac{3}{4}$ W. just clears the west side in 7 fathoms—and Backy point in line with Crag point, S. by W. $\frac{1}{2}$ W. (or Two Hummock point extreme in line with the northern end of the Bluff range N.N.W. $\frac{1}{4}$ W.), clears it, passing half a mile to the eastward.

Douglas bank leaves a clear channel to the westward $\frac{7}{10}$ of a mile, and to the eastward more than a mile, in width. From abreast Douglas bank to Two Hummock point, the coast feature is thick mangrove with low land behind.

Two Hummock Point is 6 miles N. $\frac{1}{2}$ W. from Douglas point, and is low and with alternate rock and sand beach. With two scrub-covered hummocks, one on the point and the other about half a mile to the northward, the latter is the higher, and is 86 feet above high water. There is a third or west hummock about $1\frac{1}{2}$ miles

in-shore of the other two. The sand dries nearly a half mile out at low water off Two Hummock point, and a 2-fathom bank extends three-quarters of a mile to the south-eastward.

Middle Bank is N. by E. $\frac{1}{2}$ E., $1\frac{1}{2}$ miles from Two Hummock point, and is nearly in the centre of the channel. It extends $\frac{8}{10}$ of a mile N.N.W. and S.S.E., with an average breadth of 1 cable. The least water on it is 7 feet at low water springs.

Middle bank leaves a clear channel to the westward of $\frac{7}{10}$ of a mile, and the eastward of half a mile. The west channel is preferred, and is the more direct.

The western or in-shore hummock, open north of the south hummock of Two Hummock point on a bearing of S.W. $\frac{3}{4}$ W., clears the bank, the ship passing 1 cable to the southward in $4\frac{1}{2}$ fathoms;—or the Mangrove point, north of Two Hummock point, in a line with the north side of a deep ravine in Bluff range, W.N.W., just clears the south end in $3\frac{1}{2}$ fathoms.

Mount Brown, in line with the extreme mangroves on north side of Red Cliff point bearing N.E., clears the bank, the vessel passing 1 cable to the northward in 4 fathoms.

There are no clearing marks to the westward, but, in passing, the water ought not to be shoaler than 8 fathoms.

Blanche Harbour.—From Two Hummock point the coast trends N.W. for 3 miles to a low mangrove point, and then takes a bend westward for 1 mile, and forms a bay with low mangrove shores. The low water edge, however, continues N.W. for $5\frac{1}{2}$ miles from Two Hummock point, forming the West sands, inside of which is Blanche harbour, with 1 or 2 fathoms water. This harbour has two entrances, one to the northward between West sands and the shore, and one to the eastward through the sands.

From Blanche harbour the coast runs N. $\frac{1}{4}$ E. $6\frac{1}{2}$ miles to Commissariat point, the general aspect being a rough stony beach, fronted with sand at low water, and mangroves at high water. The land behind slopes up to the Bluff range, which at Commissariat point is only $1\frac{1}{2}$ miles in-shore.

Commissariat Point is the eastern extreme of the round portion of the Bluff, and is not made out till you are well to the northward or southward. From the Bluff it bears N.E., and is W. $\frac{1}{4}$ N., 2 miles from point Paterson, on the opposite point of the estuary, which here narrows considerably.

The sand dries half a cable's length outside the mangroves at Commissariat point, and there is a 2-fathoms' bank 2 cables beyond it. A similar bank extends from the spit, forming the other side of the channel, and contracts the 3-fathom channel to 2 cables in width.

The Bluff is the eastern and highest part of a long flat-topped range which rises near point Lowly, and continues to abreast Snapper point, when it turns sharp off to the westward, leaving a detached ridge at the angle which makes out from the south-eastward in two peaks, called the Sisters. The S.E. Sister is 730 feet above high-water mark.

A cairn of stones 8 feet high has been erected on the Bluff, 940 feet above high water, but can hardly be distinguished from the scattered bushes near the summit, only a few hundred feet wide, the range then sloping gently to the westward.

Point Paterson is a low point with a sandy beach, and large clump of thick mangroves immediately to the northward. The sand flat dries nearly 2 miles off it to the south-eastward. When in the main channel, and the north end of the beach

at point Paterson bears E. by N., the entrance to port Paterson is open, and runs nearly straight for 2 miles to the north-eastward.

Port Paterson is an extensive sheet of water to the eastward of the long sand spit, which extends nearly 3 miles to the southward of Snapper point. The harbour carries $3\frac{1}{2}$ fathoms water at low water springs, over a space 1 mile in diameter, with a muddy bottom.

The approach to port Paterson is 2 miles in length, and in two places the deep water is confined to a width of one cable, with a depth of not less than 4 fathoms. The best time to enter port Paterson is at low water, as the banks show on each side; but if they are covered, the different streams of tide fill the channel with eddies, and give the appearance of the whole being blocked up. There are no marks to lead up the entrance.

An inner basin opens through a narrow passage on the northern side of port Paterson. There is about 8 feet water, at low water springs, across the mouth of the entrance; but in the passage the water increases to $2\frac{1}{2}$ and 3 fathoms. The passage is winding, about a quarter of a mile long and about 80 yards wide, opening into a circular basin at low water, half a mile in diameter, with a general depth of $2\frac{1}{4}$ fathoms.

The drawback to port Paterson is the extent of sand and mud flat surrounding it on all sides, rendering communication with the shore difficult after half ebb. The adjacent coast, too, is a swamp with the exception of the sandy beach to the northward of the inner basin, which is nearly half-a-mile from the low-water mark. Only one vessel has ever been known to use this port to discharge a cargo, and, as it is not in the main stream of tide, the fear is that it may be filling up like Yatala harbour.

Snapper Point, 3 miles N. $\frac{1}{4}$ E. from Commissariat point, is a low mangrove point, extending out a mile from the high-water beach. The estuary suddenly narrows here to $\frac{7}{10}$ of a mile from mangrove to mangrove, and assumes more the appearance of a river, with dense mangrove flats on each side. From Snapper point, northward, to **Curlew point,** the channel inclines to the east coast. Snapper point is 1 mile south of Curlew point and island.

Curlew Island is merely a large thick patch of mangroves, separated from the point by a narrow channel, dry at low water, and has a small sandy knoll at its north end, which only covers at high water springs.

To the northward of Snapper point the channel becomes so narrow and winding that a pilot is necessary at present. The South Australian Government intend, however, to mark the channel with buoys and beacons, when the navigation will be easy with a leading wind, without which no square-rigged vessel should come beyond Commissariat point. The wind from S.S.W. round by the South to E.S.E. is a leading wind through all the reaches going up, and the opposite in coming down.

Caution.—To the northward of Snapper point the channel shows at low water springs as the sands uncover, leaving a width of from a quarter of a mile to less than one cable. There are, however, some dangers which do not show at low water, the principal of which are—

1. The bank forming the narrows off Curlew point which runs out northward and north-westward of Curlew island about 2 cables. It is very uneven, with from 3 to 12 feet water on it, and leaves a $3\frac{1}{2}$ to 4 fathom channel on its northern side, half a cable in width and 2 cables in length.

2. A 10-feet bank runs half a cable off the S.E. side of the sand islet knoll between Curlew and Orchard points, and a 7-feet patch of hard sand, covered with weeds, lies 2 cables S.W. of Orchard point.

3. A much larger patch carrying the same depth lies 2 cables N.W. of the same point, right in mid-channel. At low water springs the depth right across is not more than 14 feet abreast this shoal, while there is no more than 13 feet at low water across the entrance of the narrow reach, between Brown point and the flagstaff at port Augusta.

4. S. by W. $\frac{3}{4}$ W., 4 cables from the flagstaff, the 9-feet bank shoals out on the west side, leaving the 12-feet channel less than half a cable in width.

5. S.W. $\frac{1}{4}$ S., 2 cables from the flagstaff, is the 5-feet shelf on which the barque *Rangoon* grounded in 1861, sustaining serious damage. This bank is dangerous from being composed of hard sand and stones, and from the ebb tide setting right on to it.

Port Augusta.—The township of port Augusta is situated on the east bank of the estuary, about 4 miles above Curlew point. The house of the Collector of Customs stands on a low sandy point at the south end of the township, and has a flagstaff in front of it. The township extends along the beach, to the northward, for about a quarter of a mile, as yet consisting of only a few wooden houses, and two substantial stone and brick stores.

At port Augusta the bank is pretty steep; the mangroves have been cleared away in front of the township, and two wooden jetties run out to low-water mark. Off the end of one, the coasting steamer, which runs to and from port Adelaide twice a month, lies aground at low water.

The port reach is nearly 2 cables in width, and nearly half a mile long at low water. There is plenty of room for eight or ten large vessels to swing at moorings, in from 18 to 20 feet water at low water springs.

Supplies.—All sorts of dry goods can be obtained at the stores, and fresh meat from Stirling; but vegetables are not to be had, the surrounding country not being fit for cultivation.

Fresh water cannot be obtained except from Woolundunga, a distance of 18 miles, by dray. There are some wells at Stirling, but they are very brackish. Firewood can be obtained in small quantities. The Government intends laying down water-pipes between Woolundunga and port Augusta to supply the town and shipping.

Fish may be caught in great quantities with a hook and line, principally *snapper*. The best *snapper* ground is between Snapper and Curlew points, and close off the N.W. edge of the bank forming the narrows at Curlew point.

Exports, &c.—The trade of port Augusta is chiefly in exports—vessels coming up in October and November for the year's clip of wool, and taking away a great quantity of copper ore. The trade is fast increasing.

The residence of the sub-collector of Customs on the point is also the shipping-office, post-office, court-house, &c.—that officer being the port-master, post-master, shipping-master, and in fact the only Government officer.

The estuary is navigable for about 3 miles above the port, through a narrow channel which passes close under Flinders' Red cliff, about a mile above which it is dry at low water right across; but a boat can go several miles farther up at high water.

In the form of a salt swamp, flooded at high water springs, the estuary extends some 25 miles to the northward of the port.

The flagstaff at port Augusta is in Lat. 32° 29′ 42″ S.; the Longitude is not yet determined. The variation in 1862 was 4° 36′ E.

Time of high water, full and change, 8h. 30m.; the rise of ordinary springs 12 feet.

Stirling, where the brackish wells are, is 5 miles E.S.E. of port Augusta.

Southward of point Paterson, the east coast falls in as far as Red Cliff point. The whole coast is low and swampy, and fronted by extensive sand flats. The outer ones, called the East sands, form the east side of Flinders channel.

Red Cliff point is 6 miles S.S.E. of port Paterson, and is low and sandy, with mangroves on its north side; the coast from this point trends E.S.E. 6 miles, into a mangrove swamp at the head of Yatala harbour.

One mile from Red Cliff point is the Red Cliff, about two-thirds of a mile long, and 50 feet high. The land at the back is swampy.

Three miles from the point and close to the coast is mount Grainger, a round black-looking hill 250 feet high, and covered with bushes. Mount Grainger makes out well from the flatness of the surrounding country.

Yatala Harbour.—Mount Grainger marks the position of Yatala harbour or port Fergusson, which is now nothing more than a 1 to 2-fathom hole in the sands, about 2 miles in diameter, and ending in a creek which is barred at the mouth; it is fast filling up.

To the southward of Yatala harbour the coast is straight to Ward point, a low sandy beach, and the last 3 miles thick mangrove. The sand dries more than a mile off this coast, on which the only noticeable objects are mounts Gullet and Mambray, the former 200, and the latter 100 feet high; mount Gullet has a large base and round flattish top; mount Mambray is very small and round. Both hills are covered with thick scrub.

Directions.—Fairway Courses.—From half a mile off shore at point Lowly, the best course would be N. ½ E. for about 12 miles, according to tide. This course would take you 1 mile clear of Backy point, and two-thirds of a mile off point Douglas, and past Douglas bank, leaving it to the westward. Backy point ought to be kept in sight or in line with Crag point, bearing S. by W. ½ W., until the northern extreme of Bluff range comes on with Two Hummock point (extreme) bearing N.N.W. ¼ W. When this latter mark comes on, the course can be altered to N. by W. to pass Two Hummock point.

The course of N. ½ E., from half a mile off point Lowly, passes only 2 cables outside point Lowly shoal, in 10 fathoms. From thence to Backy point the bottom is uneven—from 6 to 12 fathoms; but between that point and point Douglas you would have 12 to 10 fathoms, and then it shoals gradually to 5 fathoms, passing to the eastward of the bank.

The N. by W. course should be kept till the north hummock of Two Hummock point bears west, which will be a distance of 3½ miles nearly; then the course is N.W. ¾ N. to pass through Flinders channel between the east and west sands, taking care not to come under 7 fathoms in the vicinity of Middle Bank. The sands are nearly one mile apart, and generally show.

When Commissariat point bears north, or Red Cliff is nearly in line with the foot of mount Grainger, bearing S.E. by E. ½ E., alter course to N. ¼ E. to pass through

Bluff reach. At the point of altering course, the mangroves on the west side ought to be distant about half a mile, gradually closing as you approach Commissariat point, off which you should pass a quarter of a mile, until point Paterson bears W. ½ S., then steer N. by W. ½ W. through the first part of Snapper reach: just before you round Commissariat point the soundings decrease to 3½ and 4 fathoms at low water.

In running through Snapper reach, after passing the last stony point on the west coast, and abreast thick mangroves—with South Sister bearing W. by N.—alter to N.E. ¾ N., passing little more than 1 cable's length off Snapper point. After getting through Snapper reach, the course is curving the whole way, the reaches being very short.

If wishing to pass inshore to the westward of Douglas bank, where you have the strongest tides and deepest water, when off Douglas point in 9 or 10 fathoms, and steering N. ½ E., alter course to N. by W. for the South hummock, taking care to have Crag point out of sight behind Douglas, while mount Gullet is between the bearings of E. by N. and E. ½ S., and not coming into less than 9 fathoms. When mount Gullet bears E. ½ S., haul out from the land N. by E., till the inshore hummock comes on with the south part of Two Hummock point, W. ½ S., when you can shape the course up Flinders channel as before.

Anchorage.—There is anchorage in any part of the estuary; but southward of Douglas bank the best anchorage is towards the east coast in about 6 fathoms, as the strength of the tide runs along the west coast in the deep water.

An anchorage in Backy bay, with point Lowly bearing S. ½ W. 3 miles, has been recommended; but in winter, when strong north and west winds are frequent, more shelter may be obtained with Backy point bearing from N.W. to W.N.W., distant about 1 mile, in 6 fathoms, sand, near the head of the bay, where a ship would be out of the tide.

In the strong S.S.E. winds which prevail during the summer months, when port Augusta is most visited, a vessel seeking anchorage for the night, or a tide, would do well, when inside point Lowly, to haul to the eastward, and let go in 6 fathoms under the lee of Ward spit.

Tides.—The tides in port Augusta estuary are very peculiar. At port Augusta it is high water at full and change, at 8h. 30m., and at point Lowly at 7h. The rise of ordinary springs at the first place varies from 9 to 12 feet, and at the latter place 6 to 8 feet; but after a hot wind, when the wind veers round to west and south, and blows strong, the tide at port Augusta has been known to reach a height of 16 feet. After the full and change of the moon, the time of high water gets gradually later till the time of neap tides, when it is high water between 10h. and 11h., both at port Augusta and point Lowly. Then a day occurs on which the tide ebbs or flows for twelve hours together, the whole tide often not ranging more than a few inches. After this the tides become regular again, but the time of high water changed to between 5h. and 6h., and gradually working up to the full and change times:—from which it may be said generally that you have high water in the morning and evening, and low water in the middle of the day at port Augusta. The night tide is generally a foot or two higher than the morning tide. The stream sets fairly up and down the channel at from 1½ to 2 knots per hour, and changes with the rise and fall;—except about the mouths of the small channels through East sands, and to the southward

of Douglas bank, where the flood sets across N.W. into the deep channel, the ebb setting out S.E.

Winds and Weather.—During the summer months strong south and S.S.E. winds prevail; and in January, February, and March they are often interrupted by hot winds which blow fiercely from the northward, sometimes for seven or eight days, raising the temperature to 120° in the shade. The hot winds frequently terminate in a squall from the southward, or thunderstorm from S.W.; they blow under a cloudless sky, and a thick red haze prevails. Whirlwinds are common in the summer, but they usually confine themselves to the plain between Flinders range and the Gulf, where several may be seen at once—raising a pillar of dust to a great height. Very little rain falls in the year.

During the months of April and May some strong northerly winds were experienced, with a hard cold-looking sky. These winds, although coming from the same quarter as the hot winds, did not raise the temperature above 75° or 80°.

During the winter months, generally, N.W. to S.W. winds prevail.

Pilots, &c.—It has been the custom, hitherto, for vessels bound to port Augusta to proceed first to port Adelaide, and there pick up a pilot for Spencer gulf and port Augusta.

The outward bound vessels frequently leave their pilots at Wedge island, at the mouth of Spencer gulf.

Tugs can be procured from port Adelaide, to which place a mail goes, overland, once a week. The steamer trading to port Augusta frequently tows vessels, up or down, through the estuary, on her trips backwards and forwards.

KANGAROO ISLAND, at the entrance to the gulf of St. Vincent, is 76 miles in length east and west, and about 28 miles in breadth; it is elevated, and well wooded, presenting on its northern side a steep cliffy shore, apparently free from dangers, and extending nearly in a line about E. by N. 50 miles, with occasionally a sandy beach.

Cape Borda, the N.W. point of Kangaroo island, is in Lat. 35° 45½′ S., Long. 136° 38′ E. The hills behind it are well wooded; and about 8 miles to the N.E. by E., where the land projects considerably from the coast line, they are marked with perpendicular white streaks, visible at the distance of 15 miles. For the **Light** on this cape, see p. 672.

Investigator Strait, formed by Kangaroo island with the southern part of Yorke peninsula, extends upwards of 50 miles E. by N. and W. by S., and preserves an average breadth of 23 miles. With the exception of Althorpe isles, near cape Spencer, and a **shoal flat** that extends 3 or 4 miles off a very low point to the westward of Troubridge hill, this strait is believed to be free from dangers, and contains ample depth of water. Captain Flinders says, "From 45 fathoms, in the middle of the western entrance, the depth diminishes quickly to 25, then more slowly to 20; after which it is irregular between 12 and 20 fathoms, as far as the mouth of the gulf of St. Vincent. Of the two sides, that of Kangaroo island is much the deepest; but there is no danger in any part to prevent a ship passing through the strait with perfect confidence. The bottom is mostly broken shells, mixed with sand, gravel, or coral, and appeared to hold well."

Marsden Point, in Lat. 35° 34½′ S., Long. 137° 43½′ E., the northern extremity

of Kangaroo island, is a cliffy projection, rather lower than the land to the westward of it, and has a spit extending from it E.S.E. about 9 miles. It forms the north head of Nepean bay, which is 18 miles across its entrance to Kangaroo head.

Cape Willoughby, the eastern extremity of Kangaroo island, is a thickly-wooded projection. Round its north side is Antechamber bay, which is about 4 miles across N.W. by W. ½ W., and nearly 2 miles deep; it affords good shelter from all southerly winds; but a S.E. gale would probably throw too much swell round cape Willoughby to render this anchorage quite safe at such a time, therefore, with a prospect of its blowing hard from that quarter, a ship should give a preference to Nepean bay, round the west side of Kangaroo head, where she may lie completely sheltered at a mile from the shore.

Light.—A lighthouse, exhibiting a *revolving* light, has been erected on cape Willoughby. The light appears at intervals of a *minute and a half*, and being elevated 241 feet above high water, may be seen at the distance of 24 miles, and on all bearings from N. by W. ½ W. round by the eastward to S.W. by W. ½ W.; position, Lat. 35° 51′ 35″ S., Long. 138° 10′ 50″ E.

BACKSTAIRS PASSAGE, the eastern entrance to Investigator strait and the gulf of St. Vincent, is formed between the N.E. part of Kangaroo island and cape Jervis, and is 7 or 8 miles wide in its narrowest part. In this channel is **Yatala shoal,** extending N.W. and S.E. 3 miles, and a ¼ of a mile wide, the depths on it varying from 3 to 8 fathoms, but as soon as its margin is passed deepens to 14 fathoms; from its eastern extremity cape Willoughby bears S. by W., cape Jervis N.W. by N., and the southernmost Page islet E.S.E. ½ E. The tide flows through Backstairs passage to the eastward, at the rate of 2 knots, and having been the chief cause of the accumulation of Yatala sandbank, there may now be less water on it. The **Pages** are three small rocky islets N.E. by N. 8 to 10 miles from cape Willoughby; the two northernmost are conspicuous, bold-to, and lie 7 or 8 miles from the high land of cape Jervis; the southern islet is low, and has a reef extending 1½ miles south of it.

The Islets, Rocks, &c., off the S. side of Kangaroo island, are as follow:—

Cape Gantheaume is the southernmost extremity of Kangaroo island, in Lat. 36° 4′ S., Long. 137° 33′ E., to the N.W. of which is a deep bight, called Vivonne bay.

Pelorus Islet, 30 feet high, and visible 8 miles, has a considerable ledge (just awash) extending 2 miles S.W.-ward of it; from the islet cape Linois bears N.E. by N. 7 miles, cape Gantheaume 2½ miles, and cape Willoughby N.E. by E. ½ E. 31 miles. Some covered **rocks,** not always indicated by broken water, lie E. ½ S. 4 miles from cape Kersaint, the western extremity of Vivonne bay; there is deep water close to them.

Lipson Reef, partly awash and partly uncovered, lies S.S.W. ¾ W., 7 miles from cape Bouguer, a projection 15 miles westward of cape Kersaint. Off cape Couedic, 10 miles westward of cape Bouguer, some **rocks,** extending from S. to S.W., lie 2 miles distant from that cape.

Young Rocks, nearly on the meridian of, and 20 to 23 miles from cape Kersaint, are three in number; the largest, 30 feet high, is in Lat. 36° 20¼′ S., Long. 137° 52½′ E., and bears S.W. ½ W. 48 miles from cape Willoughby, and S. ¾ E.

19 miles from cape Kersaint; of the two smaller rocks, one (10 feet high) is to the northward, and the other to the S.W.-ward, each about 3 miles from the position given above. The depth in the vicinity of these rocks is considerable; soundings taken as near to them as could be approached, gave 45 fathoms; nevertheless, on the parallel of the northernmost rock, but 23 miles to the westward, the *Swan river packet* and the *Eagle* reported **breakers**, and the *Pelorus* also at an intermediate distance.

Michie Reef was reported in 1851, by Capt. F. Michie, of the *Phœbe Dunbar;* it is stated to be in Lat. 36° 33′ S., Long. 136° 31½′ E., and 30 miles to the S.S.W.-ward of cape Couedic; it was in sight nearly an hour, and appeared to be entirely covered, but composed of several heads on which the sea broke.

Cape Bedout, the S.W. extremity of Kangaroo island, is in Lat. 35° 56′ S., Long. 136° 36½′ E. To the southward and N.W.-ward, rocks project from it to the distance of 1½ to 2½ miles.

Troubridge Hill, in Lat. 35° 11′ S., Long. 137° 41½′ E., on the northern shore of Investigator strait, is an inconsiderable hummock standing on a low sandy land, one mile from the shore, and appears at a distance like an island.

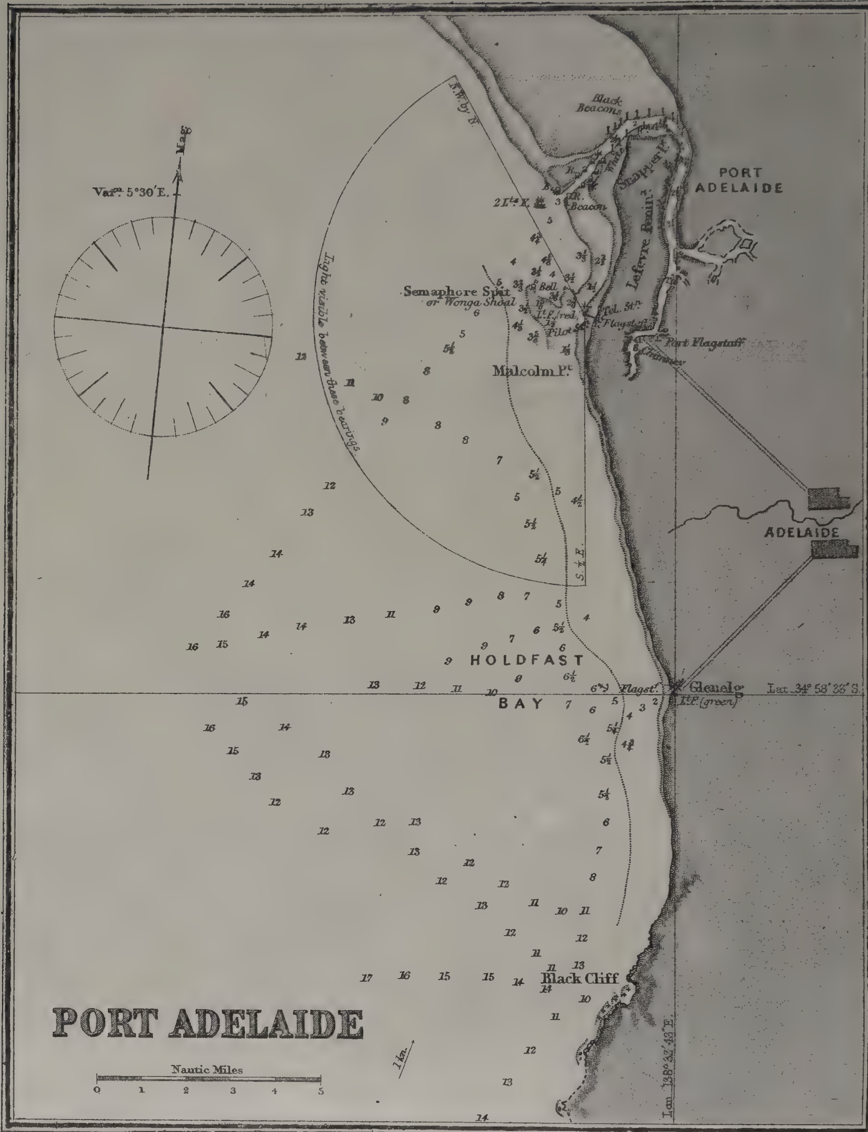
Troubridge Shoals.—Off the S.E. point of Yorke peninsula, at about 9 miles E.N.E.-ward of Troubridge hill, are the Troubridge shoals. These shoals, chiefly of hard sand, with rocks in the centre and on their southern part, are dry at low water: on the eastern shoal, which is separated from the main or western shoal by a narrow channel, is a sandy island, nearly ½ a mile long, visible 4 or 5 miles; there is also a dangerous detached reef about ½ a mile from the rocks, on the southern edge of the western shoal, and S. ½ W., 2 miles from the sandy island. Great caution is necessary hereabout, as the flood tide runs strongly over the shoals, both from Backstairs passage and through Investigator strait.

Commander Lipson, R.N., says: "I would strongly recommend every commander, when coming through Investigator strait from the westward, to take his bearings and prove his situation as often as possible, and never to be to the northward of what he considers mid-channel; he will then be in the fair stream, and, by his soundings, judge his distance from the shoals; if, on the contrary, he gets near Yorke peninsula, the tide will set him along the coast, where, the soundings varying but little, he will not have timely notice of his approach to the shoals."

Light on Troubridge Island.—The lighthouse stands in the centre of the island, in Lat. 35° 7′ 50″ S., Long. 137° 52′ E. It shows a *bright revolving* light for 12 seconds every half minute; when within a distance of about 7 miles a *continued faint* light will be seen, in clear weather, between the intervals of the brighter light. It stands at an elevation of 80 feet above the level of the sea, and is visible about 16 miles.

The following **directions** were issued in connexion with this light:—Vessels bound through Investigator strait into St. Vincent gulf should make Troubridge light on a N.E. ½ N. bearing, and steer E.N.E. ½ N. to pass it at a distance of 7 miles, bringing it to bear W. by N. ½ N.; thence a course N.E. ½ N. 30 miles will reach a berth 2 miles south-west of port Adelaide light-ship, when heave-to for a pilot or a steam-tug.

ENTADA TRIOA



PORT ADELAIDE
Nautic Miles
0 1 2 3 4 5
Var. 5°30'E.
Mag.
PORT ADELAIDE
ADELAIDE
Black Beacons
Lefevre Penins.
2 Lts. F.
R. Beacon
Semaphore Spit
or Wonga Shoal
Bell
Tel. Stn.
Pilot
Port Flagstaff
Malcolm Pt.
Light visible between these bearings
N.W. by N.
S. ½ E.
HOLDFAST
BAY
Glenelg
Lat. 34° 58' 33" S.
Black Cliff
Lon. 138° 33' 42" E.

Vessels from the westward and southward should not approach the Troubridge light nearer than 4 miles, where they will find soundings in from 10 to 14 fathoms.

Vessels bound down the gulf of St. Vincent in westerly gales will find good anchorage under the lee of Troubridge island with the light bearing S.W. about $1\frac{1}{2}$ miles distance, in 8 fathoms over a clean and sandy bottom.

Cape Jervis is a lofty and bold projection of the mainland in Lat. 35° 38′ S., Long. 138° 9′ E., and forms the east point of entrance to the **gulf of St. Vincent.** The breadth of the entrance to the gulf between cape Jervis and Troubridge hill, which bear N.W. $\frac{1}{4}$ W., is 34 miles; and in this space the soundings are regular, in 18 to 20 fathoms, decreasing to 11 or 12 on approaching within 4 miles of Troubridge shoals, and then deepening to 22 fathoms in mid-channel to the eastward. On the eastern shore of the gulf, opposite the shoals, there are some patches of cliff, with 20 fathoms 10 miles west of them, and 15 fathoms within 3 miles; above these the shore becomes low and sandy, and is fronted by a shoal flat which extends 2 miles off it, and gradually increases in breadth to 5 or 6 miles in Lat. 34° 30′ S.

N.N.E. 42 miles from cape Jervis is Holdfast bay and the town of **Glenelg**; here there is anchorage $1\frac{1}{2}$ miles from the shore, in 5 or 6 fathoms, clay, with the flagstaff in one with mount Lofty, bearing E. by N. A *fixed green* **light,** visible 5 miles, is shown for mail steamers on the outer part of the jetty; position, Lat. 34° 59½′ S., Long. 138° 33′ E.; the anchorage is in 5 fathoms, with the light bearing E. by N. Coasters may approach the end of the jetty very closely; but care should be taken to avoid a shoal patch on an oyster bank lying about a mile to the southward of the township. There is a depth of $10\frac{1}{2}$ feet at the end of the jetty at low-water springs.

Lefevre Peninsula.—At this Pilot station a *fixed red* **light,** visible 3 miles, is shown from the end of the jetty. Lat. 34° 50′ S., Long. 138° 31′ E.

ADELAIDE, the capital of South Australia, lies inland about 6 miles from Glenelg. **Port Adelaide,** 15 miles to the northward of Holdfast bay, is a considerable arm of the sea, reaching to a short distance from the town. The entrance to the port, which is well buoyed, is over a bar.

Light.—At the entrance to port Adelaide, 1 mile S.W. of the bar, a light vessel is moored in 5 fathoms. It exhibits two *fixed white* lights, one from each mast, visible 10 miles; position, Lat. 34° 49′ S., Long. 138° 30′ E.

Pilots are always in attendance. A *red* buoy is stated to be placed on the bar, where at high water there are generally 15 feet. The tides are irregular, the rise varying from 4 to 6 feet, but greatest with S.W. winds.

The following **directions** for vessels bound to the Gulf of St. Vincent are by Commander Lipson, R.N.*:—

From the westward:—"After making Kangaroo island, steer E. ½ N. through Investigator strait, passing between that island and Althorpe islands. Should the wind be from the eastward, no difficulty will be found in beating through the strait, nor anything in the way more than what is shown in Flinders' chart. In proceeding towards Holdfast bay or port Adelaide, great care is requisite to avoid Troubridge shoals, as the flood tide through Backstairs passage sets with great strength (particularly at F. and C.) directly upon the shoal; therefore, on coming from the westward,

* The light to which reference is made in these directions is the Adelaide light-vessel; the light on Troubridge shoals was not established at that date.

the course should not be altered until Marsden point bears S.W. by W. $\frac{1}{2}$ W., which will be about 10 miles from N.W. Bluff, the high land inside cape Jervis, when a course may be shaped for the lightvessel, which will be then about 40 miles distant. For about 6 leagues up the gulf the land is high and bold; but above that the shore becomes very low, with hummocks of sand upon it, and the same description of coast prevails to the head of the gulf. After passing the high coast-land, the water shoals some distance out, and in some places (when within the distance of 10 miles from the light) 5 fathoms will be found at a distance of 4 miles from the beach.

"Be attentive to the soundings, *particularly at night;* and in running up for the light, keep between 5 and 6 fathoms water, not approaching inside of 5, as within that depth the water shoals suddenly; and if in a greater depth than 6, a ship might pass to the westward of the light without seeing it. In these soundings the light will be made ahead, which may be seen 12 miles from a ship's deck. The shoal called the Bar, at the entrance of the port, bears N.E. 1 mile from the lightvessel. When within a proper distance a boat will be sent from her, with a pilot, and to receive all mails and letters.

"Should the light be made in the early part of the night, a ship might anchor anywhere to the southward of it in 6 fathoms, or remain underway, being careful to keep to the southward of the light, and as near to it as it is possible by the morning, to ensure the tide. Where the lightvessel is moored in 34° 49′ S. the anchorage is safe, but a full scope of chain is required, never less than 50 fathoms, and if it blows fresh a whole cable. Never let go the second anchor if it can be avoided; rather give more chain, as the vessel will ride much easier with one anchor down than with two.

"If, on *coming from the eastward* through Backstairs passage, and bound up the gulf, night should be approaching, keep on the north side of the passage, and haul round cape Jervis, all that coast being quite bold. When the gulf is open a course of N. by E. $\frac{1}{2}$ E. may be steered for the lightvessel.

"Bound *down the gulf*, steer from the lightvessel S.S.W., which course will keep the land on the east side of the gulf in sight, and out of the influence of the tide through Backstairs passage, until to the southward of Troubridge shoals; but on no account steer a course under the impression that it will weather the shoals, thereby exposing the ship's broadside to a rapid tide running directly upon it, until sufficiently to the southward to shape a course down the strait.

"In turning down the gulf, never exceed a distance of 10 miles from the eastern shore, as the opposite side is shallow; and be careful when standing in to keep the lead going, as it is shoal a considerable distance off, until as far down as to be abreast of the high land. In some places to the northward of Holdfast bay there are not more than 5 fathoms, at a distance of 4 miles from the beach, and the water shallows very quickly within that depth; but where the high land fronts the sea the shore is steep, with the exception of a reef lying a mile off about three miles to the southward of Holdfast bay.

"In moderate weather, by closing the shore at sunset, the wind, which usually blows from the land about that time, will be favourable for proceeding down the coast, being careful not to be thrown off until well down with cape Jervis, and to the southward of Troubridge shoals.

"Ships bound down Investigator strait meeting a strong westerly wind may

anchor on the east side of Marsden point, close to the shore, in 6 fathoms water and good holding ground."*

Port Onkaparinga.†—Lat. 35° 10′ 20″ S., Long. 138° 30′ 30″ E. High water, full and change at 4h.; rise and fall 6 feet.

This convenient and safe little harbour is formed by the protection which two reefs afford the anchorage. Port Onkaparinga is situated 21 miles S. 9° E. of the Lightship, off port Adelaide, and may be readily recognised by Witton's bluff—a reddish-coloured bold cliffy projection, having a remarkable square detached rock at its base—lying a short distance to the northward of the reefs.

Masters of vessels intending to enter port Onkaparinga, in coming from the northward, should keep a full mile off the coast, until Witton's bluff bears east, to avoid the Horseshoe shoal, which lies about half-a-mile to the northward of that headland.

Vessels from the southward should keep a mile off the land, until the Cliff called Onkaparinga head bears east, when a course for either of the passages may be shaped.

The coast in this part of the gulf is composed of sandhills, with occasional reddish-coloured cliffs of moderate elevation.

The general character of the soundings is deep and regular, but occasional rocky points on this part of the coast have reefs projecting into deep water, which can be easily avoided by keeping a moderate distance off the land. As a rule, except bound into either of the out-ports, it will be prudent not to stand in into less than 9 fathoms water.

A convenient jetty on the beach, inside the Onkaparinga reefs, having 5 feet at ordinary low water, at its outer extremity, has been lately erected under the shelter of the north reef; and, as it may be discerned at a considerable distance from seaward, is a good guide by which a stranger may pick up the entrance of the harbour.

The reefs which form the breakwater to the harbour run parallel to the coast, at a distance of about 300 yards from low water mark. They are covered at high water for a short time, but at other periods distinctly mark their extent and direction by showing above the sea.

Outside the reefs, from 6 to 7 fathoms will be found at a moderate distance. In the centre of the middle channel as much as 5 fathoms will be obtained, which depth decreases to 3 fathoms close to the extremities of the reefs.

In the north channel an average depth of 3 fathoms will be found. In the south channel (which should only be used by very small craft) 10 feet will be found close to the southern extremity of the south reef.

The north reef measures about 630 yards in length, by about 30 yards in breadth. The south reef measures 550 yards in length, by about 30 yards in breadth.

The highest portions of each reef do not exceed 4 feet above low water mark; they are, therefore, during high spring tides, covered to the depth of 2 feet.

Inside the reefs the soundings vary from 2 to 4 fathoms, the deepest water being close to the reefs; the northern part of the harbour having the most water.

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* "Nautical Magazine," 1846, p. 145.

† The directions for Onkaparinga, Yankalilla, Second Valley, and Rosetta harbour, are by Capt. B. Douglas, naval officer of South Australia (1860).

Moorings :—Under the north reef, moorings, composed of the following anchors and chains, have been placed :—*North set :*—One anchor (18 cwt.) over the reef, with 60 fathoms of $1\frac{1}{2}$ inch chain. *South set :*—One anchor (15 cwt.) in a hole on the reef, backed to a large rock, with 60 fathoms of $1\frac{1}{2}$ inch chain. To each of these chains is attached a small buoy chain, which is merely intended to hold the buoy. Masters of vessels using these moorings will therefore observe, that it is necessary to haul up on the small buoy chain, until they can shackle on their own best bower cable to the mooring chain. It is also necessary to take out an anchor in-shore, with a good scope of chain, as the land winds blow fresh at night, during the prevalence of south-easterly winds.

Under the south reef the following moorings are placed :—

One anchor (18 cwt.) over the reef, with 60 fathoms of $1\frac{1}{2}$ inch chain. One anchor (18 cwt.) on the sandy beach, with 30 fathoms of $1\frac{1}{2}$ inch chain.

Small buoy chains are attached for holding the buoys.

Masters of vessels using this part of the harbour will observe, that it is not necessary to use their own anchors; but they must perfectly understand that the mooring chains are not attached to each other; it is therefore requisite to moor to both chains, either head and stern, or allow the vessel to swing, by mooring her midway between the reef and the beach. Ample room for any vessel not exceeding 100 feet in length will be found.

Beacons :—Beacons for leading through the various channels have been placed as follows, viz. :—

For the *north channel*—A round *black* beacon on the jetty, in a line with a square and *red* beacon on the top of a sand hill, leads into the harbour in 3 fathoms.

If the wind be off the land, after having passed the end of the north reef, stand in towards the beach, as close as the draught of the vessel will admit, and drop the small bower; from this veer away towards the mooring buoy, and pick up the large chain as directed. Should the wind be from the westward, it will, of course, be necessary to pick up the buoy first; and should it be blowing fresh, it is needful to drop an anchor under foot, until the large chain is hove in, as dependence cannot be placed on the small buoy chain, if the vessel is pitching to the short sea which comes over the reef at high water.

The *middle channel* is marked by two square *red* beacons, bearing, when in line, north, which lead into the harbour in 5 fathoms. On passing the ends of the reefs, a course may be shaped for either of the moorings.

Vessels entering by the middle channel will be guided by circumstances as to which moorings they go to. The northern should be preferred, as the water is smoother under the north reef, and they are more convenient to the jetty.

The *southern channel* is marked by a round *black* beacon on the beach, under the sand hills, to the southward of the jetty, which, brought in a line with the upper *red* beacon, on the summit of the sand hills, leads into the harbour in 10 feet at low water springs.

It is necessary to borrow close to the south end of the south reef, to avoid the shoal spit which projects from the sandy beach opposite the end of the reef.

From my experience relative to this harbour, I can speak most highly as to its capabilities as a safe port for coasters, not exceeding 200 tons, of moderate draught of water.

In westerly gales, a short sea comes over the reefs at high water, but, at other times of tide, when the reefs are uncovered, the water within is quite smooth.

The jetty and tramway will be found a great convenience in loading.

Yankalilla.—The jetty at this place lies in Lat. 35° 28′ 20″ S., Long. 138° 21′ 30″ E. High water, full and change, at 3h. 30m.; rise and fall at springs, 6 feet.

The jetty is erected near the entrance of a small creek, on the long line of sandy beach, to the southward of the bold headland termed "Carricalinga."

The soundings off the jetty decrease from 5 fathoms, on a sandy bottom, at a mile distant from the shore, to 4 fathoms, at three-quarters of a mile, when the whole extent from thence, to within a few yards of the beach, is one mass of rocks.

Moorings.—As no anchors could hold on a bottom of so objectionable a nature, moorings have been placed as follows:—

In 3 fathoms at low water spring tides, at a distance of 800 yards from the jetty, an anchor of 75 cwt. is placed, from which 50 fathoms of 2 inch chain is stretched out; to the end of this heavy cable a 1 inch buoy chain is shackled on and attached to a buoy.

Masters of vessels using these moorings will have to haul up on the buoy chain until the large chain is above water; then they must shackle on the ship's best bower cable, and veer away according to circumstances. As these moorings are merely intended to afford security to vessels during westerly winds, it is hardly necessary to observe, that the vessel making use of them must let go her small bower in shore in the event of the wind coming off the land.

Masters of vessels are strictly enjoined not to hang on to the small buoy chain, as the constant friction on that portion of the chain touching the ground, effects so great a reduction in the size, as renders it necessary to renew it annually. The heavy chain, lying generally on the bottom, is not affected in this manner.

In 2 fathoms, at low water, and distant from the jetty 300 yards, moorings are placed for 2 small coasters. They are as follows:—

Two anchors of 25 cwt. each, with 90 fathoms of $1\frac{7}{8}$ inch chain, stretched north and south, having 2 buoy chains of 15 fathoms each, of $1\frac{1}{4}$ inch chain. Small craft, using these moorings, may shackle on their cable to the buoys, and veer away towards the jetty.

Second Valley.—Lat. 35° 31′ 10″ S., Long. 138° 17′ 0″ E. High water, full and change, 3h. 20m.; rise and fall, 6 feet.

This little cove lies about $4\frac{1}{2}$ miles S.W. of Yankalilla, and is formed by a slight indentation of the coast.

The soundings are bold and deep, close to a rocky point, which forms the western horn of this little bay.

A convenient wharf and tramway have lately been erected.

The anchorage is quite exposed to all winds from W.S.W., round by N.W. to N.N.E. The sea sets in rapidly, and with great violence, on the approach of a westerly gale.

The rocky point, at which the wharf is constructed, affords some protection in southerly winds to small craft; but I would recommend all masters of vessels to leave this very exposed anchorage on the first symptoms of bad weather.

Moorings.—For the convenience of coasters, not exceeding 100 tons, the following moorings have been laid down:—

90 fathoms of $1\frac{7}{8}$ inch chain, with its inshore end attached to the heavy timber of the wharf, and its other extremity fast to an anchor of 25 cwt.

On this chain, in 4 and 5 fathoms water respectively, are buoy chains of 1 inch, 15 fathoms in length.

Masters of vessels using these moorings may shackle on their own cables to the buoys, and veer away according to the state of the weather.

To the S.E.-ward of cape Jervis is **Encounter bay**, in which are soundings of 20 fathoms at 5 or 6 miles from the shore, but it is too much exposed to the South and S.W. winds. At the north end of the bay are Rosetta harbour and Port Elliot.

Rosetta Harbour, Encounter Bay.—Lat. 35° 35′ 20″ S., Long. 138° 40′ 10″ E. High water, full and change, 1h. 15m.; rise and fall 6 feet.

Rosetta harbour is formed by the indentation of the coast, under the remarkable peak termed Rosetta head. This headland may be readily recognised by its conical shape. The height of the peak is 344 feet above sea level.

Due north from the point of the headland, at a distance of one quarter of a mile, lies Wright's island. This island is high and steep on its S.E. and S.W. sides.

From the N.W. point of the island, a reef of rocks extends to the mainland, in a south-westerly direction, on which the sea breaks heavily in bad weather.

Moorings.—Moorings, capable of holding small coasters only, have been laid down as follows:—The end of a $1\frac{1}{4}$ inch chain, 90 fathoms in length, is attached to the heavy timber of a convenient wharf, situated under the peak, inside the harbour, with the northern end shackled to a 20 cwt. anchor, let go in $5\frac{1}{2}$ fathoms, to the northward of the wharf.

On the mooring chain, at a convenient distance from the wharf, in 4 fathoms, at low water, is shackled 15 fathoms of 1 inch buoy chain.

Vessels making use of these moorings may shackle on to the buoy and veer away according to circumstances.

Vessels entering Rosetta harbour, in coming from the westward, should round the headland under the peak closely, taking care, however, not to get becalmed by the high land, if the wind is from the westward.

Soundings will be found from 2 fathoms close to the wharf, to 6 fathoms alongside the rocks, on the S.W. and S.E. sides of Wright's island, with 7 fathoms 20 yards from Rosetta head.

Vessels working in with the wind at N.W., in standing to the N.E., should not bring the south part of Wright's island to bear to the southward of east, to avoid the rocks lying between that island and Granite island.

Rosetta harbour affords accommodation for 2 small vessels only.

During all winds from S.S.W. to N.E., round by N., the anchorage is smooth; all the other winds bring in a swell.

During S.E. gales the anchorage is unsafe.

Port Elliot has limited anchorage in 4 to 7 fathoms, but is well protected from the southward by Lipson island; heavy moorings have been laid down for five vessels of large tonnage; a stranger should not enter without signalling to the harbour-master.

Moorings in the Inner Harbour.—The following are the particulars respecting the moorings placed in the inner-harbour of Port Elliot.

The outer end of the mooring-chain is fastened round the N.W. rock of the "Sisters," and stretched from thence, in a W.N.W. direction, towards the beach, about half a cable's length to the southward of the *red* leading beacons, where a single-fluked anchor of 4 tons is laid down in 12 feet at low water, with the inner end of the chain attached to it.

The mooring-chain, 187½ fathoms in length, is 2 inches in diameter, with the exception of the bight round the rock, and 12½ fathoms next the anchor, which portions are of 1⅝ inch chain.

The mooring-bridle at the outer buoy, consists of 12½ fathoms of 1⅝ inch chain, and of 15 fathoms of 1½ inch chain, the latter being next the buoy.

The inner-bridle is of 15 fathoms of 1½ inch chain.

Vessels of large tonnage, drawing 12 feet, may lie at the *outer* buoy; those of smaller tonnage and less draught of water will find better shelter at the *inner* buoy.

Vessels using the moorings, whose hawse-pipes are not large enough to receive the bridles, should have both their own cables shackled thereto, and veer away according to the state of the weather; observing that, with N. and N.E. winds, it will be necessary to ride with a shorter scope, to keep clear of the foul ground near the breakwater.

The moorings, as laid down under Lipson's island, in the outer harbour, consist of chains and anchors of similar size to those in the inner harbour, and will accommodate 3 vessels of very large tonnage.

Masters of vessels, using the moorings, are required to land the mooring-buoys, if desired to do so by the deputy harbour-master; and, in all cases, must observe the instructions of that officer in reference to the moorings, or they will be held liable for any loss or damage that may occur to the moorings, whether from neglect or accident on their part.

Port Elliot now being provided with moorings of the heaviest and best description, for 5 vessels of large tonnage, the harbour-master considers it his duty to warn masters of vessels from trusting to their own ordinary anchors in the inner harbour, as the rollers setting in through the southern passage keep the bottom in so disturbed a state that no reliable holding ground exists.

The tide sets from the S.E. into Encounter bay at the rate of 1½ knots.

Cape Bernouilli, in Lat. 36° 54½′ S., Long. 139° 40′ E., and the southern boundary of Lacepède bay, is sandy land, rising from the beach to a moderately-elevated and well-wooded ridge; to the N. and W. of it are many low rocks; at 4 miles west of it is an islet visible 3 miles off. In 1826 a dangerous **reef** was reported by Captain Drake, of the *Sesostris*, in Lat. 36° 55′ S., Long. 139° 20′ E., and 12 miles from the land; the *Margaret Brook* was also reported to have been on a reef 18 to 20 miles west of this cape; and the *Rivals* struck on it; the existence of this reef is doubted.

Coast.—S.S.E.-ward of cape Bernouilli about 10 miles is **Guichen Bay,** which, though open to the west, affords good shelter in 5½ to 6 fathoms 1¼ miles from the shore. Thence the irregular coast-line trends S.E. for 68 miles to cape Northumberland; in several places there are rocks and patches of rocks as much as 2 miles from the shore, therefore in passing it should not be approached under 7 or 8 miles.

Current.—Cape Northumberland being about the northern limit of the stream of current which is usually experienced running to the eastward, from cape Leeuwin

through Bass Strait, has much deeper water along the shore to the southward and eastward of it than to the northward; and the bank of soundings is contracted to a smaller distance from the shore towards King island in Bass Strait, than in the space round the Great Australian Bight to the Archipelago of the Recherche. Therefore, in approaching any part of the south coast outside of these limits, during the night, soundings must not be expected many leagues from the shore; and in no part do they appear attainable at a greater distance than when the land may be seen in the daytime. An eddy current to the northward has sometimes been experienced, within 3 or 4 leagues of the land, between cape Northumberland and Lacepède bay; apparently occasioned by a current which Captain Flinders found in the middle of April, setting towards the cape from the W.S.W. at the rate of half a mile an hour, and which then took nearly opposite directions to the northward and S.E., parallel to the general trending of the coast.

Light.—From the lighthouse (28 feet high) on **cape Northumberland** a light is exhibited at an elevation of 123 feet above the sea: it is a *revolving* light, showing *alternately white, red,* and *green, every minute,* and visible from seaward when bearing between E.S.E. and W. by S. ½ S. The *white* light may be seen from the deck of a vessel at a distance of 18 miles; the *red* light will not be seen beyond 15 miles, and the *green* light beyond 8 miles. During hot weather, and N.E. winds, the *white* light may be observed at a greater distance. Position, Lat. 38° 3′ S., Long. 140° 37′ 45″ E.

Vessels from the eastward approaching cape Northumberland should not bring the *white* or *red* light to bear to the westward of W.N.W., and when the *green* light comes in sight on that bearing, should steer more southerly, in order to give a wide berth to the reef projecting to the eastward from the cape.

Vessels from the northward should never sight the *white* or *red* light bearing to the southward of E. ½ S., and on distinguishing the *green* light should immediately alter course so as to give an offing to the outlying reefs westward of the cape, and running parallel to the coast at a mile off.

In bad weather, with the wind hanging to the southward, it will be advisable to give the cape such an offing as not to sight the *green* light; and should the weather be thick, or it be blowing hard, it will be prudent not to sight the *red* light, which under such circumstances would not be seen at the distance above given.

The light-keepers are provided with a nine-pounder carronade, and a code of Marryat's signals, to warn vessels observed to be standing into danger.

The coast north-westward of the cape soon becomes low; and owing to the heavy ocean swell, which sets directly on shore, should be very carefully avoided. To the eastward of the cape is a deep bight, which offers no shelter, nor any inducement to enter; in about Lat. 38° 6′ S., Long. 140° 52′ E., and 4½ miles from the shore, is **Ruby rock,** 4 feet high, with deep water close to it.

The **Coast** from cape Northumberland trends E.N.E.-ward 5 or 6 miles, and then S.E.-ward, forming, with **cape Bridgewater,** a large open bight, 38 miles across; breakers extend in many places 3 miles from the shore, but at the distance of 6 miles there are depths of 18 to 25 fathoms, coral and rock.

Cape Bridgewater (on which a lighthouse is building in Lat. 38° 21½′ S., Long. 141° 24′ E.), is a bold cliffy projection, visible 30 miles. There are 24 fathoms water at 5 or 6 miles west of the cape; on the south side the depths are 43 fathoms at 4 or 5 miles off, and 71 fathoms at 6 to 7 miles further.

Cape Nelson is a bold head, E. by S. 8 miles from cape Bridgewater; and 4 miles N.E. by E. ½ E. from cape Nelson is **cape Sir William Grant,** off which, in an E. by N. direction 2½ miles, is **Lawrence island** or rock.

PORTLAND BAY is to the eastward of cape Sir William Grant. The following sailing directions for Portland bay, in the colony of Victoria, are by Mr. James Fawthrop, harbour-master :—

Vessels bound to Portland, and making the land from the westward, should endeavour to sight the high land of cape Bridgewater, cape Nelson, and cape Sir William Grant. These capes, at a distance of 4 or 5 leagues, as seen from the south-westward, form a cluster of high bold land, the western part being covered with large white sand patches,—the centre high tableland (cape Nelson) and the eastern part (cape Sir William Grant) trending low. This eastern part of the cluster forms the southern extremity of Portland bay, and is fronted to the S.E. by a small group of high rocks named the Lawrence rocks ; these will not be visible until within 5 or 6 miles, being hid by the high land of cape Sir William Grant. These rocks extend rather more than 2 miles to the eastward of cape Sir William Grant, and about a mile to the S.E. of a low point named Danger point ; there is a passage between the point and the Lawrence rocks, but it is very narrow and close to the western side of the latter. This passage should never be attempted, for it is full of sunken rocks, on which the sea breaks in southerly and south-west gales. Vessels should therefore round the Lawrence rocks, passing to the eastward at a convenient distance, and then hauling up to the north-westward should the wind prove scant. As they proceed to the northward, the houses of the town of Portland will begin to open off Observatory point, which forms the southern point of an indent in this part of the bay, about a mile in extent.

Anchorage.—Fronting the town, the soundings will be 8 or 9 fathoms ; in crossing the bay with a scant wind, vessels may pass to the northward of the town, until it bears S.W., then tack : the soundings will gradually decrease as they approach the shore, and a heavy ship may anchor about a mile from the town in 7 fathoms, with the jetty bearing W. by S., and the Lawrence rocks S.E. by S. The bay is very capacious, and by keeping the Lawrence rocks on a S.E. by S. bearing, vessels will have 3 miles of clear anchorage ground to the northward of the town, and 2 miles to the southward of Blacknose point, the limit of the Quarantine ground.

No hidden danger is known to exist in the bay but the sunken reef off **Whalers bluff** or **look-out,** a range of high limestone cliffs at the northern extremity of the town. The reef, which has 8 feet water on it, is of small extent, with a deep channel between it and the bluff, from which it bears E. about a quarter of a mile. From the bluff the land trends to the north-westward, forming a second indent of about 2 miles in extent, with good anchorage and regular soundings. The coast from thence continues to trend to the north-eastward for about 6 miles, and then bends to the eastward. At this part it is distant from the Lawrence rocks about 12 miles. This may be considered the extent of the bay in that direction ; but there is ample space in the S.W. quarter of the bay for any number of vessels to anchor in any depth of water suitable to size.

Vessels bound to Portland *from the eastward* should endeavour to sight **Percy**

island. It may be passed within half a mile, and from that position, in clear weather, will be seen the high land of mount Clay, which forms the north-east boundary of Portland bay. The high land of cape Nelson will also be visible, which forms the southern boundary of the bay. A clear passage may be found between Percy island and the main of 3 miles wide; but it is not advisable for large vessels to pass inside, for a heavy swell from the S.W. generally rolls in upon the coast, and frequent calms in summer make it unsafe, for the whole coast is fringed by a belt of dangerous rocks, with deep water close to the shore, on which a continual surf breaks. The southern extremity of this island may be assumed as Lat. 38° 26′ S. and Long. 142° 1′ E.

Lights. — There is a *fixed green* light on the extremity of the old jetty, visible 2 miles. Also a lighthouse (of stone and coloured *grey*) stands near the flagstaff on Observatory hill, and its approximate position is Lat. 38° 22′ S., Long. 141° 39′ E. It exhibits a *fixed red* light, visible 13 miles when bearing between N.W. and S. by E. by the eastward. Elevation, 116 feet above the mean level of the sea. From the lighthouse the eastern extreme of the Lawrence rocks bears S.E., distant about 4 miles; the extreme north point of Whalers look-out N.W. by N. 1 mile; and the *buoy* on Whalers reef N. by W. ½ W. 1 mile.

Caution.—Vessels bound to Portland bay from the westward at night must be careful, in rounding the Lawrence rocks, not to bring the light on Observatory hill to bear to the northward of N.W. by W. ½ W. After passing the rocks, a course may be shaped for the light, keeping it on the port bow, and not standing into a less depth than 6 fathoms. When abreast the anchorage, the *green* jetty light will be visible, bearing west.

The various headlands, on approaching this part of the coast, are very conspicuous, and cannot easily be mistaken.

Tides.—The time of tide is very uncertain, being much influenced by southerly winds; but in fine weather a regular tide runs along the whole coast from cape Otway to cape Bridgewater, the flood setting to the westward. Between cape Bridgewater and cape Northumberland the tides meet, and in strong weather create a very turbulent sea. At Portland the rise is about 4 feet.

Port Fairy, in Victoria, is 32 miles from Portland bay; the following Sailing Directions for this place are by J. B. Mills, harbour-master :—

In making it from the S. or S.E., the first remarkable land seen is a hill on Griffiths island, which forms a saddle, standing S.W. and N.E., the highest part to the S.W. This hill lies S.S.W. of the anchorage a short mile, and cannot be mistaken for any other land, as it is much higher, and lies outside the line of coast.

About W.S.W. ¼ W. 13 miles is Percy island, lying 5 miles off shore. It has a table appearance, and is very steep.

Nine miles N.E. ½ E. from the Saddle hill is some moderately high land, which, when seen from seaward, has a table appearance, and may always be known by a round peaked hill, lying close to its westernmost extremity, and may in clear weather be seen 20 miles at sea, the Saddle hill 12 miles, and Percy island 16 miles. The coast for 7 miles east and west of Belfast is low and grassy, and to the westward sloping down to the sea with a few clumps of trees, while that to the eastward,

being bare of timber, cannot be seen more than 9 or 10 miles from a ship's deck in the clearest weather.

Port Fairy bay is open from south to east, and is about 3 miles wide by $1\frac{1}{4}$ miles deep. The anchorage is in the S.W. end of the bay.

After making out the Saddle hill, steer so as to pass half a mile to the eastward of a low rocky island, bearing from Saddle hill N.E. by E., distant about three-quarters of a mile, and which has a reef extending from it about an eighth of a mile N.E. by E., which is quite covered at high water, and always breaking when there is any swell. It may always be known in fine weather by the kelp on the surface of the water. In passing this island may be seen a windmill on the south side of the town of Belfast; also a flagstaff on a high sand hummock, lying W.S.W. from the anchorage. As soon as the mill opens out clear, steer N.W. into the bay, until the flagstaff and mill are in a line. The soundings then will be $5\frac{1}{2}$ or 6 fathoms water, with a bottom of very fine dark sand. The water shoals gradually from this towards the flagstaff, and the best berth is when the mill is within a quarter of a point open to the westward.

The above directions are for the outer anchorage, or for vessels drawing 13 feet or upward: smaller vessels can, of course, lay further in towards the flagstaff. There are good moorings in port Fairy.

Light.—The lighthouse is circular, built of stone, and coloured *red*. It stands on the S.E. part of Rabbit island, about 5 yards from high-water mark, and its approximate position is Lat. 38° 24′ S., Long. 142° 20′ E. From the lighthouse the south end of Julia Percy island bears W. by S. $\frac{1}{2}$ S., distant about 13 miles; the S.S.E. extreme of the reef off Dusty Miller island, S. by W. $\frac{3}{4}$ W., three-quarters of a mile; the N.E. extreme of Rabbit island reef N.E. by E., $1\frac{1}{4}$ cables' lengths; and the outer mooring *anchor buoy* N. by E. $\frac{3}{4}$ E., three-quarters of a mile.

It exhibits a *fixed red* light, varied by a *bright flash* every *three minutes*, visible *seaward* from a vessel when bearing between N.E. $\frac{1}{2}$ E. and S. by E. $\frac{1}{2}$ E. Elevation, 41 feet above the mean level of the sea, visible 9 miles. At the *distance of 6 miles and upwards* it will appear as a *steady* light for a space of *one minute and forty seconds*, be suddenly *eclipsed thirty-four seconds*, then exhibit a *bright flash* for *twelve seconds*, and be again *eclipsed for thirty-four seconds*, when the *steady* light will reappear. When *within 3 miles* of the light the *eclipses* will be scarcely observable, a continued *fixed* light being at that distance, in clear weather, visible *between the intervals* of the *bright flashes*.

Caution.—The mariner is particularly requested to note the distinctive feature between the port Fairy light and the cape Otway light, the latter being *white*, and varied by a *flash* every minute.

No stranger should attempt to pick up the port Fairy light in thick weather, nor enter the port at night. When working in shore to the westward of the port, be careful not to bring the light to bear to the eastward of E.N.E.; nor should the light be approached nearer than a mile until it bears W. by S., when a N.W. by W. course may be steered for the roadstead. When it bears S. by W. $\frac{1}{2}$ W., anchor in $6\frac{1}{2}$ or 7 fathoms water; do not bring the light to the southward of this bearing, to avoid fouling the moorings.

Warrnambool.—To the eastward of port Fairy is **Lady bay**, in which is the town of Warrnambool; here there is a *fixed white* **light**, elevated 78 feet above the

mean level of the sea, and visible *seaward* from all points of the compass from distance of 13 miles.

The lighthouse stands on Middle island, and its approximate position is Lat. 38° 26′ S., Long. 142° 32′ E. From the lighthouse the south-east extremity of the reef bears S.E. by E. ¼ E., distant half a mile; and the southern extreme of Hopkins reef, E. ¼ S., 2 miles.

Caution.—No stranger should attempt to enter Warrnambool harbour at night, nor should the light on Middle island be approached within one mile. Vessels bound to the harbour from the *westward* should not bring the light to bear to the southward of E. ¾ S.; nor to the westward of N.W. by W. ½ W. if bound from the *eastward*.

There is also a *red* harbour **light** at the head of the bay, a little above high water mark; it is visible 3 miles between the bearings of N.W. and N. ¼ E., and serves to guide vessels in clear of the outer reefs.

CAPE OTWAY.—From Lady bay the coast trends to the E.S.E.-ward 56 miles, to cape Otway, a high bluff forming the north point of the western entrance to **Bass strait**; at less than a mile from the cape, in a S.S.E. direction, there is a dangerous reef on which the sea breaks heavily; and some rocks also project immediately south of the cape.

Light.—On the S.W. extremity of cape Otway, a lighthouse, 52 feet high, exhibits a *bright* light *revolving every minute*, at an elevation of 300 feet above the sea, and visible 24 miles; position, Lat. 38° 51′ S.; Long. 143° 33½′ E.

Caution.—Do not approach the cape within a mile on a N.W. to N.N.E. direction, and to the westward not nearer than 2 miles.

King Island divides the western entrance of Bass strait into two channels; on the north extremity of the island, and S.S.E.-ward 48 miles from cape Otway, is **cape Wickham.**

Light.—A lighthouse, 145 feet high, has been erected on cape Wickham; it exhibits a *fixed white* light at an elevation of 280 feet, visible from N.N.E. ½ E., round by S. and E. to W.N.W. to the distance of 24 miles.

From the lighthouse, the west extreme of Harbinger reef bears W. by N. ¾ N., distant 4½ miles, and the east extreme N.W. by W. 4 miles; Navarino shoal N.E. by N. 2½ miles; and south extreme of New Year islands S.W. ½ S., 9 miles, and north extreme S.W. ½ W. 7½ miles. Position about Lat. 39° 35′ S., and Long. 143° 57′ E.

Caution.—The attention of mariners is called to the following extract from the report of the Lighthouse Commissioners, appointed by the Governments of N. S. Wales, Victoria, S. Australia, and Tasmania:—"In advising the erection of a lighthouse on King island, the Commissioners wish to guard themselves from affording the public any reasonable supposition that this light can be at all considered in the position of a great highway light for the navigation of Bass strait. The south coast of New Holland, at the western entrance of the strait, being free from danger, affords, in their opinion, the safest shore for the prudent mariner to approach, and they conceive that the light on King Island is only to be regarded as *a beacon for warning navigators of danger*, rather than as a leading light to a great thoroughfare."

BASS STRAIT.—For the navigation of Bass strait it is necessary to be provided with the Admiralty Chart, No. 1695. The following remarks do not comprise a description of the *entire* coast, nor of all the islands, but rather of the most prominent points, and of the *lighthouses* and *lights* established within the limits of the strait.

The western entrance of Bass strait is 108 miles wide between cape Otway and the islands off the N.W. point of Tasmania. King island (already mentioned) occupies 34 miles of this space, leaving a channel to the northward 46 miles wide, and to the southward 39 miles—the latter, however, being encumbered by many dangers.

The *strongest winds* come from S.W., blowing probably nine months of the year from some point in the western quarter. Easterly winds, with fine weather, are not uncommon during January, February, and March. The gales usually come from between S.W. and S.E., but frequently from the latter direction, at which time it is dangerous to approach the coast between cape Howe and Wilson promontory.

The prevalence of westerly winds impels an immense mass of water towards and through Bass strait, but, nevertheless, the set, especially in the *middle* of the strait, is commonly to the westward, the *current appearing to be predominated by the tides*, the superior strength of which forces it below the surface. The flood is from the eastward.

Passing through the strait from west to east, the position of the ship at the western entrance having been well ascertained, shape a course for Curtis island, leaving it to the northward on account of Crocodile rock, and then it is generally preferable to take the route between Kent group and Wright rock, or between Kent group and Hogan group. Curtis island is visible upwards of 30 miles, and "its central position renders it quite a finger-post for ships passing through the strait."

LONSDALE POINT is on the west side of entrance to port Phillip. — A Temporary Harbour **light** has been established here; it is *fixed green*, and *red*,—showing *green* to seaward when bearing from about N.W. by N. to N.W. $\frac{1}{2}$ W.; and *red* towards Nepean point and the harbour, from about N.W. $\frac{1}{2}$ W. to W. $\frac{1}{2}$ N. The *green* light should be seen from a distance of about 4 miles, and the *red* light at about 7 miles.

Caution.—The light is exhibited from a site close to the tidal flagstaff on Lonsdale point, and is intended to warn vessels of their approach to the dangers discovered in 1862, by the *Lightning*, and the rock off Lonsdale point, at the entrance to the port. Vessels having the *green* light in sight will be outside the dangers, and with the *red* light in sight inside the dangers. The blending of the two colours will indicate that a vessel is in the vicinity of the dangers.

SHORTLAND BLUFF is just within the entrance to port Phillip. Here there are two lighthouses.

The higher and inner **light** is *fixed white*, visible from seaward to vessels in the offing on any bearing between about E. by N. and North; but when close in with the Lonsdale land, it will only be seen when bearing betweeen N.E. by E. and North. Within port Phillip heads, the light will be visible from N.E. by E., round by north and west, to S.W. by W. The light is elevated 130 feet above the level of high water, and visible 17 miles.

The tower is grey, 68 feet high, and stands N.E. by N. distant 352 yards from the low lighthouse.

The low light is *fixed red* and *white;* showing *white* when bearing from about N.E. by E. to N.E., *red* from N.E. to N.N.E., and *white* from N.N.E. round by north to W. by N. It is placed at an elevation of 90 feet above the level of high water. The *white* light is visible 14 miles, and the *red* light 10 miles. The tower is white.

Caution.—Vessels entering between the heads at port Phillip should keep the *red* light in sight, and steer in with it bearing N.E. by N., and in line with the high *white* light. The *change* of colour from *red* to *white* indicates an approach to the Lonsdale or Nepean reefs. The *white* light between the bearings of N.E. by E. and N.E. shows over the dangers extending from Lonsdale point. Between the bearings of N.N.E. to W. by N., the *white* light shows over the Corsair rock to a line passing from the lighthouse through the South channel, southward of Pope's eye and the *black* buoys, and to the northward of the *white* buoys, so that vessels during night with light winds or adverse tides will be aided by a bearing of the light.

Caution.—To clear the Corsair rock, keep the east end of the Telegraph station open westward of the *red* obelisk, which is 40 feet high and standing near the site of the old lighthouse, until the *white* beacon on Nepean point is open northward of the *red* beacon. The beacon on Nepean point open south of the *red* beacon leads to the southward of the rock.

Swan Spit light is *red* and *white:* showing *white* when bearing from about E.N.E. to N.E. $\frac{1}{2}$ E., *red* from N.E. $\frac{1}{2}$ E. to N.E. $\frac{3}{4}$ N., *white* from N.E. $\frac{3}{4}$ N. to N. by W. $\frac{1}{2}$ W., and *red* from N. by W. $\frac{1}{2}$ W., round by the west, to S. $\frac{1}{4}$ W.

The *red* light in sight between the bearings of N.E. $\frac{1}{2}$ E. to N.E. $\frac{3}{4}$ N. indicates the entrance to the West channel between No. 1 *black* buoy, and the *white* buoy with perch on the Royal George shoal.

A gong is sounded every 10 minutes in thick or foggy weather.

CAPE SCHANCK is a cliffy headland at the southern extremity of the narrow promontory which separates port Phillip from port Western; off it are three rocks, one of which is known as the Pulpit.

Light.—A circular stone lighthouse, painted red, stands on the highest part of cape Schanck, in Lat. 38° 30′ S., Long. 144° 54′ E., about half a mile N.N.W. from the Pulpit rock.

It exhibits a *fixed white* light, varied every *two minutes* by a *bright flash,* and visible from a vessel seaward when bearing between W. $\frac{1}{4}$ N. and S.E. $\frac{3}{4}$ E. The light at the distance of 8 miles and upwards (according to the state of the atmosphere) will appear as a *steady* light for the space of one minute, be suddenly *eclipsed* for twenty-five seconds, then exhibits a *bright flash* for about ten seconds, and be again *eclipsed* for twenty-five seconds, when the *steady* light will re-appear. When within about 6 miles of the light, the eclipses will be scarcely observable, a *continued faint* light being at that distance, in clear weather, seen between the intervals of the *bright flashes.* Elevation, 328 feet above the sea. Visible 23 miles.

Caution.—Mariners are reminded that the reef to the southward of the Pulpit rock lies S.S.E., about three-quarters of a mile from the lighthouse; vessels, therefore, in passing the light, must give this reef a wide berth.

Port Western is a deep bay of irregular outline, the entrance to which is fronted by **Grant island**, which forms a sea barrier stretching across the bay almost from point to point, and leaving a wide, open channel, free from any hidden dangers, on its western side; the channel by the eastern side of the island is narrow, and fit only for boats and small vessels. The bold and steep headland, called cape Wollami, 480 feet high, is at the S.E. end of Grant island.*

Cape Liptrap, in Lat. 38° 55′ S., Long. 145° 56′ E., the next prominent headland to the S.E.-ward of cape Schanck, and 25 miles N.W.-ward from Wilson promontory, has two rocks near the shore, the easternmost one having 4 to 6 fathoms water close to it.

WILSON PROMONTORY, a bold headland and the southernmost cape of the Australian continent, is a lofty mass of granite 20 miles long by 6 to 14 miles broad, rising from low sandy land to the northward; though tolerably well wooded in the higher parts, it is only covered with brushwood towards the shore, where it plunges nearly abruptly to the sea. It is visible upwards of 40 miles. There is a sandy bight on each side of the cape, and a small rocky islet off the extremity. S. by E., 5½ miles from the point, is **Rodondo island**, a conical mass of granite 1130 feet high, visible 30 miles; and to S.W. of the promontory are the conspicuous but barren **Glennie islands**, eight in number, extending north and south, with deep water close to their rocky shores: Cleft island is the southernmost of the group.

Light.—A circular stone lighthouse, painted white, stands on the S.E. part of Wilson promontory, in Lat. 39° 9′ S., Long. 146° 27′ E.

It exhibits a *fixed white* light, visible from a vessel seaward when bearing between S.S.W. and E.N.E., excepting that by the intervention of the adjacent islands the light will be *eclipsed* upon the undermentioned bearings, and for a few degrees on either side of them—when bearing N.E. by E. ½ E., the light will be *eclipsed* by the south part of Cleft island; when N. ½ E., by centre of Rodondo island; when N. ½ W., by Ten-foot rock; when N.W. ¼ N., by West Moncur island; when N.W. ¾ W., by East Moncur island; when S.W. ¼ S., by Cliffy, or South Seal island; when S.W. by S., by North Seal island; and when S.S.W. ¼ W., by Cape Wellington. The light being at an elevation of 342 feet above the sea, is visible 24 miles.

Directions.—Vessels steering through Bass strait, or from port Phillip, bound eastward round Wilson promontory, may first see the light through the space between Cleft island and the southern Glennie island, bearing E.N.E.; as they proceed to the southward and eastward it will be *eclipsed* for a few degrees by Cleft island; when it bears N.E. the channel between the latter island and Rodondo island will be open, and they may steer direct for the promontory.

Vessels to the eastward of the Seal islands, and bound round the promontory, sighting the light bearing to the southward of S.W., will be to the northward of the fairway, and should haul out until the light bears S.W. by W.; by keeping the light on the latter bearing it will lead clear of the Cliffy and the other Seal islands.

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* See Admiralty Chart, No. 1707.

PORT PHILLIP.

The following Sailing Directions for the navigation of port Phillip are by Commander Henry L. Cox, R.N., who has lately re-surveyed the port:—

PORT PHILLIP* lies at the head of the deep bight formed between cape Otway on the west, and Wilson promontory on the east. On each of these headlands is a light, visible 24 miles; that on cape Otway *revolves* every *minute*, that on Wilson promontory is *fixed*. The coast from cape Otway to the entrance of the Barwon river, 6 miles west of the entrance of port Phillip, trends to the north-east, has considerable elevation, is of a rough, broken character, and thickly wooded.

From Wilson promontory (described on p. 699) to port Phillip the land runs nearly W.N.W., and is of a varied character, including the large harbour of port Western.

Cape Schanck (see p. 698), 15 miles east of port Phillip, lies at the base of the range from Arthur's seat; on it is a red lighthouse, which exhibits a *fixed white* light varied every *two minutes* by a *flash*. The coast of this bight is at present only partially examined, and should not be closely approached, reefs being known to exist.

From cape Schanck to the river Barwon is a range of low sand hills, adjoining the entrance to port Phillip, which is a large arm of the sea between the Bellarine hills, 450 feet high, on the west, and Arthur's seat, 975 feet high, on the east. The entrance, $1\frac{1}{2}$ miles wide, in Lat. 38° 18′ S., Long. 144° 38′ E., may be readily distinguished by the lighthouse, and the signal and telegraph stations on Lonsdale point, the western point of entrance. When the entrance is fairly opened, the lighthouses on Shortland bluff and the town of Queenscliffe will be seen 2 miles within the heads.

Lonsdale and Lightning Rocks.—Port Phillip heads are about $1\frac{3}{4}$ miles apart, but the channel between them is narrowed to three-quarters of a mile, by a reef on either side. The Lonsdale and Lightning rocks, with 3 fathoms least water over them, are the shoalest heads of a reef, that running out from Lonsdale point in a S.E. by E. direction, stretches completely across the entrance; Lonsdale rock lies upwards of half a mile from the point; the Lightning rocks are between 2 and 3 cables eastward of the fairway mark. In the channel over this reef are from 6 to 8 fathoms; outside it from 8 to 15 fathoms; inside from 6 to 47 fathoms. This great inequality of depth with the strong tides, from 5 to 7 knots, dependent on the freshets, rushing through the entrance, causes the well-known *Race*, locally termed the *Rip*, at port Phillip heads. During or immediately after a south-westerly gale there is here a furious breaking sea, dangerous to small vessels: it is at all times much agitated.

Tides.—From Lonsdale point tidal signals are shown, denoting the quarter of the tide with reference to the stream; the period of slack water is very limited. The stream turns from two to three hours after high and low water by the shore.

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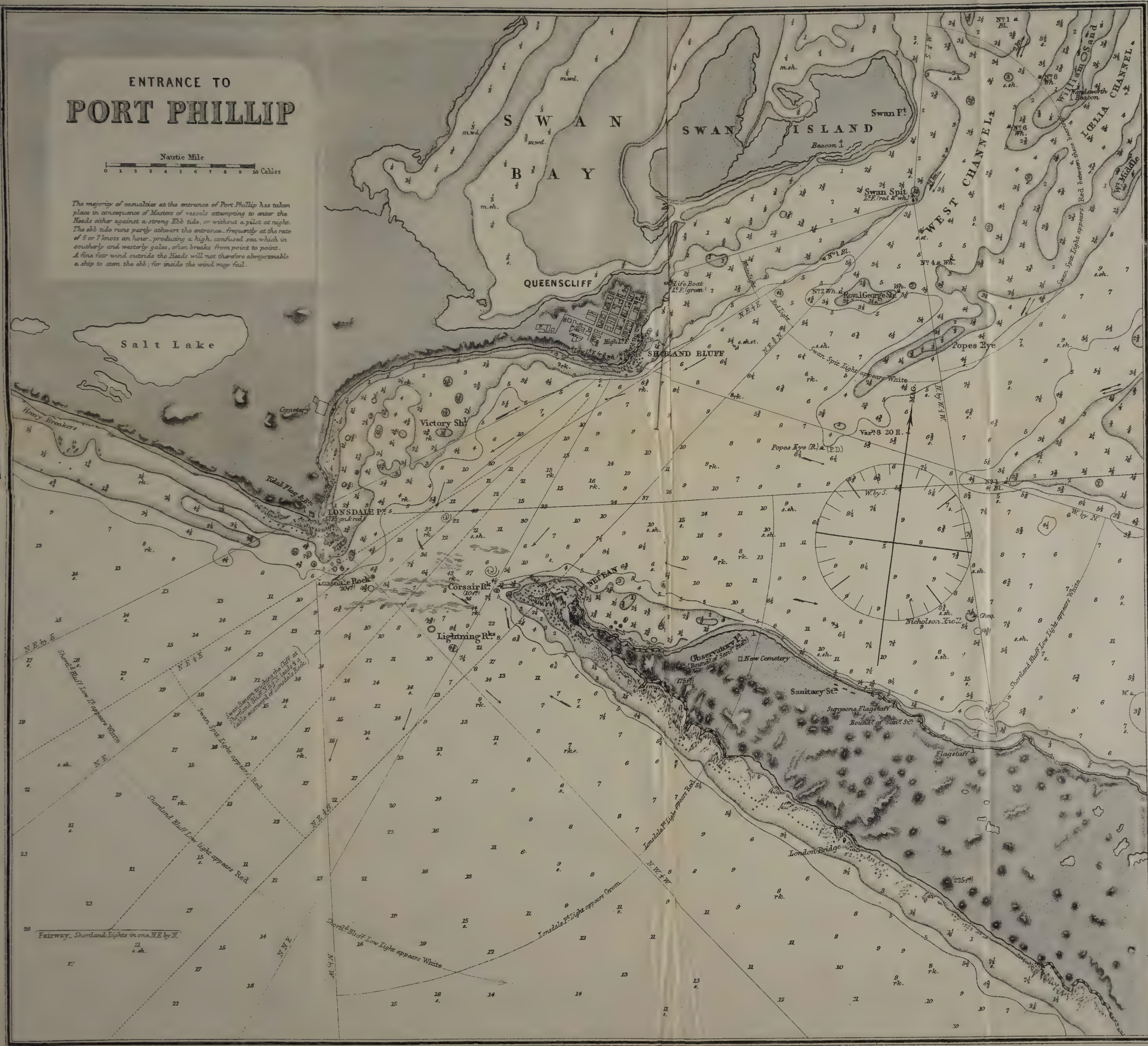
* See Admiralty Charts, Nos. 1171A and 1171B.


ENTRANCE TO
PORT PHILLIP
Nautic Mile
0 1 2 3 4 5 6 7 8 9 10 Cables
The majority of casualties at the entrance of Port Phillip has taken place in consequence of Masters of vessels attempting to enter the Heads either against a strong Ebb tide, or without a pilot at night. The ebb tide runs partly athwart the entrance_ frequently at the rate of 6 or 7 knots an hour_ producing a high, confused sea which in southerly and westerly gales, often breaks from point to point. A fine fair wind outside the Heads will not therefore always enable a ship to stem the ebb; for inside the wind may fail.
SWAN BAY
SWAN ISLAND
Swan Pt.
Swan Spit
WEST CHANNEL
ICELIA CHANNEL
QUEENSCLIFF
Salt Lake
Cemetery
Heavy Breakers
SHORTLAND BLUFF
Royal George Sh.
Popes Eye
Victory Sh.
Tidal Flag Sf.
LONSDALE Pt.
Lonsdale Rock
Corsair Rk.
Lightning Rk.
NEPEAN
Observatory Pt.
New Cemetery
Sanitary St.
Surgeons Flagstaff
Flagstaff
London Bridge
Nicholson Tro.
Fairway_ Shortland Lights in one N.E. by N.

First quarter-flood is denoted by a blue flag	. . .	half-mast.
Second quarter do.	„	do.	at mast-head.
Third quarter do.	„	red flag . . .	half-mast.
Fourth quarter do.	„	do.	at mast-head.

The same signals are used for the four quarters of the ebb; with a ball below the flag.

At Lonsdale point it is high water, full and change, at 9h. 42m.; springs rise 7 feet; neaps range 4 feet. Within the heads the tides are most irregular, the narrow entrance to the large basin within checking the fair course of the tidal wave; hence after southerly gales it may be high water all day, and the contrary with northerly gales.

On the average, it is high water, full and change, at—

	h. m.	ft. in.	ft. in.
Queenscliffe	at 10 50;	springs rise 3 1;	neaps range 1 1
Nepean point (quarantine station) . . .	10 53	„ 2 8	„ 0 5
Dromana	2 19	„ 2 11	„ 2 2
Schnapper point . . .	2 14	„ 2 8	„ 1 10
Bellarine jetty . . .	2 21	„ 2 6	„ 1 6
Henry point and Geelong	2 39	„ 2 11	„ 2 1
Williamstown (Hobson bay)	2 31	„ 2 8	„ 1 10
Melbourne quay (near bridge)	Tides 17 minutes later than at Williamstown; range the same.		

The velocity of the stream of the Yarra depends on the rains that have fallen; it generally runs down. Floods are not unfrequent, overflowing the banks and causing great destruction of property. That of December, 1863, rose 7 feet above the mean level of the river, below the falls. Above these falls, the rise was stated on that occasion to have been 30 feet; in the gorges above Melbourne, 50 feet.

Pilots.—A most efficient pilot establishment is maintained at port Phillip heads, one of the vessels being constantly outside when there is a possibility of keeping the sea. No stranger should attempt entering without taking a pilot; but the channels are so carefully lighted and buoyed, that it is quite possible to do so.

Directions.—The two lighthouses on Shortland bluff* in line, bearing N.E. by N., lead in through the fairway channel between port Phillip heads. The Lonsdale rocks on the western side are cleared by keeping Swan island beacon (*white* with a *red* top) open of Shortland bluff N.E. $\frac{1}{2}$ N. Lonsdale point mast open on either side of Lonsdale point telegraph-house (white, with a slate roof), clears the Lightning rocks to the northward and southward. The red obelisk on Shortland bluff touching the east tangent of the high lighthouse, N.E. by N., clears them to the westward. The **Corsair rocks** off Nepean point are cleared by keeping the low lighthouse on Shortland bluff in line with the east end of the light-keeper's houses,

* For a full description of these lights, see pp. 697, 698.

near the high lighthouse, N.N.E. ¼ E. The marks for the Corsair are the *red* and *white* beacons on Nepean point in line; and the obelisk on Shortland bluff in line with the centre of the lighthouse buildings before mentioned.

At night the low light shows *red* through the fairway, and *white* on either side of it. But the passage through the heads should not be attempted at night, except with steam or a fair wind; the lights should then be kept in line to ensure clearing the Lightning rocks.

Lonsdale point light* has been erected with a limited range to show over these rocks; it is *fixed*, partly *green* and partly *red*. With the *green* light in sight, vessels are outside the rocks; with both lights blending, they are in the line of the danger; and with the *red* light showing, inside it. The range of bearing on which the light is visible, is from N.W. by N. to W. ½ N.

Working Through.—To work in or out between the heads, the tides must be attended to, and it is better to do so near the time of slack water, when the *Race* will be nearly quiescent and greater command of the vessel be obtained. In working out with an ebb tide and light winds, be careful not to be drawn into the bight between Shortland bluff and Lonsdale point, the ebb tide setting from thence directly over Lonsdale point reef. A vessel within its influence, nearly becalmed, and having only her sails to trust to, has no resource but that of dropping her anchor, which she is nearly certain to lose, from the rocky nature of the ground.

Anchorage.—Having entered the heads, there are two anchorages — one off Queenscliffe three-quarters of a mile from the shore, in from 6 to 8 fathoms. Abreast and below the lighthouses the ground is rocky; it is not free from stones at any place; but its general nature is sand and shell. A *fixed green* **light,** visible 4 miles, is shown from the end of the jetty at Queenscliffe. The other anchorage is three-quarters of a mile off the south shore, abreast the Quarantine establishment, in from 8 to 9 fathoms. Strangers having taken the port from stress of weather should not attempt proceeding above these anchorages without a pilot, as a collection of banks, with somewhat intricate channels, extend to 8 miles within this.

South Channel.—Flinders point open of Lonsdale point, W. ¾ S., leads to the South Channel, the one principally used by large vessels. There are 8 fathoms and upwards at its western end, but not more than 27 feet at its eastern. This channel is *buoyed* with *white* buoys on *starboard* hand going in, and *black* buoys on *port* hand; the *beacon* buoys denote a curve in the channel. The banks on each side are steep-to, the flood setting strong over the port or northern bank, and the ebb over the starboard or southern bank.

Between the South and West channels there are several small channels, but they are shifting and intricate, neither buoyed nor recommended.

At the south-west angle of the banks between the above-named channels is a detached shoal, the Pope's eye, marked by *red* buoys, and having only 3 feet on its shoalest part.

West Channel.—In proceeding from Queenscliffe for the West channel, keep Lonsdale point lighthouse open of Shortland bluff, S.W. by W. ¼ W.; this clears the bank between Shortland bluff and Swan island spit in 3 fathoms. Immediately

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* For a full description of this light, see p. 697.

within this mark, and directly off Queenscliffe pier, is a rock with only 7 feet over it.

The West channel is buoyed on the same principle as the South. It has also a light at each end. The lighthouse at the south end is on Swan island spit (see p. 698). It is built of wood, on piles, and painted red, and exhibits a *fixed* light, which shows *red* to seaward, in the fairway from Shortland bluff to the West channel, with *white* on either side. Again it shows *red* from a N.W. (round by west) to a S.E. bearing. The light is to be left on the port hand going in, and should not be approached within a cable's length, as the spit appears to be increasing in a north-easterly direction from the lighthouse.

This channel may generally be described as a 3-fathom channel, having patches of 17 feet. It is steep to the banks on each side; runs N.N.E. and S.S.W., having an elbow near the middle, marked by a *beacon buoy* on the eastern bank. At the north end of the West channel is a floating **light-vessel,** painted red, and showing two *fixed white* lights, one on each mast; they are 50 feet above the sea, and visible at 8 miles. The light-vessel may be passed on either side. A gong is sounded every five minutes during foggy weather.

From the West channel light-vessel to Hobson bay light-vessel, the course is N. by E., and the distance 20 miles. There are no dangers in the way, but those fringing the shore, all of which are marked by buoys or beacons, and, with the exception of Prince George bank, may be avoided by keeping 2 miles off shore. The bottom generally is even and of soft mud, with 12 or 13 fathoms over it; there is therefore anchorage in any part. The tide loses its strength on passing the entrance banks, and, saving occasional freshets from the Yarra and Geelong inner harbour, its stream is scarcely perceptible.

Coles Channel.—About midway between the West channel and the shore is a 2-fathom channel, used by small vessels acquainted with the place. Its eastern bank is marked by two *red* buoys, and it is entered by passing to the northward of the West channel light-vessel. Station peak in line with the north-east tangent of George point, N.W. by W. $\frac{1}{4}$ W. clears the entrance banks to northward.

Prince George Bank, of rock and sand, extends upwards of 2 miles from George point, the south-east point of entrance of Geelong outer harbour. Its north-east extreme is marked by a *red* buoy. Should the buoy be adrift, keep 3 miles off shore in passing this point.

HOBSON BAY, the port of Melbourne, is open to southerly gales, which send in sufficient sea to interrupt traffic. It has good holding ground of soft mud, and small vessels can at all times find shelter off Williamstown. A bank, probably caused by the deposit from the Yarra, extends $1\frac{1}{2}$ miles off the eastern shore; its limits are marked by *white* buoys.

Gellibrand point, the western point of entrance of Hobson bay, has some rocks lying to the southward of it. These are guarded against by a light-vessel moored in 5 fathoms, to be left on the port hand in entering. The vessel is painted red, and shows a *white* light *flashing* every *half minute,* visible 10 miles. A gong is sounded every ten minutes during foggy weather.

Melbourne is on the north side of Hobson bay, and Williamstown on the west side;

there are piers on each side of Hobson bay, where vessels drawing 20 feet water can discharge and load. There are also two patent slips where repairs can be effected.

The Yarra falls into Hobson bay at its north-west angle. It is a narrow winding stream, in which a depth of not less than 11 feet in the channel is maintained to Melbourne quays, by constant dredging. In the lower reaches are banks on each side, the salient points of which are marked by dolphins, *black* on the port hand going up, *red* on the starboard.

Steam tugs are at all times in attendance to tow vessels either in or out the bay, or up and down the Yarra.

At the end of the Sandridge jetty (Melbourne) a *green* light is exhibited; at the end of the eastern jetty a *red* light.

There is electric telegraph communication between Cape Otway, Cape Schanck, Port Phillip heads, Hobson bay, and Melbourne.

GEELONG, also in Port Phillip, and the second port of the colony, is approached from a large arm of the port on its western side. The deep water channel up the outer harbour is near the south side; marked by *black* buoys on the port hand entering, and *white* buoys on the starboard. There is good anchorage off Henry point in 4 fathoms, mud.

The entrance from the outer to the inner harbour is obstructed by a collection of banks forming a bar. On the south side, near Henry point, is a natural channel of 5 feet water, called the Boat channel.

On the northern side a straight channel has been excavated 130 feet broad, having 18 feet water through it; the approach to it is carefully buoyed and its sides marked by dolphins, *white* on the starboard hand entering, *black* on the port. The old channel is north of this; its eastern end is marked by a floating **light-vessel,** painted red, which shows a single *fixed white* light* at night, visible 7 miles; and by day, signals showing the depth in feet in the channel, which is curved, and has 13 feet through it; its sides are marked by *red* dolphins. Having passed the bar, the inner harbour presents a large and perfectly secure basin, having a general depth of 5 fathoms over mud. The town stands on the south side; it has two piers for large vessels and three others for smaller.

The following **tidal signals** are made (1857) from the light-vessel by day, to indicate the depth of water on the Bar:

One blue flag	10 feet.
One ball	10½ „
Ball with blue flag over	11 „
Ball with blue flag under	11½ „
Two balls	12 „
Two balls with blue flag under	12½ „
Two balls with blue flag over	13 „
Two balls with red flag under	13½ „
Two balls with red flag over	14 „
Two balls with red flag between	14½ „
Red flag	15 „

* Should the vessel break adrift, two *red* lights will be substituted.

At **Schnapper point,** on the eastern side of port Phillip, there is a small pier harbour for the convenience of the coasting trade. A *fixed red* harbour **light,** visible 4 miles, is shown from the end of the jetty.

Winds and Weather.—The result of four years' observations on the prevailing winds and weather on the coast of Victoria confirms the following observations of Captain Flinders:—"The progress of the gales is usually this: the barometer falls to 29½ inches or lower, and the wind rises from the north-westward with thick weather, and commonly with rain; it veers gradually to the west, increasing in strength. At S.W. the gale blows hardest, and the barometer rises, and by the time the wind gets to South or S.S.E., it becomes moderate, the weather is fine, and the barometer above 30 inches."

Gales sometimes commence from N.E., thence round by north to N.W., and continue as above described. They are experienced at all seasons of the year, and their usual duration is from three to four days, causing a furious sea along the coast. July, August, and September, are usually the wettest months; but this is uncertain, the largest floods recorded being at December.

Few cities can boast of so rapid a rise as Melbourne. In 1835 its first founders, Messrs. Batman and Fawkner, settled here. By the census of 1841 its population was 4440, by that of 1846 it was 10,945, and by that of 1851, two months before the gold discoveries, it was 23,143. In 1864 the colony of Victoria separated from that of New South Wales.

Melbourne is regularly planned with broad straight streets at right angles to each other, and has many handsome public buildings. Its secure port and central position, with the network of railways and rivers connecting Melbourne with a large portion of Southern Australia, seem destined to command for it the chief export and import trade of an immense pastoral and agricultural district, independent of the demands of the gold-fields, in which new discoveries of great value continue to be made.

By the census of 1861 the population of Melbourne and its suburbs, within a 5-mile circuit, was 117,778. By custom-house returns for 1862, the value of its imports for that year amounted to 12,896,250*l.*; its exports to 11,615,071*l.*; the revenue of the ports to 1,130,757*l.* The principal articles of import are manufactured goods of all kinds, provisions, machinery, railway materials, coal, timber, wine, spirits, &c. The principal exports are gold, live stock, hides, timber, wine, and wool.

The number of sailing ships belonging to the port was 393; aggregate tonnage, 54,009 tons; the largest vessel, 910 tons. The number of steam vessels, 28; their tonnage, 3544; the largest being 605 tons. The number of registered seamen was 12,384. The number of vessels entered during the year, exclusive of coasting vessels, was 1489: aggregate tonnage, 522,832 tons; the largest vessel, 2605 tons. The number of ships cleared outwards during the year was 1513; aggregate tonnage, 53,417 tons.

The principal trade appears to be with the United Kingdom; this is between two and three times that of foreign countries. The inter-colonial trade is about half that with Great Britain and Ireland.

The town of Geelong has broad straight streets at right angles to each other, with large public buildings. Its population, by the census of 1861, was 23,253. The value of imports in 1862 was 390,689*l.*; exports, 1,047,619*l.*; and revenue, 130,065*l.* The number of sailing ships belonging to the port was 22; aggregate tonnage, 1825 tons; the largest sailing ship, 255 tons. Number of seamen, 551.

The chief articles of import are provisions, coal, grain, spirits, and timber. Of export—wool, gold, leather, sheep, and horses. The principal trade is with the United Kingdom and inter-colonial.

The **Moncour Islets,** three in number, bear E. by N. distant 6 miles from Rodondo island; they are bold and free from dangers.

The **Hogan group** of 5 or 6 rocky islands lie about E. by N. from Rodondo island. The largest and most elevated (430 feet high) is in Lat. 39° 13′ S., Long. 147° 1′ E., and is 1½ miles in extent.

Curtis Island, in Lat. 39° 28½′ S., Long. 146° 40′ E., is 2 miles long N.E. and S.W., and 1 mile wide; its southern part is a square summit, whence it slopes away towards the north, on which account sealers gave it the name of "the Slipper." It is visible 30 to 35 miles. From Rodondo island it bears S.E. ¼ E., distant 18 miles.

In 1839 a rock awash, about a mile E.N.E. from Curtis island, and two others (also awash), about a quarter of a mile to the eastward, were reported by Captain Livesay, of the *Pyramus*.

In 1857 the *Clarendon* struck on a sunken rock at half-tide, with 10 feet water on it, the highest part of the east side of Curtis island bearing W. by S., and the inner Sugar Loaf S.W. by S., distant about 3 miles.

The **Sugar Loaf rocks** lie to the S.E.-ward of Curtis island; one is 350 feet high, bearing S.E. by E. distant 1½ miles; and the other 316 feet high, bearing S.S.E. distant 2½ miles; they are of pyramidal form, with deep water close to them, and no known dangers except on the south side of the higher of the two, a small rock being distant from it a quarter of a mile.

Devil Tower Rock lies 8 miles N.N.E. ¾ E. from Curtis island; it is a small, bare, but conspicuous rock, frequented by birds, with no dangers near it.

Crocodile Rock, about 3 feet above high water, with a reef to the N.W. extending three-quarters of a mile, lies 9 miles in a S.E. direction from Rodondo island, and the same distance N.W. from Curtis island; it also bears W. ¼ S. 11¾ miles from Devil's Tower. Capt. Stokes places it in Lat. 39° 21½′ S., Long. 146° 32′ E., and describes it as a smooth, round-topped granite rock, just protruding above the surface, so that in fine weather the sea runs over it without breaking. To avoid this rock, ships from the westward should keep Devil's Tower to northward of E. by N., or the southward of E. by S.

Kent Group, consists of two large islands—Deal and Erith, separated by a channel half a mile wide—and several small islets or rocks.

Light.—On the S.W. of Deal island is a lighthouse 46 feet high, the upper part painted red, and the lower part white; it exhibits, at 950 feet above the sea, a *bright* light, *revolving in one minute and 40 seconds*, visible 36 miles; at 10 miles

distance it is 50 seconds *bright*, and 50 seconds *dark*; but from its great height it is frequently obscured by fog. Position—Lat. 39° 28′ 58″ S., Long. 147° 21′ 36″ E.

Judgment Rocks, so named from the highest resembling an elevated seat, lie W.S.W. 8½ miles from Deal island lighthouse; the group consists of a steep island nearly a mile long, with two small islets, and some rocks to the northward.

The Pyramid, a small flat-topped rock, 300 feet high, is in Lat. 39° 49′ S., Long. 147° 16½′ E., and lies S.S.E. ¼ E. 18 miles from Judgment rock. A sunken reef extends upwards of half a mile from its south side, but otherwise it is safe to approach, having 38 to 40 fathoms between 4 and 5 miles to N.W. and S.W., and 28 fathoms at 8 miles to the eastward, bottom of sand and shells.

The Furneaux Group lie to the S.E.-ward of Kent group, extending 60 miles N.N.W. and S.S.E. **Flinders Island** is the largest of the group, and has several conspicuous islets and some sunken rocks extending from its N. and N.E. extremity; the **Sisters,** to the northward, are lofty, and visible a considerable distance; breakers extend a short distance off the north end of both the Sisters, and a small detached rock lies about a mile S.E. of the northernmost; the other is joined to Flinder's island by a covered reef.

Craggy Island, Wright Rock, and Endeavour Reef, &c.—Between the Kent group and Flinders island is a bank that must be carefully avoided in passing out of Bass strait from the westward, for on it are several sunken reefs. **Craggy island** lies 8 miles W. by N. from the N.W. point of Flinders island; the channel between is free from danger; southward of Craggy island, at the distance of 1½ miles, are 26 to 28 fathoms water. **Wright rock,** 8 miles from Craggy island, in a line between it and the Kent group; being 200 feet high, it is a conspicuous object. There are soundings in 29 fathoms, gravel and small stones, 2 miles N.W. of Wright rock, and the same depth, coarse sand, 5 miles to the northward.

Nearly in a line between Craggy island and Wright rock is **Endeavour reef,** 2½ miles from the latter, and in Lat. 39° 36′ S., Long. 147° 36′ E.; another reef, just awash at low water, lies E. ¾ S., about 3 miles from Endeavour reef, and nearly in a line with it and Wright rock; there is also a sunken rock about a mile east of Craggy island. These constitute the chief dangers between Kent group and Flinders island; "*the extremes,*" says Captain Stokes, R.N., "*are marked to the north and south by* Wright rock and Craggy island, *between which ships should not pass,* although there is a channel close to the south side of the former;" Flinders found 30 fathoms on a coarse bottom, and must have passed very close to Endeavour reef. "The tides here sometimes run 2 knots and set across the channel, S.W. by S. and N.E. by N.; the N.E. by stream at F. and C., beginning a quarter before noon."

The **Channels** between all the groups of islands from Wilson promontory to Wright rock, are safe during daylight in moderate weather, being careful to avoid Crocodile rock; Kent group may be passed on either side. The seaman is again cautioned that for the navigation of Bass strait he should be provided with Admiralty Chart, No. 1695.

Chappell Islands, a cluster of three islands and many scattered islets and rocks, lie to the westward of the S.W. end of Flinders island, and the N.W. end of Barren island. **Goose island** is the westernmost of the group.

Light.—Near the south point of Goose island a lighthouse, 74 feet high, the upper part painted red and the lower part white, exhibits a *fixed white* light at an elevation of 135 feet above the sea, visible 20 miles. Position—Lat. 40° 18′ 41″ S., Long. 147° 48′ E.

There are many dangers to be guarded against in this vicinity.

BANKS STRAIT separates the southern islands of the Furneaux group from the N.E. part of Tasmania, and is 11½ miles wide between Clarke island and the nearest part of cape Portland. There are dangers in the vicinity of the cape, and of the Swan islands contiguous to it. Moriarty bank and rocks on the north side of the strait extend eastward of the south-east extremity of Clarke island to the distance of 4 miles.

Light.—On the north point of the largest of the Swan islands there is a lighthouse 74 feet high, the upper part painted red and the lower part white. It exhibits a light *revolving* every *minute*, and showing a bright flash every 2½ seconds, at an elevation of 110 feet above the sea, and visible 14 miles. Position—Lat. 40° 43½′ S., Long. 148° 8½′ E.*

PORT DALRYMPLE† is the principal harbour on the north coast of **Tasmania**; it is situated near the entrance of the river Tamar, but numerous shoals within make it difficult of access.

Light.—On Low head, the E. entrance to the river Tamar, there is a lighthouse 36 feet high, the upper part painted red and the lower part white.

It exhibits a *bright* light, *revolving in one minute and* 40 *seconds*, at an elevation of 142 feet above the sea, and visible 15 miles; at 10 miles' distance it appears for 50 seconds *bright*, and 50 seconds *dark*. Position—Lat. 41° 3′ 35″ S., Long. 146° 48′ 15″ E.

Caution.—Reefs and banks extend out a considerable distance on the west side of the entrance, so that strangers should always avoid that side, and endeavour to come in with Low head. The greater part of these shoals, as also those within, are covered at half tide; therefore the first of the flood, or even a little before, is the best time to enter port Dalrymple, as almost the whole of the dangers are then visible.

The outermost danger near the entrance of the Tamar is Hebe reef, on which the ship *Hebe* was lost in 1808; it is a quarter of a mile, east and west, and a part of it is nearly dry at low water; it bears west 2$\frac{3}{10}$ miles from the lighthouse; there are 7 fathoms water between it and the mainland to the south.

By making the proper signal, pilots may always be procured when the weather will admit of their going off.

George Town stands on the east bank of the Tamar, 3½ miles from its mouth.

Launceston, also on the Tamar, is 30 miles from the sea; it is the second town in Tasmania, but large vessels cannot approach it, as the river is barred.

On the east side of Wilson promontory, 4 miles from its south end, is **Waterloo bay,** which is spacious, and has a depth of 14 fathoms in it, mud; the north point of the bay is **cape Wellington,** which is also the eastern projection of the promon-

* See Admiralty Chart, No. 1706.

† See Admiralty Chart, No. 1080

tory; 2 miles northward of the cape lies **Refuge cove**, thence to **Sealers cove** is 2 miles further. N.E. by E. from Sealers cove, distant 11 miles, are the **Seal islands,** four in number, and barren; the northernmost and largest is $1\frac{1}{2}$ miles in circuit, and rising in the centre to an altitude of 380 feet. North of Sealers cove, distant 7 miles, is **Rabbit island;** it is a mile long, and the same distance from the main land; and being 200 feet high, is a good mark for vessels from the southward making Corner inlet.

Corner Inlet, 7 miles N. by W. from Rabbit island, is an extensive sheet of comparatively shoal water; the approach to it is over a bar; here is **port Albert,** for which place the following sailing directions have been issued (1854) by the harbour-master, Mr. D. FERMANER:—

In approaching port Albert from the N.E., care should be taken to run down along the shore, from 3 to 4 miles off, until the North Seal island bears S. by E., then steer for the highest white sand hummock on La Trobe island. The depth of water will be from 7 fathoms, shoaling gradually to $2\frac{1}{2}$ fathoms, close into the beach of La Trobe island, where will be seen the outer red buoy, which, with the other *red* buoys, must be left on the starboard hand, and the *black* buoys on the port hand.

In coming from Wilson promontory, care should be taken not to shut Rodondo island in with the end of the promontory, but just close to it.

Marks for the outer red buoy: Mount Hunter, S.W. by W.; Rabbit island, S.S.W.; North Seal island, S. $\frac{1}{2}$ E.; Rodondo island, S. by W. Course in, from the first red buoy to the second, E.N.E.; from the second to the third, N.N.E.

Through the Sylvanus channel the depth of water is from 9 to 10 feet at half tide, earlier than which no vessel should take it; when past the third red buoy the depth of water will be from 10 fathoms to $2\frac{1}{2}$ fathoms up to the port, leaving the buoys the same as in the Sylvanus channel—the red on the starboard, and the black on the port hand.

Light.—A lighthouse, built of wood and coloured white, stands on the eastern end of La Trobe island, in the northern part of Corner inlet, and its approximate position is Lat. 38° 46′ S., Long. 146° 31′ E. From the lighthouse the *outer red buoy,* old channel, bears S.E. by E. $\frac{3}{4}$ E. distant $3\frac{1}{2}$ miles; Cliffy island S.S.E. $\frac{1}{2}$ E., 13 miles; North Seal island S. by E. $\frac{1}{2}$ E., 9 miles; Rabbit island S. by W. $\frac{3}{4}$ W., 11 miles; and point Townsend S.W., $3\frac{1}{2}$ miles.

The light is *fixed red,* varied by a *bright flash* every *three minutes,* visible *seaward* from a vessel when bearing between W. by S. and N.E. Elevation, 40 feet above the sea, and visible 9 miles. At the *distance of* 6 *miles and upwards,* it will appear as a *steady* light for a space of *one minute and forty seconds,* be suddenly *eclipsed thirty-four seconds,* then exhibit a *bright flash for twelve seconds,* and be again *eclipsed for thirty-four seconds,* when the *steady* light will re-appear. When *within about* 3 *miles* of the Light, the *eclipses* will be scarcely observable, a continued *fixed* light being at that distance visible *between the intervals* of the *bright flashes.*

At Corner inlet commences the **Long Northern beach,** which extends in a concave sweep upwards of 160 miles, to the steep projection of **Rame head,** thence to **cape Howe** the distance is 22 miles. The low sandy shore of the Long Reach should be avoided, as it is very dangerous during S.E. gales, which generally come on very suddenly.

Cape Howe, the S.E. extreme of Australia, is a low point of rocks and sand, off which, S.S.W. ½ W., distant 5 miles, is the small island of Gabo; Howe hill, in the vicinity of the cape, rises to an elevation of 1250 feet.

Light.—A circular lighthouse of grey granite has been erected 100 fathoms northward of the S.E. part of Gabo island, and 5½ miles S.W. ¾ S. from Cape Howe. It exhibits a *fixed white* light at an elevation of 172 feet above the sea, visible 22 miles between the bearings of E. ½ N. round by North, to S.S.W. Position—Lat. 37° 35′ S., Long. 149° 55′ E.

Tide.—The flood, after sweeping S.W.-ward along the great beach from cape Howe, strikes off for the Seal islands and Wilson promontory, and then runs to the westward, past it, at the rate of 2 or 3 knots; the ebb sets to the eastward.

HOBARTON AND THE SOUTH COAST OF TASMANIA.

The **South Coast of Tasmania,** comprised between the South-west and South capes, is rugged, abrupt, and barren—being constantly exposed to the storms of the Antarctic regions. **South-west cape** is in Lat. 43° 33½′ S., Long. 146° 2′ E.; and **South cape** in Lat. 43° 39′ S., Long. 146° 53′ E.; the bays between the two capes are open to the south and westward, and consequently afford no refuge from the prevalent winds of the region.*

Several islands and rocks lie off this part of the coast; the **Mewstone** is an islet 253 feet high, with rocks and breakers close around it; its position is Lat. 43° 44½′ S., Long. 146° 23′ E. To the N.N.W.-ward of the Mewstone between it and the mainland—are the **Maatsuyker islands,** the S.W.-ermost of which has reefs with several rocks stretching both to the north and S.W. of it, one of which is known as the **Needle rock.** Between the Mewstone and the Needle rock there are soundings of from 45 to 60 fathoms, but the best route is to the southward of the Mewstone, at 6 miles S.W. of which are 84 fathoms.

South cape is a short, broad promontory, the S.W. point of which is **Three Hillock point,** in Lat. 43° 39′ S., Long. 146° 51′ E.—the most southern point of Tasmania; the eastern point is **Whale head.**

S.W. by S. from South cape, distant rather more than 13 miles, is a rocky reef extending W. by S. and E. by N. for 3 miles; near the west extremity of this reef is the island of **Pedra Blanca** (or Swilly of FURNEAUX), in Lat. 43° 51½′ S., Long. 146° 59½′ E.; near the east end is the **Eddystone,** which has the rude outline of a tower: both islets are bold and cliffy,—and are the most outlying dangers known to exist off the south shore of Tasmania.

N.E. by N., distant 5 miles from the Eddystone, and N.E. 6½ miles from Pedra Blanca, is the **Sidmouth rock,** 100 yards in diameter, with a reef projecting from it about ½ a mile to N.E. There is no bottom with 20 fathoms of line close around it, and the passage between it and the Eddystone appears safe, but should not be used except in an emergency.

Near the middle of the channel, between these islets and rocks, the depth is 60 fathoms, broken coral and shells.

Rurick rock, or islet, was reported by the Russian ship *Rurick,* in 1822; it was

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* All the positions in Tasmania are dependent on Fort Macquarie, Sydney, being in Long. 151° 14′ E.

stated to be in Lat. 44° S., Long. 147° 45′ E., or 29 miles E. ¾ S. from Pedra Blanca.

Between South cape and **Tasman head** is the southern bluff of **Bruny island**, between which and the Actæon islands is one of the entrances leading to the river Derwent, known under the name of **D'Entrecasteaux channel.** The channel is upwards of 30 miles in length, being formed by Bruny island on the east, and the coast of Tasmania on the west side; its breadth is irregular, varying from seven-tenths of a mile to 7 miles.

Light.—On the S.W. point of cape Bruny, and on the east side of entrance to D'Entrecasteaux channel, there is a lighthouse 44 feet high, coloured white. It exhibits a *bright* light, *revolving* every *minute and forty seconds*, at an elevation of 335 feet above the sea, and visible 22 miles. Position: Lat. 43° 29½′ S., Long. 147° 10′ E. At 10 miles' distance it appears for 50 seconds bright, and then 50 seconds dark.

Recherche bay, on the west side of the channel, is about 3 miles wide and 2 miles deep. In this bay there is anchorage in 12 fathoms water, at about three quarters of a mile northward of Arthur point, in Lat. 43° 34′ 50″ S., Long. 146° 56′ 30″ E.

Some rocks, called the **Images**, lie off **Sullivan's point**, the north point of Recherche bay, extending a considerable distance from the shore, some of which are even with the surface of the water, and others tolerably elevated. Nearly a mile to the eastward of these rocks is a blind or sunken **reef**, on which the sea breaks, with a depth of 13 fathoms near its south end, and 16 fathoms between it and the Images; the reef bears from Arthur point N.E. ½ N. 1½ miles. Nearly a mile further in the same direction lies another, called the **Black reef**, about a mile distant from the coast; between these and the coast there are from 8 to 10 fathoms water.

The **Actæon Islands** and reefs lie about 3 miles to the N.E.-ward of Recherche bay, and consist of two islands lying nearly north and south from each other, with reefs and breakers extending from them in a southerly direction. Actæon island is the largest and northernmost; from its south end a reef extends nearly ¾ of a mile in the direction of a smaller island named Sterile island, the east and west sides of which are fronted with rocks, and an extensive reef projects from its south side to the S.S.E. 1½ miles. There is a narrow passage with 4½ fathoms water between the N. end of Sterile island and the southern extremity of the reef extending from Actæon island. At ¾ of a mile E. by N. from the south end of this reef lies a small patch, called the **Deep Water bank**, with 7 fathoms close to the eastward of it. The **South Break** of the Actæon reefs bears from Whale head N.E. ½ N. 6¼ miles, and from Arthur point E. ½ N. 3 miles. Vessels working in the channel must be careful to keep the lead going, and not approach those dangerous reefs to less than a depth of 20 fathoms.

About 6 miles to the northward of Recherche bay is **Southport** or **Muscle Bay**, having a small island and some rocks off its southern point,—the southernmost of which is called **Blanche rock**, which is dangerous to approach. Southport is about 2¼ miles deep to the westward, with 14 fathoms in the middle, and 6 fathoms near the shore on the south side. To the southward of some islets or rocks that lie well up the bay, there are 4 or 5 fathoms, on fine grey sand. Close to the north point of this bay, named Rossel point, is a small rock above water.

N. by E. 6½ miles from South port is the entrance of port Esperance, about 1¼

miles wide, and more than $2\frac{3}{4}$ miles deep in a westerly direction. At a mile within the entrance there is a small island, named Hope, of half a mile in extent (and covered with trees), with a small islet lying near to its north side; between which and the north point of entrance there are from 15 to 7 fathoms water.

Bruny Island is about 9 leagues long, and of very irregular form, having several isthmuses, the most remarkable of which separates Isthmus bay from that of Adventure on the east side of the island. The land is unequally elevated; some parts, rather high, are remarkable for their geological character. Fluted cape, among others, and that part of the coast which is joined to it to the southward, presents to the eye an abrupt cut, which appears composed of immense basaltic columns; vegetation is vigorous everywhere. Many deep bays afford good anchorage; Great and Little Taylor bays, Isthmus bay, and that which runs to the N.E. of cape Le Grand, all on the west side of the island, are capable of receiving the largest vessels. Great Taylor bay is spacious, and consequently but little sheltered from the winds. The coast on the outside of Bruny island presents two remarkable bays; one, called Cloudy bay, is exposed to all the fury of the S.W. winds; the other, called Adventure bay, is, on the contrary, an excellent place for shelter with the winds from that quarter. At all seasons an abundance of fresh water is found.

The soundings in the middle of D'Entrecasteaux channel are from 6 to 23 fathoms, on a black muddy bottom, and the navigation is not difficult.

The following **Directions** for the entrance of D'Entrecasteaux channel, on coming from the S.W., are by Commander George King, R.N., when port officer at Hobarton:—Vessels coming from the westward, unless a pilot has been received on board, are recommended in no case to pass between the Actæon reefs and the western shore; but having arrived abreast of Whale head, they are to bring that head to bear S.W. by W. $\frac{1}{4}$ W., and not open it to the southward of that bearing before the lighthouse on cape Bruny bears N. by E. $\frac{3}{4}$ E., at which time the S.E. break of the Actæon reefs will bear W. $\frac{3}{4}$ N. distant $2\frac{3}{4}$ miles, which must not be approached nearer, unless the vessel be in charge of a pilot; from that position a N. by W. course will keep her in mid-channel, where no danger exists.

In baffling or contrary winds, vessels should keep to the eastern shore, which may be approached boldly. Several reefs and rocks being on the western shore, higher up than the Actæon reefs, it will be necessary to approach that shore with great caution, until South port, formerly Muscle bay, opens out, and the light on cape Bruny is brought to bear E. $\frac{1}{2}$ S.

Vessels working in the Channel must be careful to keep the lead going, and not approach the Actæon reefs to less than a depth of 20 fathoms. After having passed South port, the shore on either side may be approached to half a mile.

Captain J. Welsh, who surveyed the south part of D'Entrecasteaux channel in 1825, says:—This channel, which affords at once the safest shelter for shipping, perhaps, in the world, is not to be recommended as a passage for ships bound to Hobarton, except in the summer season, when dependence may be placed on the sea-breeze, as the following observations will demonstrate. In making the land from the westward ships have frequently taken this passage, as affording immediate anchorage, secure from all winds; but they are likely to be detained several days before they can reach Hobarton. The detention is caused by the direction given to the wind, even when it blows strong at sea from the S.W., by the very high hills


HOBARTON
Nautic Miles
0 1 1 2
Lat. 42°53' 32" S.
Mt Wellington
Sandy B.
Sandy B.Pt
One Tree Pt
Mt Nelson
Range of Forest Hills
Crayfish
Sharp Hill
Brown R. Settlement
Kingston
Blackman B.
Margate
Howden
Flowerpot Pt
NORTH-WEST BAY
Mt Louis
Snug R.
Snug Bay
Snug Pt
Oyster Cove
Little Cove
Flight B.
Trial B.
Perch B.
Apolla Bay
Barnes B.
Petchey Cove
Simmond Bay
Yellow Bluff
Sykes Cove
Bull B.
Kelly B.
One Tree Pt
C. Delasorte
Tinder Box B.
Trywork Pt
Jane Pt
Oposman Bay
Half Moon Bay
South Arm
RALPH BAY
Maria Pt
Mortimer B.
Mt Augustus
Mt Mather
Single Hill
Goat Bluff
Hope Reach
C. Direction
Iron Pot
BETSY I.
Betsy Rks
Breaks in heavy weather
Var. 10° 31' E.
MAG.

and deep openings that line the western coast of the channel; such as South port (Muscle bay), port Esperance, the Huon, and the opening to the river above Green island, each of which gives a distinct course to the wind. Experience proves that the passage to Hobarton by Storm bay is preferable. I have, in several voyages to this colony, found great advantage by taking this route, and strongly recommend all commanders to follow it.

From **Cape Bruny** to Tasman head the bearing is east, distant nearly 8 miles. **Tasman head** is high and abrupt, being composed of basaltic pillars, and nearly a mile to the southward of it there are several islets. The two easternmost, called the Friars, are bare pyramidal rocks, of a black weather-beaten colour; a patch of breakers lies one mile to the N.E. from them.

From Tasman head to **cape Pillar** the distance is 35 miles in a N.E. $\frac{1}{8}$ E. direction. Between these points is the entrance to **Storm bay**, in the N.W. corner of which, between **cape Delasorte**, the north end of Bruny island, and **cape Direction**, lies the entrance to the river Derwent. Seven miles N.E.-ward from cape Direction is the mouth of **North bay**, leading to Pitt water and Norfolk bay. On the western shore is **Adventure bay**, the south point of which, named Fluted cape, is high, steep, and projecting, composed of basaltic columns, and covered with trees, and adjacent to its northern part is Penguin island, of moderate height, and also covered with trees. This was surveyed by the French in 1793, who give the latitude of Penguin island in 43° 20′ 38″ S. There is anchorage nine-tenths of a mile S.W. by W. $\frac{1}{2}$ W. from Penguin island in $11\frac{1}{2}$ fathoms water, at the distance of 4 cables' lengths from the point, near which are two rivulets of fresh water; also in 13 fathoms, on sandy bottom, with Penguin island bearing E.S.E. $\frac{1}{2}$ E. distant half a mile, and cape Frederick Henry N. by E. $\frac{1}{2}$ E. This bay is a good place of shelter from S.W. and westerly gales.

The entrance of the **river Derwent** between cape Delasorte and cape Direction is about $2\frac{1}{2}$ miles wide, and continues of the same breadth for 5 miles, to the south point of Ralph bay, which extends six miles north and south, with an entrance of $1\frac{1}{2}$ miles wide, and the soundings from 7 to 2 fathoms.

Vessels from the westward, bound into the Derwent, through Storm bay, ought to give Tasman head a good berth, in order to avoid the islands and rocks lying off it before described. In proceeding northward past Fluted cape, the most remarkable object will be mount Table, which is very high, and in appearance resembles the mountain of the same name at the cape of Good Hope.

Advancing up the bay, **Betsy Island**, which is high, soon appears in sight, when a course may be steered for a small rocky islet, named the **Iron Pot.**

Lights.—A square lighthouse, 40 feet high, and coloured red, is established on Iron Pot island, in the mouth of the river Derwent. It exhibits a *fixed white* light at an elevation of 65 feet above the sea, visible 10 miles. Position.—Lat. 43° 3′ 45″ S., Long. 147° 26′ E.

Between the Iron Pot islet and cape Direction there is only a passage for small vessels. Having now entered the Derwent, steer about N. by W. for a low sloping point on the port hand, and when abreast of it, the town will open in view to the westward.

There is no danger all the way up, and ships may stand within half a cable's length on either side; the holding-ground is good in every part, and the depth of water nowhere exceeds 18 fathoms. The anchorage is called **Sullivan cove,**

although it is merely a bend of the land; here there is a *fixed red* light on the pier-head. The anchorage is good anywhere off the town in from 12 to 9 fathoms, on soft mud; but care must be taken to give the jetty, where the wharfs are, a good berth, as there is a ledge of rocks extending to the eastward a cable's length, over which there are only 10 feet at low water.

HOBARTON stands on the west bank of the river, about 11 miles from cape Delasorte, on a gently sloping plain, at the foot of mount Wellington. About a mile to the northward of the town stands the Magnetic Observatory.

Risdon Cove is 4 miles higher up the Derwent; there the river becomes contracted in breadth to less than half a mile.

The **tides** in the Derwent, and all through D'Entrecasteaux channel, seem to be very irregular; "in the Derwent they are much influenced by the freshes and prevailing winds; should there be a heavy flood during the winter months, and strong S.E. winds prevailing outside Storm bay, the rise in Sullivan cove will be sometimes as much as 14 feet; but there always appears to be a surface set down the river, and it runs down much stronger on the northern side. Should a vessel have a working wind, and after passing the Iron Pot lighthouse, I should advise keeping along the south shore until close up to Sandy point, as an eddy appears to run up on this side; the shore is quite bold, and you may stand to half a cable's length, and by making short tacks on this side, you will avoid the fresh in the centre and north sides of the river; I have known the fresh running down four knots over a flood tide."—(Mr. C. J. POLKINGHORNE, H.M.S. *Fantome*, 1852.)

Betsy Island, about $2\frac{1}{2}$ miles to the eastward of cape Direction, is high, and accessible only towards its north end; its length is about $1\frac{1}{4}$ miles, and mean breadth about half a mile. Two flat rocks lie near the main to the northward of it; and at three quarters of a mile to the southward of its south point, off which is a small islet, there is a dangerous rocky reef.

The ground in Storm bay consists of fine red sand, with black specks, mixed with small broken shells. The depth of water at half a mile from cape Raoul is 50 fathoms, whence it gradually decreases towards Bruny island, there being in the middle of the bay 35 fathoms; and in a direct line from thence, about N. by W. to Betsy island, it shoalens gradually to 25, 16, and 12 fathoms. In crossing towards the Derwent the bottom becomes muddy, which is generally found to be the case where there is any run of fresh water. This is corroborated by the remarks of MR. R. SKINNER, who commanded H.M.'s store-ship *Dromedary*, in January, 1820. He says, "In approaching Betsy island, the water shoals gradually from 40 to 30, 20, and 10 fathoms. Between cape Frederick Henry and cape Pillar there are from 45 to 50 fathoms, on sandy bottom; so that in calms or light winds vessels may, if necessary, anchor with a stream or kedge until they get a breeze. During a great part of the summer season, when the weather is fine and settled, sea and land breezes generally prevail, the land breeze coming off between 8 and 10 o'clock; both these changes are preceded by an interval of calm or light airs for two or three hours.*

* The land and sea breezes prevail from November to April; from January to March, the N.W. winds come in very hard squalls.

The navigation seems perfectly safe and easy even for strangers, as there appears, as far as my observations and inquiries enabled me to judge, no danger in entering, or sailing up or down the river Derwent by daylight. Cape Direction appears at a short distance like a low island."

Coming from the eastward, after rounding cape Pillar and cape Raoul, steer over towards cape Frederick Henry, and sail up along that shore, which is a direct guide to the entrance of the river Derwent. If with a beating wind, work up along the same shore, in order to avoid the outset from North bay, which, with a N.W. wind, is strong.

Should the wind come to blow hard from the N.W. when off Betsy island, so as to prevent a ship from working into the river, she may obtain good anchorage either in Adventure bay or North bay.

Ships bound to sea from the Derwent, and caught in Storm bay with a S.E.-ly gale, may find safe anchorage in the north entrance of D'Entrecasteaux channel, between the north end of Bruny island and Pierson point, in 9 fathoms water, on good holding ground.

From **cape Raoul** to **cape Pillar** the distance is 9 miles E.N.E. ½ E. Between these two high columnar capes the shore falls back and forms a bay, called port Arthur. It is about 3½ miles N.E.-ward of cape Raoul, and the entrance is about two-thirds of a mile wide, from whence it extends to the N.N.W. about 3½ miles. The eastern shore is nearly straight, but on the west side there are some good coves, capable of affording excellent shelter for the largest ships; the first of these is named Safety cove, the next Opossum bay, in the N.W. part of which there is a little creek, called Stewart's harbour. The depths are from 26 fathoms in the middle, to 8 or 7 on each side. Captain J. Welsh says, "This harbour, affording shelter for any number of shipping, is easy of access. The bays on the west side afford good anchorage; fresh water is easily procured; it abounds with fish of various descriptions; and excellent timber of gum stringy bark, light-wood, and sassafras, in great quantities, can be had conveniently. With the exception of Safety cove, all the heads of the bays are surrounded with soft banks of sand and mud, most of which dry at low water. The harbour is surrounded by an amphitheatre of lofty mountains, which extend from cape Raoul to Dolomieu bay, and form a sort of barren chain or barrier, about three miles from the shore."

REPORTED ISLANDS AND SHOALS—DOUBTFUL DANGERS, VIGIAS, ETC.

THE following Catalogue contains the *names* and *approximate positions* of nearly all the *rocks, banks, shoals, breakers*, &c., that have, at different times during the last century and a half, been reported as existing in the Indian ocean—exclusive of those which, bordering on the mainland, are noticed in the Sailing Directions. The chart of this ocean has never been disfigured by *vigias* to the same extent as that of the North Atlantic; nevertheless, when they are all looked up, they present a formidable array. Of the entire list, probably not more than two or three in the northern part of the Indian ocean are worthy of notice—as the GLENDINNING shoal, &c.

That some of these reported dangers are fictitious is probable, for it must be told with regret that both islands and shoals have at times, and recently too, been announced with great pomp and circumstance merely for the sake of notoriety—very unenviable in such a case; others are given on *hearsay* evidence of the vaguest character; while some unquestionably represent what is described, but greatly in error as to position. The latter is no supposition, remembering the reliance once placed on *dead reckoning;* and, as a case in point, it is well known that the Hon. E.I.C.'s ship *Derby*, bound from the Cape for Bengal in 1719, made the islands off the west coast of Sumatra, and thought them to be the Maldivhs, having made 57° 24′ east meridian distance from the Cape. Thence, with S.W. and S.E. winds, she proceeded southward and called Trieste island—a supposed new discovery—Gama island, stating it to be the southernmost of the Maldivhs; still proceeding southward to get round the *supposed* Maldivhs, and having made 60° 40′ meridian distance east of the Cape, being then in Lat. 7° S., she spoke a ship, from which she learnt that the low land in sight was Clap's island on the south coast of Java. On the subsequent voyage (1720) she made an error in the opposite direction, sighting Manapar point with the church and flagstaff on a N.W. by W. bearing, and at first mistaking it for the east coast of Ceylon.

It is well, however, for the navigator, when he approaches the neighbourhood of *any reported danger*, to be on the alert, and should he see what *appears to be a rock*, make some small effort in the cause of hydrography to satisfy himself and his brother seamen whether it may not be a wreck, a whale, or some floating substance, such as, when viewed from a distance, has been frequently mistaken for a rock or shoal until closely examined; instances of such mistakes are numerous. Thus, from WILKES' "Narrative of the United States Exploring Expedition" (1838—1842), it is related that when in the vicinity of St. Anne's shoal, Lat. 38° 8′ N., Long. 34° 3′ W., he resolved to sail over its assigned position. "We passed over it, the sea was smooth, the horizon clear, and the day beautiful. At 8 A.M., the look-out cried out, 'Rocks or a wreck on the starboard bow!' which at once created an excitement on board. We stood for it. It had at first every appearance of a rock, then that of a wreck with the masts gone. It proved, however, to be a large tree of

cotton wood, one hundred and twenty feet in length, and 14 feet in circumference at the height of five feet above the roots. It had been a long time in the water, was full of barnacles, and much eaten by the teredo navalis. Great quantities of fish were about it, consisting of dolphins, sharks, &c., we did not, however, succeed in taking any. In rough weather it might easily have been mistaken for a rock, particularly if passed in twilight, or at night."

The following observations by CAPTAIN WINGATE of the iron ship *Sarah and Emma*, on the facility there exists for mistaking floating wrecks, &c.—when viewed from a distance—for rocks, deserve the consideration of shipmasters, who, it is to be feared, have too often heedlessly reported a rock or other danger in the open ocean, when, in the majority of cases, the point would have been definitively settled, by putting the vessel temporarily four or five miles out of her course:—

"While I am writing to you, I may as well mention two other circumstances that occurred on the same passage.

"In the Java sea, 21st November, 1863—at 10.30 A.M. officer of the watch reported 'sail on starboard bow,' which on a nearer approach I took for an island, having trees on it distinctly visible; of course I thought it a new discovery, as in my then position, nothing appeared on my chart 'latest and best.'

"At 2.30 P.M., wind being light, I sent second officer in a boat to ascertain the nature of it—then about $1\frac{1}{2}$ miles off. According to his *description* it was—a solid mass of roots of trees entwined together; eighteen trees on it averaging twenty-four feet high, the largest being one foot in circumference—cabbage or palm trees—left on it ship's name; Lat. 4° 54′ S., Long. 106° 36′ E.

"Again—28th February, 1864, at 8.30 A.M., saw something on starboard beam about $1\frac{1}{2}$ miles off, bore down to it and found it to be about 40 feet of the after end of a vessel, bottom up, and from appearance should think it about half the original; by the way the broken part of the timbers and planks were worn, as well as by the large amount of barnacles and weed on it, think it had been a long time in the water; no copper, or sign of any, having been on—Lat., at noon, 40° 11′ N., Long. 32° 11′ W.; difference from 8.30 A.M. 8′ N. 11′ E.—position of wreck, 40° 3′ N. and 32° 22′ W.

"I have mentioned this from my attention having been drawn to a notice in your 1863 magazine, p. 125, concerning the 'defined position of Gough's rock.'

"Now I do not dispute the existence of said rock, and in that particular locality, but I do positively say that my floating mass was seen and passed within twenty feet, and most assuredly had there been any sea on at the time I should have taken it for *a fixture at least*, because I believe it would have caused a *heavy* break around it; for although there was little wind at the time, the water comparatively smooth, still, with the hollow part down, there was quite a break caused by the sea running up both sides of the run or quarters, and there meeting the splash from the wide open part as it rose and fell, and the water rushing into it and the rebound. Any one knows what a ripple a boat bottom-up will cause by its motion on the surface of the water.

"By appearance I should think it part of a vessel of about 150 tons or so. Now a rock most certainly would not shift, but may not my floating mass have been more to the eastward twelve months before, and I think there is a deflection of a part of the Gulf Stream somewhere in this locality—but that I leave to your calculation."

If shipmasters would only take a little trouble in order to verify their questionable *new discoveries*, we should then see more frequently than we do reports such as the following, which justify the remarks of CAPTAIN WINGATE :—

"Schooner *William Inglis*, CAPTAIN SMITH, Sept. 6th, 1855: Lat. 37° 43′ N., Long. 35° 11′ W., at 2 P.M. saw what we took to be breakers on the starboard bow; luffed up and ran close to: found it to be a large ship (800 tons), bottom up, copper bottom, copper quite fresh and bright."

"On my passage from Figueira for St. John's, on the 25th of June, in Lat. 45° 40′ N., Long. 29° W., I saw something to leeward, which I took to be a rock, standing about 3½ feet out of water;—put the vessel about, to make sure. Coming near to it, found it to be an iron buoy. From the water to the top it very much resembled a flat topped sugarloaf. Thinking it might be seen again in hard blowing weather, and be taken for a rock—as I could have believed it was had it been blowing strong at the time—I resolved to get it on board, which I did, but not without getting my boat out, and with great difficulty, the lower part being very much covered with barnacles, some as long as nine inches. Dimensions of the buoy about 5 feet long,—3½ feet out of the water; 10 feet round the base, 4½ feet round the top, quite tight from leakage, no mark of any kind upon it; apparently had been coal tarred. I believe it has been a fairway buoy of some gatway, or a warning buoy of some rock; apparently been in the water some time.—S. THOMSON, schooner *Eclipse*, of Great Yarmouth."

"The wreck of a barque was passed in the channel, September 19th, in Lat. 49° 21′, Long. 6° 18′ W., colour similar to that of submarine rocks, covered with seaweed."

"April 3, 1864, Lat. 36° 30′ S., Long. 40° 20′ W., at 1.30 P.M., passed within a quarter of a mile of a large iron tank, or buoy, floating with one end about 10 feet out of water, having five streaks round it, two white and three black, each about two feet deep; when it lifted out of water with the swell, could perceive grass on the lower part two or three feet thick; this at a distance, or during the night, might be taken for a rock."

These are instances enough to show how cautious the navigator should be before he stops the way by an uncertain danger.

It may not be amiss, however, to quote in this place the remarks of the late hydrographer, ADMIRAL WASHINGTON, on *Vigias*, in his "Instructions to Surveyors":—

"The constant endeavour to pass over the places of all the Vigias which are marked near her track in the charts, should be considered as one of the prominent duties of a surveying-vessel. Multitudes of those imaginary dangers are circumstantially described, and are traditionally inserted in all our ocean charts, and from which they ought not to be expunged without the most satisfactory evidence of their non-existence, within wide limits of their alleged positions. It is true, that pieces of wreck, sleeping whales, shoals of fish, and sundry other floating substances, may account for a large proportion of these pretended rocks; yet, on the other hand, the mighty operations which are perpetually and silently going on in nature's great laboratory, and which are occasionally manifested by the protrusion of a real rock above water—and again by its withdrawal—should teach us not to be too sceptical as to the former existence or future confirmation of some of them.

"A full day will, therefore, be well employed in every such search; and, as it is

incredible that in very deep water any rock should rise like a column perpendicularly from the bottom, the search must be accompanied by some deep sea casts, say to 1000 fathoms at least, in order to strike some part of the slope.

"With the like object in view, the observant seaman will keep his eyes open to every unusual appearance in the sea—such as partial ripplings, and, when out of the reach of rivers, to all discoloured water, whether white, brown, or green, flocks of birds, or shoals of fish, as they may possibly be indications of some change in the nature or depth of the bottom; and in all such cases a deep-sea cast of the lead should be obtained."

Name of Rock, Bank, &c.	Lat.	Long.	Date.
Gauntlet bank	50° 50′ S.	77° 30′ E.	1853
Cook island (? iceberg)	50 40	53 35	1863
Herron island (? iceberg)	44 41	48 14	1855
Marseveen island (? iceberg)	41 25	20 50	
Denia island (? iceberg)	40 42	20 25	
Nachtegal rock	40 35	54 5	
„	40 20	52 50	1861
Wellington shoal	39 53	71 43	1817
Hudson shoal and rock	39 52	35 13	1864
Comala reef	39 42	65 50	1836
Canning bank (88 fathoms)	39 40	26 43	1827
Vikingen shoal	39 39	68 32	1858
Slot van Capelle	38 20	43 27	1732
„	40 0	43 30	„
„	36 30	41 0	„
„	37 24	38 47	1748
„	„	41 55	„
„	37 24	38 47	1754
Albion bank (centre)	38 24	18 1	1822
Telemaque rock	38 11	21 56	1786
„ breakers	37 57	23 0	1816
„ rock	38 12	22 0	1818
Barkers' rock	37 40	32 0	
Marion reef	37 26	26 55	1853
Brunswick soundings	37 20 to 37 30	36 19	
Atalanta shoal	37 0	52 0	
„ reef and rocks	36 44	51 52	1818
Atomatia soundings	36 35	41 8	1801
Union rock and reef	35 23	41 29	1812
Maenevins shoal	35 22	41 20	
Augusta or Otter shoal	33 44	36 7	1765
„ „	33 56	36 0	1810
„ „	33 43	36 30	1830
Fortune shoal	33 8	43 0	
Dutch bank	31 44	44 0	1795

Name of Rock, Bank, &c.	Lat.	Long.	Date.
Romeiro island	28° 50′ S.	70° 10′ E.	
Belliqueux soundings	28 43	42 26	1801
Danish bank	28 30	98 20	
Hagus rocks	28 20	42 13	
Irma breakers	28 8	43 6	1788
St. Juan de Lisboa	27 30	52 40	
Cloates island	22 0	112 37	1719
„	22 7	112 23	1743
Moffat shoal	21 37	112 25½	1818
Tryal rocks	21 0 to 19 30	103 34 to 105 44	1718
Harcourt soundings (40 fathoms)	21 0	106 23	1770
„ (75 fathoms)	20 54	105 25	1789
E.S.E. of Rodrigues	20 30	65 50	
Anacreon reef	17 30	65 20	
Brandon shoal	16 20	62 30	
Rajaswarre shoal	11 25	52 2	1858
South Roquipiz island	10 25	64 30	
Grafton (sunken) rock	10 20	81 20	
„ „	„	82 20	
Glendinning shoal	9 54	97 50	1860
Apaluria island, or Pulo Vareira	9 30		1712
„ „	9 50	84 30	1719
„ „	9 22		1731
„ „	9 37	85 57	1770
„ „	9 30	89 14	1800
St. Michael's bank	8 0	59 10	
London bank	8 0 to 6 0	76 40	
Candy island	8 0	76 45	
Adu island and reef (centre)	5 25	76 25	
George island	7 10	60 50	
North Roquipiz or Bridgewater island	6 24	60 0	1812
Rose Galley rocks	5 30	61 52	1746
Swift Bank (18 to 35 fathoms)	5 17 to 4 35	61 5 to 61 30	1744
Gama island	2 10	76 10	
Bonvouloir island	0 50 S.	74 55	

Ouro or Grenville island	0 42 N.	80 54	
„ „	0 55	81 30	1728
„ „	1 0	82 0	1799
Louvre shoal	4 4 N.	94 40	1848

ARABIAN SEA.

NAME OF ROCK, BANK, &c.	Lat.	Long.	Date.
Futtay Rahimon rock and soundings	9° 19′ N.	76° 21′ E.	1834
Jack reef	10 10	63 40	1863
Bank	10 15	54 0	
Rock—off Perim island—Red Sea .	—	—	1858
Shoal	13 20	58 0	
Elizabeth bank	17 0	71 20	
Shoal	17 20	59 55	
Mary breakers	19 45	69 20	
Shoal	22 15	63 0	
Arabian shoal	22 15	63 50	

BAY OF BENGAL.

Vespasian soundings	5° 7′ N. to 4 7	83° 41½′ E. to 83 38¾	1861
Bale of Cotton rock	5 22	88 2	1767
„ „	5 18	87 48	1794
„ „	5 18	88 20	1797
„ „	5 18	88 20	
Anna Maria shoal	10 24	97 10	1849
Planet shoal	16 25	84 10	
„	16 23	84 51	1861
Gore bank	17 26	85 51	1832

AUSTRALIA—S. COAST.

Shuttleworth reefs	38° 30′ S.	137° 15′ E.	
Island—old Admiralty Chart . . .	38 30	127 0	
Hammant island	36 27	137 2	1817
Brockman's reefs	36 30	137 0	1831

Gauntlet bank.—CAPTAIN INGLIS, of the *Gauntlet*, reported "a bank, the water suddenly becoming of a muddy appearance." Probably dissolving ice.

Cook island.—Reported by CAPTAIN H. C. CLEAVER, of the ship *Captain Cook*, as "islets having the appearance of two haycocks, with rounded summits." Probably icebergs, of which several were in the vicinity before and after.

Herron island.—The following is the very unsatisfactory report made of this supposed discovery:—"On the 9th September, 1855, the sea was high, with thick

snow showers, and heavy clouds to the eastward, but clear to the westward; by observation the ship was in Lat. 44° 41′ S., Long. 49° 51′ E. On the morning of the 10th there was a heavy swell, with snow squalls; swell from the westward. At 0·30 P.M. saw land a-head, bearing E.S.E., distant about 15 miles; concluded it to be the Crozets, from the very vague directions given concerning their position. When the land was seen the ship was 90 miles (by good observation) north of the most northerly position assigned to these islands by any authority in possession of CAPTAIN HERRON (which was HORSBURGH'S Directory, latest edition). The ship was hove to till sail could be reduced, then stood to the southward, close hauled, under double-reefed topsails and courses; had frequent snow squalls. At 3.15 P.M. saw land on the port bow, which the ship could not weather; wore her, and stood north-westward in the hope of clearing it on the other tack. At 6.15, the land was indistinctly seen; wore ship again, and decided to hold her to windward through the night, within the space we had traversed during the day; at midnight the squalls were much lighter, but the weather very thick. While in the act of wearing ship, the wind shifted to west; kept the ship to southward, with a good look-out; saw the land indistinctly to leeward, bearing east, distant about 8 miles; weather more moderate; set more sail; kept a S.E. course, true, with the intention of continuing so for 50 or 60 miles, in order to pass the two easternmost islands at a good distance; during the night thick fog, but clear at intervals; Lat., by observation, 45° 50′ S.; position of the land seen at 0.30 P.M., Lat. 44° 41′ S., Long. 50° E. On the 11th September, the weather was squally and unsettled; ship surrounded with sea-weed, water discoloured, and numerous land birds about, and every indication of being in the vicinity of land."

The Crozets were sighted shortly afterwards, but the position of Penguin island, according to their observations, was 1° 46′ more easterly than its true position, consequently the discovery, if it had been an island, was in Long. 48° 14′ E.

As to the probability of islands being near the parallel of 45° S., and between the meridians of 48° and 52° E., the tracks of thirty-four vessels (bound to the Australian colonies), are given in the *Mercantile Marine Magazine*, Vol. IV. (1857), and some of these must have reported them had anything of the kind been in the vicinity of the track of the *Ben Nevis*.

CAPTAIN JARVIS (of the *Irene*) shortly afterwards published the following remarks on these supposed islands:—

"Seeing in a London publication, shortly before leaving home, that CAPTAIN HERRON, of the White Star liner, *Ben Nevis*, had fallen in with an island 110 miles to the northward of the Crozets, I noted the same in my chart, and when in that parallel of latitude, had a good look-out kept for it, when, north of the supposed island, instead of seeing land on the starboard-hand, to my great astonishment I perceived what appeared to be land on the port-beam, about 20 miles distant, and apparently extending about 30 miles in length. Not satisfied, and the water being perfectly smooth, I hauled the ship up, and stood towards it; shortly afterwards, what appeared to us mountains covered with snow, changed their form, and formed themselves into a straight line, tinged with white clouds, which all on board imagined was snow. Keeping the ship still nearer, we plainly perceived it to be nothing but a fog-bank; kept the vessel still in her course, and in about half an hour afterwards she was enveloped in a dense fog, which lasted 3½ days. Had CAPTAIN HERRON'S statement, respecting the position of the supposed land, been correct, I

must have fallen in with it. I merely make this communication, being of opinion that no such island exists in the position as stated."

But there are *appearances* over some extent of the Southern Indian ocean, which go far to give the impression of being close to land, and it is of very common occurrence for captains to record notices of birds, whales, and abundance of seaweed (*See* p. 214—216.) Captain Boyd (of the *Sir Ralph Abercrombie*), a most accurate observer, remarks:—"The noise of penguins, together with the sea being so green, and lots of fungi matter floating on the surface of the sea, and the thick foggy weather prevailing, did I know the existence of any land hereabout, I should certainly say we were not far off it—also about midnight and during the morning we had a very long ground swell, which is not to be seen except about land after strong winds."

In 1851, Captain W. Phinney, of the *Gertrude* (American), reports kelp and seaweed from October 5th, in Lat. 46° 7′ S., Long. 81° E. to October 10th, Lat. 45° 4′ S., Long. 103° E.; and on October 7th, says, "should think there must be land somewhere in this vicinity, from the great quantity of kelp seen for three days past."

Captain S. P. Griffin (American ship *Tarolinta* 1851), in reference to the same subject, says:—From 66° E. to 104° E., on or about the 47th S. parallel, the water had a dirty, shoal appearance, like that on soundings inside the Gulf Stream along our own coast. The swell ran in parallel lines somewhat like the beginning of a breaker. The dense fog that prevailed most of the time, I thought, went far to account for so strange an appearance; but as the same was observed when the atmosphere was clear, I was at a loss to reconcile it without the existence of a bank of soundings. . . . . After arriving in port Phillip, I learnt from several captains that they had observed a similar discoloration. Comparing the information thus received, I found it extended over a surface of ocean lying in a south-easterly direction, say from Lat. 41° S., Long. 40° E. to Lat. 54° S., Long. 120° E.

Captain Cass, of the *Caduceus*, says:—"We continued to fall in with ice, edging to the northward of the Crozets to get clear. On January 8th, in Lat. 45½° S., Long. 45½° E., in another dense fog, we fell in with icebergs, and were compelled to go easy."

Additional testimony is abundant, all tending to the same effect, viz., that over a linear distance of 30 to 50 degrees of longitude, seaweed and birds are frequently seen, that the water has a discoloured appearance as if in soundings, and that fogs are very prevalent; there are also two records of earthquake shocks. Captains not unfrequently enter in their logs, when noticing the discoloured water, that they should like to try a cast for soundings, "but the wind being fair, they are unwilling to heave-to." If an opportunity offers for taking a cast of the lead, they would do well to try.

It must be borne in mind, that fog-banks and clouds often assume the most fantastic shapes, and that both these and icebergs have frequently been mistaken for land by the most experienced eye. Now, fogs are very common in the neighbourhood of the Crozets, and icebergs are often encountered much further to the north than these islands lie.

Marseveen and **Denia islands** were sought for by Captain Cook, and not found by him. They were probably icebergs.

Nachtegal rock.—This reported danger, long supposed to be doubtful, was again supposed to have been seen by H.M.S. *Sphinx*, in March 1861.

Wellington shoal.—"Spots of discoloured water, with apparently 8 to 10 or 12 fathoms water over them, resembling coral shoals; sailed 7 miles among these patches, which were separated from each other by about 100 to 200 yards, and none of them appeared above 60 or 70 yards in diameter."

Hudson rock and shoal.—Captain J. P. Potter, of the American ship *Hudson*, bound from Sunderland to King George Sound, reported: "October 5th, 1864, at 8 A.M., civil time, passed a shoal extending N.N.W. and S.S.E., about one mile in length, with heavy breakers on it; also a rock about 20 yards in length and 10 feet high; the shoal bore S.S.W. from the ship, distant one mile. By good observations this shoal is in Lat. 39° 52′ S., Long. 35° 13′ E."

It was probably the remains of an iceberg rapidly dissolving. The tracks of other vessels to the colonies sufficiently disprove its existence; in fact, two last year (the *Sarah and Emma*, Capt. Windgate, and the *Maori*, Capt. Ashby), *passed over* the spot indicated.

Comala rock.—Extract from the log-book of the ship *Comala*: "January 26th, 1836, at 7h. P.M. passed a small coral rock even with the water's edge, with a number of aquatic birds round it; by the Latitude carried from noon, we make it in Lat. 39° 42′ S., Long. 65° 50′ E. It was perfectly visible, being only a ship's length to windward, in appearance about half the size of a jolly-boat." The reason assigned for not lowering a boat to sound on it was, that they had none that they would trust to float. A reef had been previously reported in the exact position.

Canning bank.—"Sea discoloured; at 3 P.M. hove-to and sounded in 88 fathoms, very fine sand, with some red and black specks; at 5 P.M. got soundings again in 100 fathoms, hard rocky bottom."—Capt. J. Clark, ship *George Canning*.

Vikingen shoal.—Capt. Zernichow, of the *Vikingen*, reported: "February 27th, 1857, at 12h. 30m. P.M., bound for Akyab, passed a shoal, with apparently white sand or coral, and some sea-weed, which could distinctly be seen. The circumference of the shoal seemed to be about a cable's length and a half; and, as far as could be judged, from 10 to 12 feet on the shoal. The sea broke heavily on it at the time. The ship had a fine breeze, going at the rate of 10 knots, and narrowly escaped, being not more than a quarter of a cable's length off in passing; the weather clear. At 10 o'clock on the same day, also observed some coloured water, say about 22 miles to the W. by N. of the reef. Observation at noon, Lat. 39° 39′ S., Long. 68° 32′ E.*

Slot van Capelle.—It is doubtful if the first three reports (1732), relate to the Slot van Capelle, though they come through a Dutch source; the first is described as a shoal above water; the second, as a shoal even with the water and three spots of dry sand on it; the third, as sand above water. The meridian distance was measured 60° E. from Teneriffe. The last three relate to the supposed discovery, by Captain J. Bows, of the *Slot van Capelle*, of "breakers," near which he sounded in 62 fathoms, grey sand. The discrepancies in the Longitude arise from two meridian distances being given—viz., 20° 20′ E. of the Cape, and 58° 25′ E. of Teneriffe.

* "Mer. Mar. Mag.," p. 59, 1858.

Albion bank.—Reported in 1822 as seen by the *Albion*; its N.W. end in Lat. 38° 20′ S., Long. 17° 3′ E.; and its S.E. end in Lat. 38° 29′ S., Long. 18° 58′ E.; no other particulars.

Telemaque rock.—Reported to have been discovered in January, 1786, by the French brigantine *Telemaque*, on a voyage from Madras to the Cape; the evidence is from the passengers, who "not only saw green moss and grass on the rock, but in some places bare rock *on both sides of the vessel;*" "the depth of water in some parts was not more than 2 fathoms." The next report is by Captain Blakeman, of the American ship *Macedonia*, who, on May 5th, 1816, "at 7h. A.M., saw breakers, distant 7 miles; sounded in 90 fathoms; at 8h. A.M., saw a very extensive patch of breakers, distant 6 miles; at 8h. 30m. A.M., saw a small breaker; at 9h. 30m., all three breakers distinctly visible;" according to observations and bearings the shoals would be in Lat. 37° 57′ S., and Long. 23° E. Another report was made by Captain Wilkinson, of the ship *United States*, as follows:—"July 20th, 1818.—At 1h. P.M., passed a rock within 50 yards, about 6 feet above the level of the sea; saw the shells and small stones in the holes of the rock when the sea left it; size of a large ship's hull."

The Telemaque and Albion shoals were sought for in 1822 by Captain Hanmer, of H.M.S. *Heron*, and not found. Search was also subsequently made for the Marion rock, but nothing seen of it. All three positions are so directly in the track of vessels sailing round the Cape of Good Hope—outward and homeward—that did any such dangers exist, they must, long ere this, have become well known to navigators. It is quite possible that in each case it was no more than an iceberg in the last stage of dissolution, surrounded by the drift-wood, seaweed, and kelp which accumulate in the vicinity.

Marion rock.—Reported January, 1853, as an oblong reef, on which the sea was continually breaking, surrounded by discoloured water to the distance of 200 yards. The *Marion* passed within 80 yards of it.

Barker's rock and all the subsequent dangers printed in *Italic* are taken from old charts, and nothing further is known of them.

Brunswick soundings, 85 to 95 fathoms. (See p. 262.)

Atalanta shoal.—Reported by the American ship *Atalanta* as a shoal; and the Dutch ship *Samarang* "as an extensive reef, with some pointed rocks above water at the western extremity."

Atomatia soundings.—Captain W. Bennett's journal says, "Hove-to and got soundings in 82 fathoms, shells and gray sand; sailed 4½ miles east and got soundings again in 62 fathoms; small white shells and sand, with black specks."

Union rock and reef.—The *Union* is stated to have been becalmed for three hours within 3 miles of a small rock, in length about 20 yards, and 6 feet above water, and from which a reef extends nearly 6 miles.

Augusta, or **Otter shoal**, reported by Captain Baddison, of the *Princess Augusta*, in 1765; subsequently the *Otter*, bound from Réunion to the Cape of Good Hope, in 1809, fell in with a dangerous shoal near the same position, and reported it as "very extensive, but no part above the water." And lastly, Captain Blakiston, of the *Anna Maria*, reports, "January 15th, 1830, at 8h. 30m. A.M., observed the water discoloured, bearing from the ship E.N.E., about ⅓ of a mile,

which I have no doubt is shoal water; the spot appears very small, and, from the best of my judgment, there may be 10 or 12 fathoms water on it. By means of several lunar observations and chronometers deduced from the Cape, I make it to lie in Lat. 33° 43′ S. (mer. alt.), and Long. 36° 30′ E. I had no opportunity of sending a boat to sound on it."

Dutch bank, reported by a Dutch officer who sounded on it, in 24 fathoms, when attempting a passage to Mauritius, and was afterwards captured by the *Royal Admiral*, October, 1795. "He assured me," says CAPTAIN BOND, "he had several good casts, the sea running very high and confused. From the mast-head to the northward appeared shoaler water and breakers, on which he stood to the southward, and had no ground with 60 fathoms in less than 15 minutes, the vessel going about 3 knots."

Belliqueux soundings, bottom in 80, then 132 fathoms by H.M.S. *Belliqueux*; three ships of the fleet sounded at the same time, but got no bottom with 110, 150, and 170 fathoms.

Hagus rocks and Irma shoal.—Breakers were reported by the French ship *Irma*, bound from Marseilles to Mauritius. In the abstract log of one of the Hon. East India Company's ships (1820), communicated by J. DAVY, M.D., F.R.S., to the *Edinburgh Journal of Science*, 1824—the vessel bound from Ceylon to the Cape of Good Hope, and being south of Madagascar—the following notes occur: "We tacked twice during the night, being apprehensive of running on the Hagus rocks; and at 10h. A.M. the temperature of the water fell 2°, when we were probably crossing the southern extremity of Belliqueux shoal; no change appeared in the colour of the water."

St. Juan de Lisboa, perhaps **Joao de Nova,** in the Mozambique channel, misprinted 10 degrees of Latitude and 10 degrees of Longitude.

Cloates island, reported by two of the Hon. East India Company's ships; 8 to 10 leagues in extent N.E. by N. and S.W. by S.; of moderate height, level, with a gradual slope at both ends, and high breakers projecting 3 miles from them.

Moffat shoal.—"White water, but no breakers; there may be 8 to 10 fathoms over the white coral or sandy bottom."

Tryal rocks, on which the English ship *Tryal* was reported to be lost in 1622. The Dutch and Danish accounts vary much in the position assigned to them. A Dutch plan makes their extent E. and W. 40 miles, and 15 miles broad. A Danish account says, "The direction is N.W. and S.E. 24 miles, and that they are low rocks about the height of a ship's hull, much broken, especially towards the extremes." One Dutch account places them 80 leagues off the coast of New Holland.

Harcourt soundings were said to be on stiff clay or mud.

None of these reported dangers exist near the spots assigned them by the early navigators. They may be indifferent and abbreviated accounts of known islands and shoals near the N.W. coast of Australia.

Off Rodrigues.—The rock recorded in the position given in the table is from a French chart of recent date; it is stated to be 16 feet high.

The attention of mariners is also called to the following remarks:

In 1843 two British ships were lost on coral reefs, said to be about 14 or 15 miles to the south of the island of Rodriguez. CAPTAIN MARSHALL, of H.M.S. *Isis*, was

sent to determine the position of these rocks. The report of Captain Marshall agrees with the Hydrographical authorities, namely, that these reefs do not extend beyond 5 or 6 miles. Since this report was made, other ships have been wrecked in this quarter; and it appears from the testimony of several commanders of ships, both French and English, that there is good reason to believe, notwithstanding the report of Captain Marshall, that the reefs actually extend 10 or 12 miles. Under these circumstances, mariners cannot exercise too much care and vigilance in passing south of the island.

Anacreon reef.—The following is from the log of the *Wings of the Wind*, from London to Bombay, June, 1857—"When near the position of Anacreon reef, sailed over white-coloured water, no bottom, with 60 fathoms."

Rajaswarre shoal, *see* p. 566.

Glendinning shoal.—Captain Glendinning, of the barque *Queen Mab*, of Liverpool, reports, that on his passage from Singapore to the Cape of Good Hope, on the 20th October, 1860, in Lat. 9° 54′ S., Long. 97° 50′ E., he came upon a dangerous shoal, not marked in any of the charts, and lying in the direct track of vessels coming from the Sunda strait on their homeward voyage.

Captain Glendinning states that at 9 P.M. of the above date, he observed the water all around the ship much discoloured—in appearance milky white; that he immediately hove the ship up in the wind, had a cast of the hand-lead, and got 7 fathoms; but the next cast (having run about 2 miles W.S.W.), had no bottom with the hand-lead. The water continuing discoloured, at 11 o'clock, having run 10 miles further to the W.S.W., hove-to the ship, and sounded with the deep sea lead in 55 fathoms, hard ground.

Caution.—This shoal lies about 130 miles N.N.E. of the Keeling or Cocos isles, and directly in the track of ships on the homeward voyage from China and Singapore by the Straits of Sunda.

As it is most desirable to verify the cast of 7 fathoms, and to ascertain how far the bank extends, any captain passing this neighbourhood is requested to get a few deep-sea casts of the lead, and, if time and circumstances will permit, to endeavour to trace the possible connexion of the bank with the Cocos isles.

Apaluria island is stated to have been sailed round by Captain Moffat, of the *Phœnix*, bound from England to Bengal in 1800. "It appeared to extend N.N.E. and S.S.W., about 7 or 8 leagues in circumference, high and uneven, and may be seen 14 or 15 leagues off." Van Keulen states it was seen in 1712, bearing S.W. distant 40 miles; Lat. 9½° S.

For **St. Michael's** bank, **George** island, **Roquipiz** or **Bridgewater** island, **Rose Galley** rocks, and **Swift** bank, *see* the remarks p. 263.

London bank, **Caddy** island, and **Adu** island were probably the Chagos archipelago—the vessel being four degrees of Longitude out of her reckoning.

Ouro, or **Grenville rock.**—Mr. Dalrymple, of the *Grenville*, is in doubt as to whether he saw this rock; but what appeared to him like a small black rock, with breakers of some extent, he places in Latitude about 0° 42′ N., Long. 80° 54′ E.

The *Compton*, Captain Misenor, 1728, thought they saw the island Ouro, making in three hummocks; they lost sight of it in an hour; when they saw it, it

bore N.E. 4 to 6 leagues. The reckonings (Captain and Mate) made it Lat. 0° 16′ N. and 0° 2′ N. The accounts published represent it to be in Lat. 0° 55′ N., Long. 81° 30′ E.

Van Keulen says it has been seen three times; and he records the instances.

In January, 1799, Captain La Meme, of *La Unie*, saw a shoal, and sent an officer to examine it; but, night coming on, he was prevented from landing. The officer reported that the reef was 8 or 10 feet above the surface of the water, and about a mile long from east to west; no soundings with 100 fathoms of line at the distance of a mile from it. Its situation was estimated at about Lat. 1° N. and Long. 82° E.

Louvre shoal.—Off the N.W. extremity of Sumatra the bottom was seen, with probably about 5 fathoms water over it; at a short distance off there was the appearance of less water.

Rocks, &c., in the Arabian Sea.

Futtay Rahimon soundings.—Capt. William Butler saw a rock in Lat. 9° 19′ N., Long. 76° 21′ E.; had soundings of 35 fathoms a quarter of a mile outside of it. If it was actually a rock that was seen it must be very dangerous, as it is quite in the track of ships working up or down the Malabar coast.—Bombay, 13th June, 1834.

Jack reef.—Capt. Jack, of the barque *Eddystone*, while on a voyage from Aden to Colombo, reports:—On the morning of the 11th August, 1863, discovered a dangerous reef in Lat. 10° 10′ N., Long. 63° 40′ E. It appeared to be above water, about 2 miles in extent, and resembling a recent coral formation.

Captain Jack passed close to the reef, and sounded in 10, 9, 8, and 7 fathoms water. Its discovery is of material importance, as it lies immediately in the track between Ceylon and the Red Sea, and mariners on this route are therefore earnestly requested to search for this danger, in order that its existence and position may be verified.

With reference to this report, the following information from Commander H. B. King, R.N., gives to the reef a *doubtful existence*.

On the 24th August last (1863), at 7.30 A.M., in fine weather, with a clear visible horizon, the wind being S.W., the *Nemesis* passed over the spot indicated. No shoal was seen, but patches of discoloured water were observed, in which no bottom was found with 85 fathoms.

Deeming it of great national importance that the newspaper report should, as far as possible under the circumstances, be either confirmed or refuted, it was with my full concurrence that the commander of the *Nemesis*, on the 30th September, made that more lengthened search which the exigencies of the public service had not permitted to be done on the 24th August.

With reference to the track chart sent herewith, I note the following—

"4.50 A.M., Sept. 30th, 1863, Lat. (by Capella), 10° 10′ N., Long. (by account), 62° 57′ E. Steered S. 88° E. 35 miles.

"8.0 A.M., Lat. by account, 10° 11′ N., Long., chron., 63° 24′ E. Steered E. 16 miles.

"9.45 A.M.—Lat., by account, 10° 11′ N.; Long., chron., 63° 40′ E. Steered N. 10 miles.

"Noon.—Lat., observed, 10° 18′ N.; Long., chron., 63° 40′ E. Steered S. 8 miles.

"1 P.M.—Steered S.E. 5 miles; 1.30 P.M., N.E. 5 miles; and at 2 P.M. steered S. 88° E. 16 miles; at 3.30 P.M. shaped course for Galle."

As on the previous date, long dark patches of discoloured water, greenish and purple, were seen, but no shoal, although the eye extended over a radius of at least 10 miles from every position noted, the wind blowing a moderate breeze from the northward, and the horizon remarkably clear and visible. I concur with the opinion of the commander of the *Nemesis*, that no such reported shoal exists.

Off **Perim island.**—Reported danger S.W. of the island. CAPTAIN BROWN, of the *Candia* (s.), writes, under date from the Red Sea, 10th January, 1858, and says,—"In running through the straits of Bab-el-Mandeb, the Peak being at E.N.E., half a mile off Perim island, the ship struck something very slightly for about 6 seconds, but did not stop; whether a shoal or sunken wreck not known." Much caution will be required here, as there can be little doubt, from the nature of the ground hereabouts, that the *Candia* must have grazed a rock."

The other banks and shoals are from old charts, and nothing further is known of them;—the so-called Elizabeth bank may be Direction bank, misplaced as regards position.

ROCKS, &c., IN THE BAY OF BENGAL.

Vespasian soundings.—CAPTAIN F. O. HIGGINSON, of the *Vespasian*, of Liverpool, on the voyage from England to Calcutta, made the following observations:—July 3, 1861; being to the S.E. of Ceylon, and on the southern limit of the Bay of Bengal, noticed the water to be discoloured, "brownish green;" at 11 A.M., took a cast of the lead (MASSEY'S patent lead) in 30 fathoms; steered N. ¼ E. (true) 9 miles till noon, when being in Lat. 4° 16′ N., Long. 83° 39′ E., the water still discoloured, and a large number of birds around, sounded in 32 fathoms, bottom of fine white sand: continued steering the same course (viz., from noon, N. ¼ E., true, 28 miles) till 3 h. 15 m. P.M., when soundings were taken in 34 fathoms, hard rocky bottom—the lead came up bruised and bent; at 6 P.M., hove to and sounded in 41 fathoms, hard bottom, having made a course N. ¼ E. 51 miles since noon; no soundings afterwards.

Bale of Cotton rock.—MR. CALLENDAR first reported this danger: "March 2nd, 1767, shipwrecked in the Hoogly; 28th instant, a passenger on board the *London* for Bombay, on which day the pilot left us. Light airs and calms all the way down the bay of Bengal, with a prevailing current to the eastward. On the 5th May, steering S.E.-ly, with a variable, light breeze from the northward, we saw something ahead of us, in appearance like a large *bale of cotton*, being very white and round; it bore from us about S.S.E. distant about 2 miles. The sea being very smooth we kept our course as before we saw it, and by the time we got an observation, it being then noon, the rock bore, I think, about E. or E.N.E., distant half a mile or less. When we went close past the rock, being then on the west side, it was of a

dark-brown, and had something like moss upon it. I think it may be about 40 feet long, about half as broad, and not over 2 feet above the surface of the water."

A Portuguese captain is reported to have seen this rock in April, 1767, describing it as 1½ or 2 feet above the water, steep-to, about 12 feet broad and 20 feet long, smooth at the top, lying S.E. and N.W.; about three ships' length from it; no ground at 170 fathoms.

Mr. Douglas, an officer of the *Countess of Errol*, is said to have been upon the rock in 1794. It was described by him to be formed like a ship's bottom, and covered with barnacles. On the east side soundings of 120 and 130 fathoms, on the N.W. and south sides no ground.

In 1797, Captain Le Meme, privateer *La Unie*, saw the Bale of Cotton Rock; he states it "to be 20 feet high, 60 long, and 20 broad, situated on a bank of sand about 300 feet long, lying S.E. and N.W. At a mile distance no ground at 100 fathoms, and 30 fathoms only a boat's length from the rock."

Lieut. W. H. Smith, R.N., reported that "the Bale of Cotton Rock is in Lat. 5° 18′ N., and Long. 88° 20′ E. The summit of the rock may be about 20 feet above the level of the water, and is about 50 feet in length, and 20 in breadth. At 130 feet from the rock we found no bottom with 120 fathoms of line. We landed on the rock, where we made several good observations for the longitude, by distances of the sun and moon; it agreed exactly with the longitude given by our chronometers in the ship's run home from cape Comorin."

Anna Maria shoal.—1849, May 10th, at 5 h. 30 m. A.M., standing E.S.E., with a light wind from the southward, and smooth sea, observed rocks under the vessel's bottom, took a cast of the lead and found 11 fathoms, kept the lead constantly going, and had overfalls from 13 to 18 fathoms; at 7 h. 30 m. had 30 fathoms, another cast no ground with 50 fathoms. Whilst passing over the shoal, observed the bottom to be very uneven, and some of the pyramidal rocks apparently with much less water on them; land in sight from the masthead bearing about E. ½ N., Long., by chronometer, 97° 10′ E., and Lat., deduced from noon, 10° 24′ N. Roe's bank is 96° 45′ E., and 10° 20′ N., and 95 miles west of St. Mathews. I consider that shoal out 35 miles of its true position, or the shoal passed over by me to be a discovery. The portion passed over appeared to extend E.S.E. and W.N.W., about 5 miles, but as I was on the shoal at daylight I am unable to state its full extent. At 8 h. A.M., tacked with a light air to the W.S.W.; at 8 h. 30 m. got the jolly-boat out, and tried the current and found it setting slightly to the northward; hoisted the jolly-boat in again at 11h.; shoaled again to 17 fathoms, the rocks plainly visible, and a light breeze having sprung up, braced on the starboard tack, and at noon had 30 fathoms. With reference to the above I would observe, that the position assigned by me is correct to a mile, allowing the Great Seyer island to be correctly laid down, as we saw that island on the following day, and had sights of chronometer before and after noon.—*Calcutta Englishman*, July 23.

Planet shoal.—Capt. F. O. Higginson, of the *Vespasian*, bound to Calcutta, reports:—"July 8th, 1861; at noon, Lat. 16° 1′ N., Long. 84° 51′ E., approaching the position in the bay of Bengal marked 'Rocky Breakers (D);' from noon till 2h. 45m. P.M. made a true north course 22 miles, when shoal water appeared a-head, and I had to alter the course three points to clear the danger. I thought it extended from S.W. to N.E. about 2 miles, having various depths of water on it, much red weed, and many turtle around."

PASSAGES in the INDIAN OCEAN

LONDON, James Imray & Son.

Gore bank.—Vice-Admiral Sir John Gore, K.C.B., in H.M.S. *Melville*, on her way from Saugor roads, observes: "At noon, on the 24th July last (1832), the Latitude by D. R. was 17° 11′ N., and Long. by D. R. 85° 48′ E. No observation had been obtained for two days before, the wind having blown constantly from the south-west, with heavy squalls and rain. At 4 P.M. obtained a good observation, by chronometer, which gave Long. 85° 51′ E.;—observing the water to be discoloured, sounded in 56 fathoms, doubtful. At 5 P.M. sounded in 45 fathoms, certain bottom. Wore ship and stood S. by E.; then followed three casts, having 42 fathoms, rocky bottom; then two casts, no bottom with 60 fathoms. At 7 P.M. had two casts, one in 25, the other 23 fathoms. At 7.45 P.M. had two good observations of the Pole-star, which gave the Latitude 17° 30′ N. and 17° 31′ N., agreeing within a mile or two of the dead reckoning. At 8 P.M. sounded in 25 fathoms; at 8.10 P.M. in 35 fathoms; at 8.20 P.M. in 40 fathoms; at 8.30 P.M. in 45 fathoms. At 8.45 and 9 P.M. 55 and 75 fathoms, no bottom. During the whole of these soundings the lead came up bruised, and the arming displaced, without anything attached to it to indicate the nature of the bottom.

The mean of three observations (one by Antares), will place the rocky bank in Lat. 17° 26′ N., and Long. (brought forward from 4 P.M.), 85° 51′ E."

Australia.

The islands and shoals, the positions of which are given on page 721, are not known to our regular traders; and did they exist, they must have been frequently reported. Hammant island was stated to be 30 feet high and 400 yards in circuit, with breakers 3 to 6 miles off it; Brockman's reef was reported as of large extent, *in patches;* they are possibly some of the known dangers lying off the south side of Kangaroo island, *see* page 685; according to Brockman's account, they lie between 60 and 10 miles south of the island.

NOTES ON MAKING PASSAGES.

N.B.—In these *Notes*, when the tracks of vessels are spoken of, the authorities are as follow:—1. The abstract voyages of upwards of 1000 English vessels, in the possession of the author, and made during the last 20 years; 2. H. Wise's 100 voyages to and from India and China of the E.I. Co.'s ship; 3. Maury's "Sailing Directions" for American ships; and 4. Maandelijksche Zeelanwijzingen Java naar het Kanaal, and Maandelijksche Zeelanwijzingen van het Kanaal naar Java,—which refer to Dutch ships.

Where the *names of places* occur in these "*Notes*" a description is not recapitulated,—a full account of each will be found in the previous part of the work under the proper heading.

The Atlantic portion of the Voyage to India and the Colonies.

To the Equator.—The *time* taken by ships from the English channel to the Equator can at once be illustrated by a table,—from which it appears that those making the route W. of the cape Verde islands have a slight advantage at the beginning of the year,—those going E. of the cape Verde islands having a similar advantage towards the end of the year:—

Period of the Year.	English Ships.				Dutch Ships.				American Ships.				Average of the three nations.			
	West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.		West of C. Verdes.		East of C. Verdes.	
	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	No. of Ships.	No. of Days.	Total Ships.	No. of Days.	Total Ships.	No. of Days.
Jan., Feb., March	33	29·0	48	30·3	43	31·5	31	34·5	23	30·3	8	28·7	99	30·3	87	31·2
April, May, June	78	29·0	33	29·8	110	31·3	36	32·5	37	29·2	8	31·0	225	29·8	77	31·1
July, Aug., Sept.	204	33·6	30	30·5	122	34·6	17	35·7	34	32·8	7	35·7	360	33·7	54	34·0
Oct., Nov., Dec.	99	34·8	51	33·0	66	34·4	30	33·8	17	30·3	11	30·8	182	33·2	92	32·5
Average Days from March to October .	282	31·3	63	30·2	232	32·9	53	34·1	71	31·0	15	33·3	585	31·8	179	32·6
Average Days from October to March . .	132	31·9	99	31·6	109	32·9	61	34·1	40	30·3	19	29·7	281	31·8	131	31·9
Average Days .	414	31·6	162	30·9	341	32·9	114	34·1	111	30·6	34	31·5	866	31·8	310	32·2

For the English vessels on the *Western route* we have the following details:—

January, February, and *March;* from the log-books of 33 vessels:—

The *mean* position of the vessels north of the Line was 26° 10′ W. in 16° 15′ N.: they were occupied $7\frac{2}{3}$ days sailing from 10° N. to the Equator, which they crossed in $23\frac{1}{2}$° W.;—making the passage from the Channel to the Line in 29 days.

April, May and *June;* from the log-books of 78 vessels:—

The *mean* position of the vessels north of the Line was 26° 35′ W. in 14° 5′ N.: they were occupied $8\frac{1}{2}$ days sailing from 10° N. to the Equator, which they crossed in 24° 36′ W.;—making the passage from the Channel to the Line in 29 days.

July, August and *September;* from the log-books of 204 vessels:—

The *mean* position of the vessels north of the Line was 26° 50′ W. in $14\frac{1}{2}$° N.: they were occupied $10\frac{3}{4}$ days sailing from 10° N. to the Equator, which they crossed in 22° 25′ W.;—making the passage from the Channel to the Line in $33\frac{1}{2}$ days.

October, November and *December;* from the log-books of 99 vessels:—

The *mean* position of the vessels north of the Line was 26° 40′ W. in 13° 5′ N.: they were occupied $11\frac{3}{4}$ days sailing from 10° N. to the Equator, which they crossed in 25° 50′ W.;—making the passage from the Channel to the Line in $34\frac{3}{4}$ days.

For the English vessels on the *Eastern route* the details are as follows:—

January, February and *March;* from the log-books of 48 vessels:—

The *mean* position of the vessels north of the Line was 22° 36′ W. in 4° 48′ N.: they were occupied $8\frac{1}{3}$ days sailing from 10° N. to the Equator, which they crossed in 22° 48′ W.;—making the passage from the Channel to the Line in $30\frac{1}{3}$ days.

April, May and *June;* from the log-books of 33 vessels:—

The *mean* position of the vessels north of the Line was 22½° W. in 7° N.: they were occupied 10⅓ days sailing from 10° N. to the Equator, which they crossed in 23° 6′ W.;—making the passage from the Channel to the Line in 29¾ days.

July, August and *September;* from the log-books of 30 vessels:—

The *mean* position of the vessels north of the Line was 23° W. in 9° N.: they were occupied 9¼ days sailing from 10° N. to the Equator, which they crossed in 21° 36′ W.;—making the passage from the Channel to the Line in 30½ days.

October, November and *December;* from the log-books of 51 vessels:—

The *mean* position of the vessels north of the Line was 22½° W. in 12° 6′ N.: they were occupied 12¼ days sailing from 10° N. to the Equator, which they crossed in 24° 18′ W.;—making the passage from the Channel to the Line in 33 days.

Of the English ships,—taking the *western* route, the shortest period was 19 days; the longest, 46 days. For the *eastern* route, shortest, 19 days; longest, 43½ days.

The late Admiral Fitz-Roy, in Meteorological Papers, No. II., says:—"When bound southward across the Atlantic Equator, under sail only, it is advisable to make the *eastern* or in-shore passage, near Africa, from November to May; and to take the *western* crossing, between 23° and 32° W., from June to October."

The Dutch on the other hand say, that while the winds are always more or less favourable on the *western* route, vessels can with greater advantage take the *eastern* route during June, July, August, September, and October, when the S.W. Monsoon in the North Atlantic will place them in good position for crossing the Equator to the eastward.

Maury recommends the *western* crossing of the Equator in all seasons, which of course is very advantageous for vessels bound round the Cape *from* American ports; but the policy of going so far west as Las Roccas is very questionable, and it is quite certain that in *many* instances as much as 10 or 14 days have been lost in clearing the Brazilian coast.

Any attempt to take the route *through* the cape Verde group inevitably results in making a long passage to the Equator.

Most Westerly Position, South of the Equator.—Of 162 vessels that made the passage E. of the cape Verde islands, the mean westerly point was Long. 30° 36′ W. in Lat. 17° 36′ S.; of 414 vessels passing W. of that group, the mean westerly position was Long. 33° W. in Lat. 19° S.

It may be here remarked that in some years—as, for example, in 1856—it is possible to make southing with very little westing; in that year many vessels that crossed the Equator in 27°, 28°, and 29° W., did not subsequently make a degree of westing, and in fact, within 10° of the Line, some of them commenced to make easting.

Position of Crossing the Meridian of Greenwich.—The mean position of 200 vessels bound to India or China was Lat. 37° 11′ S.; lowest, Lat. 31° 2′ S.; highest, Lat. 42° 15′ S.

The mean position of 376 vessels bound to the Australian colonies, Lat. 38° 36′ S.; lowest, Lat. 31° 33′ S.; highest, Lat. 47° 3′ S.

Of Dutch vessels bound for the East, 574, taking the *eastern* route, crossed the

Meridian of Greenwich in Lat. 36° 15′ S.; 135 vessels by the *western* route crossed the Mer. of Green. in Lat. 40° 40′ S.

Time from Equator to Meridian of Greenwich.—Of the vessels taking the eastern route, the mean number of days was 23; shortest, 12 days; longest, 32¾ days. Of the vessels by the western route, mean number of days, 24; shortest, 17¼ days; longest, 36 days.

Of 709 Dutch vessels, the average is 24 days by each route.

It may be set down as an axiom, that any attempt to make *easting* at too early a period on the voyage must result in loss of time. In one instance, in 1850, when the meridian of Greenwich was first crossed in Lat. 33° S., it was subsequently crossed and recrossed no less than *three* times, the last being in Lat. 40° S.; in another instance, in 1856, it was crossed twice on the same voyage, the first time in Lat. 29° S.; so that it may generally be recommended to take the mean position given above—viz., Lat. 37° to 38½° S.

From the Meridian of Greenwich to the Australian Colonies.

Admiralty publications still recommend vessels to run down their *easting* on the parallel of 39° S.; and it is well known to navigators that Maury says, "the winds most favourable for the prosecution of the voyage are to be found southward of Lat. 50° S." The log-books—650 in number—that have been examined for these remarks, show that the *mean* parallel on which English ships run down their easting is 44° 35′ S., and the range in latitude is between 38° S., and 56° 37′ S.,—very few, however, higher than 51° or 52° S.

On the parallel of 39° S., the distance from the meridian of Greenwich to cape Otway, is 6694 miles. From the same meridian, in about 38½° S., to cape Otway, by the composite track, max. Lat. 45° S., the distance is 6308 miles; by comp. track, max. Lat. 48° S., the distance is 6161 miles; and by comp. track, max. Lat. 51° S., the distance is 6049 miles.

On the parallel of 39° S. of 64 vessels, the shortest time taken to run down easting was 38 days, the longest 50 days; mean of the whole, 45 days.

On the composite route, say max. Lat. 44° 35′ S., as given above, 436 vessels ran down their easting, on an average, in 37 days; the shortest time being 27 days, and the longest 47 days. And comparing the two routes, it appears that the 64 vessels must have averaged 6·2 knots per hour, while the 436 vessels averaged 7·1 knots.

Probably, then, vessels cannot do better than, taking a departure from the meridian of Greenwich in about Lat. 38½° S., pursue the composite route of max. Lat. 45° S., the difference in the distance in favour of max. Lat. 48° S., which is 147 miles, and in favour of max. Lat. 51° S., which is 259 miles, being more than counterbalanced by the less risk and anxiety on the former track, for there is no disguising the fact, that icebergs, snow, and sleet, with concomitant cold, are more prevalent in the higher than the lower latitudes; but, at the same time, there appears to be no special advantage in the parallel of 39° S.

In our logs we have the *Frances Henty* making her mean of 233 miles per day, for 8 successive days, between 45° and 46° S.; the *Kent* her 227 miles for 10 successive days, between 44° and 45° S.; the *Southern Cross* her 196 miles for 13 successive days, between 49° and 50° S.; and the *Earl of Sefton* her 271 miles for 8 successive days, between 50° and 53½° S.,—but this vessel encountered icebergs

in 48° S., and had snow and sleet for several days on her voyage. The *Earl of Eglinton*, on a voyage to Australia in 1854, reached max. Lat. 56½° S. in December, having met icebergs in 47°, 52°, and 56° S.; calms are also recorded several times, and snow and sleet frequently. There is no doubt that in both winter or summer the weather is worse to the southward of the 50th parallel than to the northward of it, and the winds no better for making the passage.

Capt. J. Leeman, in a communication addressed to the editor of the "Mercantile Marine Magazine," in 1857, on this portion of the Australian route, says:—"In the May number of your Magazine for 1856, you have an interesting paper, entitled "On the occurrence of an Atmospheric Wave in the Southern Indian Ocean," and containing extracts from the logs of two vessels proceeding to the eastward across this space, tending to throw doubts on the deduction that the *Havannah* experienced a succession of cyclones in her much-quoted passage on the parallel of 39° S.

"Lieut. Maury, in his sailing directions, says, in respect to this part of the world:—'If you do not meet westerly winds, go south, and you will find them.' Now, if the *Havannah's* theory is right, by going south you will meet with easterly winds, by falling in with the southern half of the Storm Circle.

"My own experience tends to convince me, that the turning winds experienced by the *Havannah*, the *Hooghly*, and the *Celestial*, whether to be considered true cyclones or not, are confined to certain limits, varying according to season, but that south of this limit strong westerly gales continuously prevail, sometimes veering as in a cyclone, *i.e.*, from N. to W. and S.W., and sometimes back again without moderating, from S.S.W. to W. and N., the barometer always indicating (by rising for the south and falling for the north wind) which way the wind will veer, and consequently enabling a ship to career along without any of the frequent stoppages which occur farther north, occasioned by the wind falling light when it reaches south, and very frequently a calm interval while it is hauling round easterly, previous to the commencement of another cyclone (?)

"To enable you to judge, I enclose three separate Logs of passages across this space, in the *Esmeralda*, all nearly about the same season of the year—viz., the southern spring and early summer.

"The first, in 1854, was made in September, from the meridian of the cape of Good Hope to the meridian of 115° E., in 33 days, 41° 40′ S. being the highest lat. attained, the westerly winds not steady, generally commencing N.E., increasing as the wind veered northerly, compelled to reef at N.W., double reefs and strong gale at W., moderating at S.W., and calm at S.E.,—this repeated frequently, all in accordance with the theory of storms: any attempt to *keep* on the northern or left-hand semicircle would have been useless, as the gale so speedily left us, that the foul wind of the cyclone (?) hardly gave steerage way, and it was not until another cyclone (?) commenced that we made any progress.

"In 1855, month of November, from the Cape to the same meridian, 29 days, 43° 23′ S. being the highest lat.:—nearly 2° further south gave an advantage of four days, wind shifting occasionally, as on the previous voyage, cyclonically (?), but not so frequently,—remaining much steadier at west. Query, did the cyclone travel more slowly, or was the atmospheric current stronger and more steady?

"In 1856, months of November and December, from the Cape to the same meridian, 23 days, highest Lat. 48° 50′ S., experienced a steady gale throughout, sometimes two reefs, sometimes three, sometimes all sail and studdingsails, and always

westerly, sometimes veering to south, sometimes north, but never easterly, and quite devoid of any cyclonic symptoms.

"During this passage you will perceive a gain of 10 days on the first, and 6 days on the second voyage, always improving as a higher latitude is reached.

"My reason for only carrying on the passage to 115° East, is, that on the first two voyages they terminated at Swan River, and the third was to Adelaide; the latter was performed in 28 days, from the meridian of the Cape.

"As I have frequently heard the remark made, 'Ah, it's all a mistake going south, you shorten the distance, but you get on the wrong side the cyclone,' I send you the foregoing, not with the wish to bring any one to my way of thinking, but to throw light upon a much-frequented route, and although I have placed a query after the word cyclone, where it appears in my letter, it is not that I undervalue the beautiful theory of the Law of Storms, but that I think in extra-tropical regions, the theory does not always apply."

Although cyclones are not unfrequent in both high northern and high southern latitudes, there is no doubt that the majority of the gales are those known as *straight* gales. Also, easterly winds are not more common in summer than in winter;—they occur in both seasons, but they never predominate the general N.W. and S.W. winds, though in certain years there may be a good per-centage of them; however, a vessel is in a better position for making the voyage when she encounters them between 45° and 50° S. than if she were in a lower latitude.

For the following *composite routes* from the meridian of Greenwich (in Lat. about 38½° S.) to cape Otway, the data are,—

For Max. Lat. 45° S., strike the parallel of 45° in Long. 37° E., and leave it in Long. 107½° E., having sailed 2994 miles along it.

For Max. Lat. 48° S., strike the parallel of 48° in Long. 43° E., and leave it in Long. 99½° E., having sailed on it 2271 miles.

For Max. Lat. 51° S., strike the parallel of 51° in Long. 50° E., and leave it in Long. 94½° E., having sailed on it 1683 miles.

Passages from England to the Australian Colonies.

Taking the average of all the routes (between 38° and 56° S.), the mean of 438 voyages to Melbourne gives 98¼ days; of 212 voyages to Sydney, 105⅓ days.

Of the vessels sailing on or near the parallel of 39° S., the average is 104 days to Melbourne and Sydney; 102 days to Adelaide; 99 days to Swan River; and 114 days to Tasmania.

Of the vessels taking the route south of 40° S., 400 log-books give—to Swan River, 94 days; to Adelaide, average 99 days, shortest 70 days, longest 111 days; —to Melbourne, average 88 days, shortest 69 days, longest 120 days;—to Hobarton, average 103 days, shortest 81 days, longest 122 days;—to Sydney, average 96½ days, shortest 83 days, longest 112 days.

In 1861, when the *Norfolk* made the run to Melbourne in 69 days, sailing from Plymouth in October, her max. Lat. was 45° 25′ S.; in 1863, when the *Murray* made her run to Adelaide in 70 days, sailing from Plymouth in July, her max. Lat. was 47° S.

From off Cape Otway to Sydney,—the average, from these logs, is 6½ days, shortest 3½ days, longest 14½ days.

On the route to India and China, the usual sailing directions say that the navigator should run down his *easting* in about 39° S., a parallel which seems to be a great favourite, and our English log-books show that (generally) this part of the voyage is made between 38° and 40° S.; from the Dutch log-books, however, it appears that when a vessel has to run over 80 or 90 degrees of longitude in a middle latitude, a better course can be adopted than the parallel of 39°, as might have been supposed from what has already been said respecting the voyage to Australia.

Ships sailing North of Lat. 40° S.

No. of Ships.	Months.	Mer. of Green. crossed in Lat. S.	Points of Intersection of the E. Meridians.				No. of Days from Mer. of Green.
			20° E.	40° E.	60° E.	80° E.	
			Lat. S.	Lat. S.	Lat. S.	Lat. S.	Days.
34	January . .	36°6	39°0	39°3	39°6	37°6	26·2
23	February .	37·3	38·9	39·3	39·3	37·9	24·9
38	March . .	37·3	38·3	39·6	39·0	37·6	26·8
32	April . .	36·9	38·9	39·0	38·9	36·6	26·2
34	May . . .	36·6	38·6	39·0	39·0	37·9	24·2
63	June . . .	36·3	38·6	38·5	38·9	37·3	24·1
47	July . . .	35·9	38·6	39·0	38·6	36·3	24·3
59	August . .	36·6	38·6	39·0	38·6	37·0	24·1
77	September .	36·6	38·6	38·3	38·9	37·6	24·7
47	October . .	36·6	38·6	39·0	39·0	37·6	24·8
50	November .	37·0	38·9	39·0	39·0	38·0	24·1
45	December .	37·3	39·3	39·0	39·6	37·3	24·5

Ships sailing South of Lat. 40° S.

No. of Ships.	Months.	Mer. of Green. crossed in Lat. S.	Points of Intersection of the E. Meridians.				No. of Days from Mer. of Green.
			20° E.	40° E.	60° E.	80° E.	
			Lat. S.	Lat. S.	Lat. S.	Lat. S.	Days.
10	January . .	39°3	42°0	43°3	42°9	38°9	22·8
11	February .	40·3	42·6	43·9	43·3	40·9	22·6
12	March . .	42·0	43·6	44·0	43·9	41·6	20·7
9	April . . .	42·6	42·9	43·6	43·6	41·9	21·5
11	May . . .	40·3	42·9	43·0	43·0	40·6	21·3
10	June . . .	37·9	40·6	41·9	41·9	39·0	21·0
8	July . . .	39·9	41·0	42·0	42·0	40·3	21·1
19	August . .	39·3	41·3	42·6	42·0	38·3	21·6
14	September .	39·6	42·3	43·3	42·0	39·9	21·9
21	October . .	39·3	40·6	41·6	41·3	39·3	22·3
14	November .	41·6	42·6	43·3	42·3	37·6	21·7
20	December .	40·6	42·3	42·9	43·0	40·3	20·7

Comparing the two tables, there is a clear gain of $3\frac{1}{4}$ days by vessels making this portion of their voyage *south* of Lat. 41° S.

Round the Cape of Good Hope to India.

In the first place it may be as well to recapitulate briefly the distinctive difference between the seasons in the Indian ocean.

The N.E. Monsoon prevails in the northern part of the ocean, and the N.W. Monsoon in the equatorial part, when the sun is in the southern hemisphere, from October to March. The S.W. Monsoon reigns in the northern part, and the S.E. Monsoon in the equatorial part, when the sun is in the northern hemisphere; the end of September and beginning of October at one period of the year, and the end of March and beginning of April at the other period, marking the separation of the two seasons by a succession of calms or light variable airs.

In the Southern Indian ocean, during the months of January and February (summer) the S.E. Trade attains its highest southern limit; at that period, on the east side, it is found in Lat. 35° S.; but between the meridians of 80° and 90° E., it does not extend higher than 30° S.; while on the meridians of 35° to 40° E. it again pushes down to 35° S. In August and September its southern limit is in Lat. 28° or 29° S. on the east and west sides of the ocean; but no higher than Lat. 25° S. between the meridians of 70° and 80° E.

It is this marked change in the direction of the winds — which distinguish the seasons—and this vibration of the southern limit of the S.E. Trade wind that necessitates so marked a difference in the various routes at different periods of the year.

Bound from the Atlantic for ports in the bay of Bengal, the Arabian sea, the Persian gulf, and the Red sea, the navigator may make choice of SIX ROUTES, according to the season of the year;* these are—

I. The MOZAMBIQUE CHANNEL (OR INNER) ROUTE (p. 738);
II. The ROUTE EAST OF MADAGASCAR (p. 740);
III. The so-called BOSCAWEN ROUTE (p. 740);
IV. The MIDDLE ROUTE (p. 740);
V. The FIRST OUTER ROUTE (p. 741); and,
VI. The SECOND OUTER ROUTE (p. 741);—

all of which are delineated on the chart "Passages in the Indian Ocean," and it will suffice to give a *general* description of each. Remarks as to the parallel on which to run down the *easting* have already been made, and need not be here repeated.

I. The **route through the Mozambique channel** — for the West coast of India and all parts of the Arabian sea, including the Persian gulf and Red sea; for Ceylon and the bay of Bengal, including the straits of Malacca—having passed the Cape of Good Hope at such period as to insure reaching the northern part of the Indian Ocean *during the S.W. Monsoon* (April to September, both inclusive).

Intending to adopt this route, it is generally recommended to gain the meridian

* These routes were originally indicated by D'APRES DE MANNEVILLETTE, and afterwards modified by HORSBURGH.

of 37° E. before crossing the parallel of 34° or 35° S., so as to avoid as much as possible the strongest portion of the S.W.-ly current from the Indian Ocean: thence steer a direct course for the entrance to the Mozambique channel; after which, either pursue the voyage along the west coast of Madagascar, avoiding a too close proximity to the dangers off the coast,—or, as is preferable, take the middle of the channel, where the wind is stronger and more regular; in the latter case, however, remember that Europa island, the Bassas da India, and Pilot rock (reported to be N.W. of the latter), stand in the way; during the night these dangers should be passed either to the eastward or westward,*—no attempt being made to pass between them; when to the northward of them, shape a course for Juan de Nova, leaving it (preferably) to the eastward, so as not to make too near an approach to Chesterfield bank and islet.

Any of the channels among the Comoro islands is safe—remember, however, that there is a strong westerly set in their vicinity. In April and May the best winds are probably found between Comoro island and the African coast. Bound to Johanna, take care not to fall to the westward.

From the Comoro islands aim at crossing the Equator in Long. 54° E., whence the course must be altered according to the port of destination.

Bound for Karachi or Bombay, the route from the Equator is direct. In the height of the S.W. Monsoon it frequently happens that steady gales, with clear weather, may be experienced until about 70 or 100 miles off the coast; after which, cloudy weather, with rain and squalls, precluding good observations, may be expected on the bank of soundings; good sails should therefore be bent for hauling off the land, until the latitude is correctly ascertained.

For Bombay, the parallel of Khundari island should be made at a considerable distance from the coast, and then steer due east for it; if there is any doubt as to the latitude, endeavour to obtain soundings on Direction bank, to the S.W. of Kundari island; for making the port, see p. 411.

Bound to Surat, steer so as to be well to the westward, on the parallel of the high land of St. John.

Bound to Goa, make the land off Burnt island. For Cannanore, Tellicherry, Mahé, or Calicut, the passage may be shortened, as regards time, by passing north of the Laccadivhs, whence make for Pigeon island, and then run down the coast to the southward, keeping a good offing; having made the port of destination, anchor well out, and be prepared to put to sea on the approach of threatening weather.

Bound to Cochin, Alipey, Quilon, &c., either the Nine Degrees or the Eight Degrees channel may be adopted, keeping as nearly as possible in mid-channel. The One-and-a-Half-Degree channel, though free from danger, should not be used during the strength of the Monsoon.

The Eight Degrees channel is preferred when bound for Ceylon; a vessel sure of her position, from having sighted Minicoy, may steer direct for point de Galle; but if uncertain of her position, she should steer to the eastward until soundings are obtained on the bank off cape Comorin; the depths are from 45 to 50 fathoms at 24 to 27 miles from the coast, which will be visible at that distance if the weather is clear—a rare thing, however, during the S.W. Monsoon.

* The channel between the African coast and these dangers is cleaner than that on the Madagascar side, but the winds are light near the coast, and a very *strong* southerly current is always running through it.

Bound for the bay of Bengal, and having struck soundings on the bank off cape Comorin, steer to pass well to the southward of point de Galle, so as to avoid the current setting towards the gulf of Manaar,—besides which, the S.S.W. winds that often prevail at this season off the point might otherwise cause delay in weathering the S.W. extremity of Ceylon.

II. The **route East of Madagascar,** like that just noticed, also appertains to the season of the S.W. Monsoon; and is often preferred, not only as being less intricate, but from the general certainty of finding steadier winds.

Having rounded the Cape, endeavour to enter the S.E. Trade wind region—or what is the same thing, cross the parallel of 27° or 28° S.—in about Long. 53° E.; then steer for the parallel of cape East, Madagascar (or Lat. 15° S.), so as to cross it in Long. 51°; edge in with the land (not too close), and make cape Amber. The reason why the S.E. part of Madagascar should not be made direct is—to avoid the *so-called Fort Dauphin winds,* which often blow from E.N.E. to N.E., besides which the S.W.-ly current from the Indian Ocean is then very strong. From cape East to cape Amber the current is favourable—towards the north; but having past the latter, it runs strong to the westward.

From cape Amber steer to pass between the Farquhar islands and the Cosmoledo group, leaving M'Leod bank, &c. well to the eastward; cross the Equator in Long. 54° to 56°, and then proceed as directed on page 739.

Vessels bound for the West coast of India, passing the Cape of Good Hope after the middle of August and during September, being then *uncertain* whether they can reach their port of destination before the setting in of the N.E. Monsoon, have the choice of two routes—III. and IV.

III. The **Boscawen route** is so called from an admiral of that name, who was the first that adopted it.

Having rounded the Cape, and made sufficient easting, cross the parallel of 30° S. in Long. 58° E., steer to pass between Réunion and Mauritius, then between Tromelin and Cargados Garajos, and afterwards between Galega and the Saya de Malha bank; thence make a direct course to cross the Equator in Long. 62° or 63° E., leaving the Seychelles (and the islands and banks southward of them), to the westward. The ship will then be in a good position, whichever Monsoon may be prevalent in the Arabian Sea. If the N.E. Monsoon has already set in, indications of it will be found in the recession of the S.E. Trade from the Equator, and the general prevalence of variable winds in that region,—chiefly, however, from N.W. to W., with calms.

IV. The **Middle route** for the same time of year is more easterly still than the Boscawen route. Sufficient easting must be made after passing the Cape to cross the parallel of 30° S. in about Long. 68° to 70° E., then steer North to pass well to the eastward of Cargados Garajos and Saya de Malha bank, and be in about Long. 67° to 69° E. when passing the Chagos archipelago and its outlying banks; also cross the Equator between the same meridians, and the ship will be in a good

position even should the N.E. Monsoon have set in, for the N.W. and W. winds prevalent near the Equator at that season will be favourable, but guard against an easterly set towards the Maldivhs; with light variable airs put the ship on the tack most advantageous for making the port.

Having passed the north end of the Lacadivhs, there will be no difficulty in reaching the more northern ports; for those to the southward take the Nine Degrees or Eight Degrees channel.

Bound to Ceylon, and having taken the Middle Route in September or October, as also in March or April, a vessel as soon as she has passed the Chagos archipelago may steer direct for the One and Half Degree channel, or even to the south of the whole of the Maldivhs.

V. The **First Outer route** is for vessels bound to the bay of Bengal with the *certainty* of making their port *during the S.W. Monsoon.*

Having rounded the Cape, and run down the easting, steer to cross the parallel of 28° S. in Long. 82° E.; then proceed to the northward, tending to the eastward rather than the westward in crossing the S.E. Trade-wind region; cross the Equator, for the northern part of the bay of Bengal, in Long. 84° or 85° E., and then steer direct for the port of destination.

For Trincomalie, Madras, or ports in the southern part of the bay, cross the Equator in Long. 82° or 83° E., and make the land to the *southward* of the port, as a strong northerly current is prevalent during the S.W. Monsoon.

For the gulf of Manaar, Colombo, or point de Galle, by this route, there is no necessity to go further east than Long. 78° or 79°, because in making the land the vessel must be to the westward, since the current during the S.W. Monsoon invariably sets round cape Comorin into the gulf, and thence to the southward down the west coast of Ceylon.

VI. The **Second Outer route** is exclusively for the bay of Bengal *during the N.E. Monsoon.*

Having run down the easting, cross the parallel of 28° S. in Long. 85° E., then lay up to the northward so as to pass 100 or 150 miles to the westward of Acheen head, the N.W. point of Sumatra; and thence steer for the Nicobar islands, leaving them to the eastward; from this point vessels may frequently make the northern part of the bay of Bengal without tacking. (See also p. 468.)

Bound to Madras, a direct course can be shaped from the Nicobars; but generally there is no occasion to cross the Equator further east than Long. 86° or 87°, if bound to the Coromandel coast or Trincomalie at this season.

The route east of the Nicobars and Andamans, when bound to the northern ports of the bay of Bengal, is now rarely (if ever) attempted, for between those islands and the mainland the winds are generally light and variable.

When the Monsoon has fairly set in, remember the land should be made to the *northward* of the port of destination, as the current is southerly.

Bear in mind that, on any of these routes, when crossing the region of the S.E.

Trade-wind, and of the Equatorial current, the tendency is to the westward, for which due allowance must be made.

The Western Route to China during the S.W. Monsoon:—and for Sunda Strait and the W. coast of Sumatra during both Monsoons:—

Run down the easting between the parallels of 43° or 44° S.; there is no necessity for sighting St. Paul or Amsterdam island unless to verify the position of the ship. Between April and September, having passed the meridian of those islands, bear up to the N.E.-ward, and cross the parallel of 20° S. between the meridians of 102° to 104° E., and be well to the eastward when making the land about Java head—especially in June, July, and August, when a strong westerly current prevails along the south coast of Java. Bound to Bencoolen and ports on the west coast of Sumatra at this season, make them to the southward and eastward. It is only at this season (when the S.W. Monsoon prevails in the China sea) that the route by Sunda strait is taken for the China ports.

From September to March the parallel of 20° S. may be crossed with advantage between the meridians of 96° to 98° E.; thence steer for Java head, and be well to the northward and westward on making it, as the W. and N.W. winds blow strong at this season, producing an easterly set along the S. coast of Java. For Bencoolen, make the parallel of Keeling island in 96° E., and then steer for Trieste island.

According to Dutch ships, the following are the best routes to adopt for Sunda strait; vessels that take more easterly meridians in the several months generally lose a day or two on this part of the voyage:—

No. of Ships.	Months.	Cutting 80° E. in Lat. S.	Cutting the Parallels of						No. of Days from 80° E. to Sunda Strait.
			35° S. in Long. E.	30° S. in Long. E.	25° S. in Long. E.	20° S. in Long. E.	15° S. in Long. E.	10° S. in Long. E.	
30	January	37°5	83°5	90°5	93°5	96°0	98°5	99°8	18·4
22	Feb.	37·0	82·8	93·5	94·8	98·0	100·0	97·8	19·3
20	March	37·5	85·5	93·2	97·3	99·5	102·5	103·5	20·9
25	April	38·3	87·8	94·8	98·5	102·0	104·3	104·0	19·2
17	May	37·5	86·8	95·5	100·5	102·5	104·0	105·0	17·6
34	June	37·5	89·0	98·5	102·5	104·0	104·8	105·3	17·9
51	July	36·8	88·8	98·0	101·5	104·5	104·5	105·3	16·2
50	Aug.	37·0	87·8	99·5	101·3	104·5	104·5	105·3	16·3
53	Sept.	37·3	88·8	97·5	101·3	104·3	104·3	105·3	16·4
63	October	37·5	87·6	95·5	99·3	100·8	103·0	103·8	15·9
35	Nov.	37·3	87·0	95·0	97·0	99·5	101·5	103·0	17·3
44	Dec.	37·8	87·5	93·0	96·0	97·5	99·3	101·3	18·3

Sunda Strait.—Having arrived off the entrance of Sunda strait, in the S.E. Monsoon, it is preferable to proceed through Princes channel, as there is anchorage in it if becalmed. In the Great channel the water is deep, and with baffling winds

or calms, which occur even in the strength of this Monsoon, a vessel may be driven out of the strait, as there is no anchorage. If the strait is entered by the Great channel, Princes island should be kept close on board, and when farther in the strait, keep on the Java shore.

By Princes channel avoid the Carpenter rocks off the south end of Princes island.

From Third point (on the Java shore) a vessel may steer N.N.E. for Thwart the Way, if the winds are steady; but with variable winds, the Java shore should be kept on board, taking care to avoid the dangers in Pepper bay, for when the current is running to the westward, in the middle of the strait, an eddy will be experienced near the land; anchorage will be found anywhere along shore, except near Fourth point, where the bottom begins to get foul and rocky. A *fixed bright* **light** is shown on Fourth point; elevation 97 feet, and visible 16 miles.

Vessels entering the Java sea take the channel between Java and Thwart the Way (formerly Middle) island. Homeward bound vessels from China, with the N.W. Monsoon, often take the channel between Sumatra and Thwart the Way; it is the most direct; in mid-channel stand the Stroom rocks; with the assistance of the strong westerly current, and a fresh breeze blowing, the channel north of these rocks may be taken, otherwise pass south of them.

To China—the Eastern Route—when the N.E. Monsoon prevails in the China Sea.

Running down the *easting* a composite track, such as described on p. 736, may be adopted, so as to strike the meridian of 111° E. in Lat. 30° S.; then make towards the N.W. cape of Australia, sighting it or not according to the prevailing winds.

From November to April, with the N.E. Monsoon in the China sea, the N.W. or westerly Monsoon prevails to the southward of the Sunda isles, producing an easterly set, therefore, from the parallel of the N.W. cape, steer to keep to the westward of the strait through which it is intended to pass.

From April to November the S.E. Trade, with a westerly set, prevails over the whole region between the coast of Australia and the Sunda isles; taking this route at that season, keep to the eastward of the entrance strait to the Indian Archipelago.

For China by the Eastern Route, the following channels may be used:—

The Strait of Lombok may be known by the island of Pandita, which divides its entrance into two nearly equal channels, either of which may be used; but the eastern channel is preferred; taking the western one, avoid the west point of Banditte, and generally give the island a good berth in light winds.

Taking the eastern channel of Lombok strait, keep midway between Pandita and Lombok, and afterwards nearer to the eastern than the western shore; the current is very strong, and no soundings can be had.

Taking Allas Strait—which is safe and much frequented—keep nearer the Lombok than the Sombawa shore, because there are soundings near the S.E. point of the former island, while the shore of the latter is very steep; this is the strait to use if intending subsequently to pass through Salayer strait.

The Strait of Sapie is much frequented, although imperfectly surveyed. A

vessel making for the strait of Sapie with light variable easterly winds should sight the western extremity of Sumba or Sandalhaut island. With westerly winds—which are generally strong—make the south coast of Sombawa. Once in the channel, a vessel may proceed through it to the Sea of Java, passing either east or west of Banta island. There are several shoals in the middle of the northern part of this strait.

The straits of Flores, Alloo, and Pantar, between the islands of Flores and Ombay, are small, with strong currents in them; therefore Ombay is preferred, or perhaps one of those west of Flores.

The Ombay Channel is deep and safe; from the N.W. coast of Australia, pass between Sumba and Savu, or between Savu and Rotti, if the winds are favourable. With the N.W. Monsoon and strong easterly currents, take the route to the west of Sumba or Sandalhaut island, passing between that island and Flores.

Round the Cape of Good Hope to Mauritius, Reunion, Red Sea, &c.—Bound to Mauritius or Réunion, enter the southern limit of the S.E. Trade on the meridian of the island from March to October; but from October to March make two or three degrees more easting, as at this season the Trade is nearly due east, and on approaching their vicinity the wind will be found to vary from N.W. to N.N.E.

Bound to the Red Sea or the Persian Gulf, either of the passages east of Madagascar (II. III. p. 740) may be adopted from September to March; but from March to September, the Mozambique channel route (I. p. 738) is the most direct.

From Mauritius or Reunion to India.—When the S.W. Monsoon prevails in the Northern Indian Ocean the course is direct towards the Equator, passing east or west of Cargados Carajos, and then proceed as indicated on p. 740.

During the N.E. Monsoon, stand to the northward towards the Equator as above; then, if bound to Ceylon or the S. part of the bay of Bengal, take the Equatorial or the One and Half Degree channel as shown on p. 741. On taking the Boscawen route as far as Lat. 4° or 3° S., keep the parallel, steering eastward to Long. 82° to 84° E. if bound for the west coast of India, but make for the meridian of 92° or 94° E. if bound for the northern part of the bay of Bengal.

To the **Cape of Good Hope** *from the westward*, log-books sufficiently indicate that few good passages are ever made by attempting to cross the meridian of Greenwich in too low a latitude; vessels may safely go as high as 37° or 38° S., hauling up as they approach towards the land.

Bound from the **Cape of Good Hope** to the Indian Ocean, steer boldly to the south into the parallel on which it is proposed to run down the easting.

Navigating *from the eastward* towards the **Cape of Good Hope**, the longer a vessel can keep within the strength of the S.E. Trade, the greater is the probability of shortening the passage. Passing the south extreme of Madagascar at the distance of 90 or 100 miles the African coast may be made anywhere between port Natal and Algoa bay, and by that course advantage will be taken of the Agulhas current

running to the S.W.-ward; then follow the outer edge of the Agulhas bank to the meridian of 24° or 23° E.; passing on to the westward and keeping well clear of the land, sight cape Agulhas if possible, and then stand out so as to double the cape of Good Hope well to the southward. If not sure of the vessel's longitude, do not steer to the N.W.-ward to double the Cape until she has lost soundings on the western edge of the bank. "In passing the Cape of Good Hope with a view of stopping there, the cold water on the Agulhas bank will be entered. The use of the thermometer in navigation is now well known; if used here it will give timely warning, and should claim attention, whatever confidence may be put in the position of the ship. All that is necessary in passing the Cape is to preserve the temperature of the water above 70°, which is the temperature of the current setting to the S.W., and which will carry a vessel quickly to the west. The water on the Agulhas bank is always below 70°, and if due attention is paid, the land cannot be reached without noticing it; no possible danger can occur. When bound to Table bay keep within the cold water: the current will carry a vessel to the northward along the coast."—*U. S. Exploring Expedition.*

When the wind is strong from N.E., varying from N. to W., it is better to sight or keep near the land—where the water is smoother than in the offing.

The weather is sometimes foggy, obscuring the coast, while the summits of the mountains alone are visible; a vigilant look-out is then indispensable, for the soundings on the bank are irregular, and in some places very steep near the coast. There is now a good light on the cape of Good Hope.

The Homeward Passages.

From the **Red Sea,** the **Persian Gulf,** and ports on the **W. coast of India,** during the N.E. Monsoon, the route by the Mozambique channel may be adopted; it is the most direct route from the Red Sea and Persian Gulf. But from the ports on the W. coast of India it should only be taken during the height of the Monsoon, in December and January, when N.E. winds generally prevail throughout the Mozambique channel, and reach very nearly to the southern part of it; towards the beginning or end of the Monsoon a vessel would be detained by southerly winds (frequent in October and November, as also in February and March,) notwithstanding the strong southerly current is undoubtedly favourable.

From the Red Sea or the Persian Gulf the route, as already said, is direct. Steering for the entrance to the channel, make the Seychelles, and then pass west of Comoro, or take either of the channels between this island and Mayotta. With the wind fresh from the northward, keep in mid-channel; if, on the contrary, the wind be variable or southerly, approach the African coast to profit by the favourable current prevailing there. Always pass to the west of Juan de Nova, the Europa rock, the Bassas da India, and make cape Corrientes, if possible; then preserve a distance of from 20 to 30 miles from the Natal coast, unless the S.E. wind brings a heavy sea, in which case stand further from it; thence proceed to double the Cape as stated on page 744-745.

From the **W. coast of India** with the N.E. Monsoon vessels cannot cross the Equator so far east as those from the bay of Bengal; hence they are often carried near Rodrigues by the S.E. Trade winds.

Leaving the west coast of India, make for the S.W. coast of Ceylon and Dondra head. From this cape stand S.E. with the N.E. Monsoon, and endeavour to cross the Line between the meridians of 84° and 85° E.

From April to November stormy weather is very rarely met with in the Southern Indian Ocean, and a vessel may then pass 30 or 40 leagues east of Rodrigues; but during the other months it is prudent to give it a berth of 70 or 80 leagues.

From Mauritius or **Reunion**:—Steer so as to pass at a distance of about 90 miles from the S.E. part of Madagascar. From the parallel of 26° 30′ or 27° S. bear away to the W.S.W.-ward until the African coast is made about Algoa bay, or even as far up as port Natal.

Leaving **Madras** or **Pondicherry** with the N.E. Monsoon, endeavour to cross the line between 86° or 87°, or still further east in 89°; then adopt the most practicable course for Mauritius or Réunion, if bound for either; otherwise pass to the southward of them, and then steer for the African coast as above.

From Bengal or **the Straits of Malacca**:—Cross the Equator in 89° or 91° E. Leaving the Strait of Malacca stand well out on a W.S.W. course before making southing, and thus avoid the light variable winds off the S.W. coast of Sumatra. With light winds near the Equator, take the course that makes most southing, in order to reach the S.E. Trades as soon as possible. When in the Trade shape a course so as to pass at a convenient distance from Rodrigues, Mauritius, or Réunion.

Leaving **Sunda Strait,** or the straits to the Eastward, and bound round the cape of Good Hope, stretch away to reach as soon as possible the zone of the Trades.

The Meteorological Institute of Holland gives the following as the best routes to be taken in each month:—

From Sunda Strait.

Months.	Long. 40° E.	Long. 50° E.	Long. 60° E.	Long. 70° E.	Long. 80° E.	Long. 90° E.	Long. 100° E.
	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.
January .	30°	28½°	25½°	22½°	19½°	18°	12°
February .	31	29	26	23½	21½	18¾	12½
March . .	30½	28½	25	23	19⅓	16½	12 & 9½
April . .	29½	27	24	20¼	17¼	13¾	9¼
May . .	29½	26⅓	23½	20	16⅔	13	8¾
June . .	29½	26¼	23½	19	15¾	12½	8½
July . .	29	26⅓	23	19	15¾	12¼	8¼
August . .	28¾	26¼	23	19¼	15¾	12¼	8¼
September .	29½	26¾	23	19⅓	15¾	12	8¼
October .	29½	27½	24¼	20¼	16¾	12¼	8¼
November .	30	28	24½	21	17	13¼	8¾
December .	30	28¼	25	22½	19¼	17½	9½

From Baly Strait.

Months.	Long. 40° E.	Long. 50° E.	Long. 60° E.	Long. 70° E.	Long. 80° E.	Long. 90° E.	Long. 100° E.	Long. 105° E.	Long. 110° E.
	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.	Lat. S.
November .	30°	28°	24½°	21°	17°	16½°	15½°	13°	11°
December .	30	28	25	22½	19¼	17¼	16¼	13	11
January . .	30	28½	25½	22½	19½	18½	17½	14½	11
February .	31	29	26	23½	22	20	17¾	16	10½
March (1st ½)	30⅓	28½	25	23	21½	20	17½	14⅓	12
„ (2nd ½)	29½	27	24	22	20½	19½	16½	14½	14½

From **Madras,** in the S.W. Monsoon, endeavour to work along the coast as far as Pondicherry before leaving the land; if this cannot be done stretch off close hauled; in the offing the wind will generally veer to the westward, when a S.S.E. course may be practicable; approaching the Equator the wind will be more southerly, in which case stand on that tack on which most southing can be made; when the S.E. Trade zone is reached, steer a direct course to pass south of Rodrigues and Mauritius, as before stated.

From the **Sandheads** in the S.W. Monsoon, endeavour to keep well to the westward, and, if possible, avoid the Andamans; but this cannot be always accomplished. Horsburgh recommends getting into Lat. 14° N. before edging away for the channel between Landfall island and the Cocos, being more to windward than that between the Cocos and Preparis.

The following notes relate to two passages down the bay:—Capt. L. Bilton, of the *Queen of the East,* in 1862, says: "May 15th—the last day of the springs—got to sea. We had light, variable, and baffling winds up to the 20th, when we got the S.W. Monsoon in full strength. However, I kept my reach on the starboard tack, chiefly under double reefs, and on the 23rd passed through the Preparis channel into the Andaman sea, and on the 25th was off Barren island; here I met with a series of light, baffling, southerly winds, with a low barometer, and was in sight of the island till the 29th, when the S.W. wind again sprang up, and on June 3rd I made the Golden Mountain, Sumatra. On the 8th I was again on the open sea, with fine weather, having escaped the heaviest of the S.W. Monsoon—I crossed the line on the 15th, and on the 22nd got the S.E. Trades, blowing very fresh, and bringing a great beam sea. July 14th, made Mauritius."

The following remarks by Captain Blanchard, of the *Rivière d'Abord,* are from the *Annales Hydrographiques,* 1865:—

"I sailed from Calcutta river for Réunion, July 11th, 1864, the pilot leaving me at 6h. A.M.; the wind being tolerably strong from the S.W. and the sea rough. The next day, the appearance of the weather was bad, the sea had considerably increased, and the wind blew in heavy and sudden squalls from W.S.W. From this time until the 20th I experienced, without intermission, hard gales with strong squalls from W.S.W. and S.W., which did not admit of my making the coast of Orissa, but drove me over to the coast of Pegu.

"I determined to pass to leeward of the Andamans, and on the 20th made the

channel between the two Cocos. I passed half a mile N. of the Little Coco, which at that end is quite steep; the bank of coral fringing the S. and W. sides terminates near the N. point and approaches nearer the coast. From that point, the dangers at the south end of the Great Coco were visible to the eastward, though the horizon was indistinct. The distance between the N. point of the Little Coco and the S. point of the Great Coco is 5 miles, but with the wind from W.S.W. and S.W., or even S., whatever its strength, care is requisite in avoiding the breakers off the larger island; when once under the lee of the smaller island, you may always go to the south.

"Having doubled that island, the sea was smooth, and though the squalls were still very strong, I could make sail sufficient to carry me quickly to the southward: I also found, when near the land, a counter-current running S.S.E. at the rate of from half a mile to a mile an hour. When Landfall island bore west the weather entirely moderated—the squalls fewer, and the breeze favourable.

"July 24th, I made Pulo Rondo to the S.S.W., Pulo Way to the S., and the Golden Mountain to the S.S.E.;—the weather beautiful, the sea smooth, and a fine breeze from W.S.W.; I steered towards Pulo Way until half a mile from the land, then tacked, and soon sighted (at a short distance to the W.) the rocks south of Pulo Rondo. These rocks appeared to me united by a line of breakers level with the water, with the exception of the highest, which is separated from the others by a small, impracticable channel, and in which is considerable rippling; this rock is also distinguished by having on it two coco-nut trees of sufficient height to render it conspicuous from a distance. The second stretch on the starboard tack brought me to the N. point of Pulo Brasse, and by 6h. P.M. I had doubled (at the distance of three cables to the westward) the N.W. islets; these rocks are not perceived to be detached from Pulo Brasse until the impassable channel between is brought to bear W.N.W. In the channel between Pulo Way and Pulo Rondo, I found the current setting to the west, and it is stronger the nearer you are to the N.W. islets. The wind now varied from S.W. to W.—a gentle breeze with occasional puffs.

"On the 31st of July, I crossed the Line 180 miles to the west of Sumatra. Thus, despite very unpropitious weather at the commencement of the voyage, I took but 13 days to pass down the bay of Bengal, and in 20 days had crossed the Equator. It appears to me, therefore, more judicious to start with the determination of passing to leeward of the Andamans—at least between the middle of June and the middle of August—making no attempt to pass to windward of them; by so doing you gain time, and put less strain on the endurance of the men, while the wear and tear of the vessel is considerably lessened."

The tracks from **Bombay, and down the bay of Bengal,** during the S.W. Monsoon, are marked on the Chart of Passages.

To and from Swan River or S. Australia.

From Swan River to Calcutta.—If sure of making the bay of Bengal before the *S.W. Monsoon* is over, steer to the N.W.-ward for the S.E. coast of Ceylon, and then proceed up the bay on the western side.

When the *N.E. Monsoon* prevails in the bay, steer N.W. (westerly) through the S.E. Trade, so as to enter the N.W. Monsoon near the meridian of 85° E., then shape a course towards Acheen head, and proceed up the bay as directed on p. 468.

From Swan River to Singapore.—In both Monsoons adopt the route through Sunda strait, making the land to the eastward in the S.E. Monsoon, but to the westward, in the N.W. Monsoon; then pass through Banka strait.

From Swan River to China.—From April to September, shape a nearly direct course for Sunda strait; from October to March, steer for the N.W. cape of Australia, and take the *eastern route* by Allas and Macassar straits in October and November; but by the Ombay and Gillolo passages from the middle of November to the middle of March.

From Calcutta to Swan River.—During the S.W. Monsoon work along the west coast of the bay of Bengal far enough to windward to weather the Nicobars, then lay out of the bay on the starboard tack, cross the S.E. Monsoon and Trade, and having entered the westerly winds, proceed to the eastward for Swan river.

During the N.E. Monsoon steer to pass 80 or 90 miles west of the Andamans and Nicobars, and having entered the N.W. Monsoon, proceed along the S.W. coast of Sumatra, giving the islands a good berth in the event of the wind veering to the S.W.-ward; on this course, having reached the meridian of 110° E., stand across the S.E. Trade into the westerly winds, and then steer eastward.

From Singapore to Swan River.—Between November and March, from Singapore strait, proceed S.E.-ward through Carimata strait, and across the Java sea, then through Sapoedie and Baly straits. Between April and October, proceed southward through Banka and Sunda straits.

From Swan River to the Cape of Good Hope or Mauritius.—Steer to the N.W.-ward to enter the S.E. Trade. The track from Australia, given on the chart of "passages," is the mean of 52 voyages; in the southern winter, two or three degrees lower latitude, in the summer, a degree or two of higher latitude than indicated on the track, will suffice to make the voyage either to Mauritius or the Cape.

The following is the track of *The Murray*, Captain Legoe, from **Adelaide** in 1865; but it was an extraordinary good run, and the winds very propitious:—

Sailed from the light ship January 16th, 1865, at 9h. P.M.; January 17th noon, McDonnell mount due South.

Jan. 18	Lat. 35° 36′ S.	Long. 134° 38′ E.		Feb. 5	Lat. 31° 46′ S.	Long. 69° 11′ E.	
19	„ 35° 23′ „	131° 48′ „		6	„ 31° 36′ „	64° 42′ „	
20	„ 35° 40′ „	128° 22′ „		7	„ 31° 27′ „	61° 0′ „	
21	„ 35° 8′ „	125° 46′ „		8	„ 31° 19′ „	58° 0′ „	
22	„ 35° 6′ „	123° 0′ „		9	„ 31° 17′ „	53° 28′ „	
23	„ 35° 6′ „	121° 46′ „		10	„ 31° 42′ „	48° 36′ „	
24	„ 35° 37′ „	119° 36′ „		11	„ 31° 52′ „	44° 40′ „	
25	„ 35° 51′ „	115° 38′ „		12	„ 32° 13′ „	40° 30′ „	
26	„ 35° 21′ „	113° 16′ „		13	„ 32° 25′ „	37° 43′ „	
27	„ 33° 38′ „	110° 0′ „		14	„ 32° 56′ „	32° 40′ „	
28	„ 31° 58′ „	105° 27′ „		15	„ 33° 25′ „	29° 28′ „	
29	„ 31° 6′ „	100° 20′ „		16	„ 34° 48′ „	24° 47′ „	
30	„ 30° 28′ „	95° 45′ „		17	„ 35° 51′ „	22° 24′ „	
Jan. 31	„ 30° 23′ „	91° 45′ „		18	„ 35° 32′ „	21° 40′ „	
Feb. 1	„ 30° 18′ „	87° 5′ „		19	„ 36° 42′ „	19° 52′ „	
2	„ 30° 27′ „	83° 1′ „		20	„ 34° 46′ „	19° 30′ „	
3	„ 30° 36′ „	77° 56′ „		21 Cape Good Hope N.N.E. 15 miles.			
4	„ 31° 19′ „	73° 47′ „		22 Stood into Table Bay.			

Vessels do not make for such low latitudes as formerly recommended on this route.*

For the MAURITIUS the track is south of Rodrigues, giving it the widest berth from November to April, the hurricane season.

For the CAPE there is no necessity to approach the S.E. extreme of Madagascar.

From ADELAIDE on this route stretch across the Bight as the winds permit, but do not approach too near the coast.

Passages up or down the Bay of Bengal.

For the navigation of the Bay of Bengal it may be remarked, in general terms, that there is no difficulty in proceeding from southern to northern ports during the prevalence of the S.W. Monsoon; nor from northern to southern ports during the N.E. Monsoon: also, in the lower part of the bay, vessels bound from a port on the east side to another on the west may make it with facility during the N.E. Monsoon, as vessels from a western to an eastern port have no difficulty during the S.W. Monsoon. When, however, the Monsoon is adverse, it results that a vessel must either *beat* (up or down as the case may be),—or, after standing some distance across the bay, then shape course for the port of destination; and again, at the *change* of the Monsoon the voyage may be tedious, for the light and variable winds of this period must be quite as often adverse as favourable,—requiring great judgment on the part of the commander, since no instructions would completely suffice for all the different meteorological changes which at that season occur; certain it is he should take advantage of every favourable slant, and avoid the east coast as much as possible —unless bound to or from one of the ports on that side of the bay.

Remember that on the Coromandel coast and the east coast of Ceylon the current always runs strong to the southward during the N.E. Monsoon, and to the northward during the S.W. Monsoon; consequently the land must be made 20 to 40 miles to the northward of the port in the former season, but to the southward in the latter. Also, when beating down the bay during the S.W. Monsoon every endeavour should be made to keep as far west of the Andamans as possible, so as not to make them a lee shore in case a strong westerly gale sets in. In all seasons the coast of Aracan should be avoided as much as possible.

Opinions are, however, divided as to whether, in beating down the bay of Bengal, the Andamans should be passed to the east or to the west. If the winds permit of beating some short distance down the west side of the bay, it may be possible, when stretching across, to pass westward of the Little Andaman at the distance of about 100 miles, in which case the Nicobars may also be passed to the westward. Others are of opinion that time is lost by tacking to the westward, and that it is more advantageous to pass north of the Andamans through the principal channel, and *then* work down to the southward.

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* The Admiralty Directions, however, say, "Take the parallel of 19° or 18° S. in summer, and two or three degrees nearer the Equator in winter."

Captain Miller, in a communication to the *Nautical Magazine* in 1843, gives the following general rules for the navigation of the Bay of Bengal:—

From 15th January to 31st May . .	Going north, or up the bay, take the western side; coming south, or out of it, take the eastern side.
In June, July, and August	Going north, keep in the middle of the bay; coming south, take the eastern side, even east of the Andamans.
In September, October, and November	Going north, take the eastern side; coming south, take the western side.
In December, and to the 15th January	Going either north or south, keep the middle of the bay, and make short tacks.

From Ceylon or Madras to Bengal, during the S.W. Monsoon the course is direct; keep a moderate distance from the land, and do not approach it till north of Vizagapatam.

During the N.E. Monsoon make casting across the bay; the northing can always be made on its east side, though frequently it may be possible to do so in the middle of the bay.

In February and March—end of N.E. and beginning of S.W. Monsoon—a vessel from the east coast of Ceylon may possibly make her northing direct, otherwise she must stand to the eastward. From Madras give the coast a good berth, and take advantage of the variable winds near the middle of the bay.

In September and October—end of S.W. and beginning of N.E. Monsoon—avoid the coast; stretch over to the North Andaman, or towards cape Negrais, and when 90 to 100 miles off either, tack to the N.W.-ward.

From Bengal to the Southern Ports on the west side of the Bay.—The N.E. Monsoon is favourable, but avoid approaching too near the coast, where strong gusts prevail at the height of the Monsoon, and light variable winds towards its close. In September, with light southerly winds, work to the S.W.-ward, without leaving soundings—if possible; otherwise stand out to sea and make use of every available slant of wind.

With the S.W. Monsoon, make all the southing possible without going too far over to the east side of the bay; when 60 to 80 miles south of the port of destination steer for it. If the winds are favourable, Ceylon may probably be made from Lat. 10° N. on the meridian of point Palmyra.

From Malacca Strait or Acheen to Bengal.—During the N.E. Monsoon, pass E. or W. of the Nicobars as the wind permits, in the former case entering the bay of Bengal between Carnicobar and Little Andaman, if possible. Horsburgh, however, recommends taking a departure from Junkseylon, then making for Narcondam pass north of the Great Andaman, between it and the Cocos, or between the latter and Preparis.

During the S.W. Monsoon the passage should be made to the westward of the Nicobars and Andamans.

From Bengal to Malacca Strait.—During the N.E. Monsoon, the most expe-

ditious route is to pass through the channel between cape Negrais and Preparis island, or between Preparis and the Cocos, and then shape course to the southward. During the S.W. Monsoon, the same route (viz., between Preparis and the Cocos), may be used, but greater caution is required in making the latter group as the weather is thick and hazy; from the north end of the Andamans make for Barren island, thence towards Sayer island, giving it a good berth; in making to the southward, avoid alike the Andamans and the islands on the Tanasserim coast.

From the Various Ports of the Bay of Bengal to Rangoon.—From Bengal, during the N.E. Monsoon, sight Cape Negrais. Do not make easting until the reefs off the cape are passed. From ports on the Coromandel coast make to the northward, and take the channel north or south of Preparis, as most convenient.

From Bengal for Rangoon during the S.W. Moonson, if the wind permits, endeavour to make Preparis—or what would be still better, Cocos island. Then take the most convenient channel, so as to make the coast of Pegu, a little west of the bar of Rangoon. From a port on the Coromandel coast, a vessel should endeavour to make Landfall island (Andamans) if the wind hangs to the southward, or Cocos island if the wind draws westerly, and then pass through the channel between them; on leaving Cocos channel steer east to sight the island of Narcondam; then steer N.E. to make the coast of Pegu, as before.

Vessels from the strait of Malacca or Acheen, bound for Rangoon during the N.E. Monsoon, should sight the westernmost of the Mergui islands, and then make to the northward for the entrance to Rangoon river.

A vessel from Acheen or the Malacca strait in the S.W. Monsoon, should sight the island of Narcondam, and from thence steer for Rangoon bar.

These routes are equally available for ports on the coast of Martaban.

From Rangoon to the Various Ports of the Bay of Bengal.—From Rangoon during the N.E. Monsoon for Bengal, a vessel having passed outside all the shoals near the coast of Pegu, and southward of the dangers off cape Negrais, should then continue along the coasts of Ava and Aracan, not approaching them too close. Bound for some port on the Coromandel coast, take one of the channels between cape Negrais and Landfall island, and then proceed for the port of destination. Bound for the strait of Malacca, sight the southern extremity of Junkseylon. If for Acheen, steer direct for it.

Leaving Rangoon for ports on the west side of the bay of Bengal, during the S.W. Monsoon, a vessel should standing out to sea, endeavour to pass between the Cocos and Preparis, or through the channel north of Preparis, from whence, if bound to Bengal, the course is direct. Bound to any port on the Coromandel coast, to Acheen, or to Malacca strait, keep out to sea if the wind becomes westerly, and endeavour to sight the island of Narcondam. Going south some boards should be made to keep the islands near the coast of Tanasserim at a moderate distance, although there are several safe channels among them. For the strait of Malacca, after having passed the south point of Junkseylon, make direct for Prince of Wales island. Bound for Acheen, if possible get to the westward, towards the Nicobars, or else keep the southern tack till Pedir (N. coast of Sumatra) is made, and where the current (running west) will be favourable for reaching Acheen. For the Coromandel coast take the channel between Pulo Way and Pulo Brasse, then, when out at sea, make the most of every change

of wind to gain westing. The voyage from Rangoon to southern and western ports is always a tedious one during the S.W. Monsoon.

From the Bay of Bengal to Ports on the West Coast of India, during the S.W. Monsoon.—Having crossed the Equator, and entered the region of S.E. winds, steer west between the parallels of 4° or 5° S., taking care to pass well north of Speaker bank—the northernmost danger of the Chagos group; then pursue a course to cross the Equator in 62° or 63° E., whence the ports on the Malabar coast can readily be made; this is the *northern route*, and could only be tried successfully in June, July, and the beginning of August, when the S.W. Monsoon is at its height.

The *southern route*, practicable during the whole period of the S.W. Monsoon, and especially for vessels from Bengal, Sumatra, or Java, is to run down the *westing* between the parallels of 8° or 9° S.,—and south of the Chagos Archipelago; from the meridian of 70° E., bear away to cross the Equator in 62° or 63° as before. Bound to the Persian gulf, the Equator should be crossed near the meridian of 52° E. Bound for the Red sea take the meridian of 48° E.

NOTE ON THE TIDAL CHART OF THE INDIAN OCEAN.

The co-tidal lines on this chart represent the "Establishment of the Port," Greenwich time, at all the places through which they pass.

In the Indian Ocean, the tide wave, little interrupted by submarine inequalities of surface, makes its way in an irregular curve to the shores of India, and there divided by the pyramidal form of the peninsula of Hindostan, one portion proceeds up the bay of Bengal, and the other towards the Persian gulf; the former having no escape, and not dissipated by irregularities in the form of the land, gradually increases in height as the bay narrows, and finally reaches the mouth of the Ganges, where it expends its force on the shores in the form of the well-known and terrific *bore* of the Hoogly. (*See* also p. 192.)

[N.B.—For full reference to the Winds, Weather, Storms, Currents, Tides, Ice, Whaling Ground, the Magnetism of Iron Ships, the Variation of the Compass, Specific Gravity and Temperature of the Ocean, &c., see "TABLE OF CONTENTS" at the commencement of the book.]

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AFRICA,—THE SOUTH, EAST, AND N.E. COASTS; THE S.E. COAST OF ARABIA; MADAGASCAR, AND THE COMORO ISLANDS.

INDEX II.

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INDEX III.

AUSTRALIA,—WEST AND SOUTH COASTS; AND TASMANIA.

LIST OF LIGHTS.

The following is a complete List of Lights in geographical order for all places mentioned in this work, corrected to June 1867. Where the Lights are already described, reference is made to them simply by the page;—where New Lights have been established, or where the Lights have been altered, they are given below according to the official notices.

F. for fixed; *Fl.* for flashing; *Rev.* for revolving.

TABLE BAY:—Robben island p. 274.—Green point p. 277.—Mouillé point p. 277.—N. and S. Jetties p. 277.—Staging of Breakwater, *F. green* light.

CAPE OF GOOD HOPE, p. 286.

SIMONS BAY:—Roman rocks p. 286.

CAPE AGULHAS, p. 296.

MOSSEL BAY:—Cape St. Blaize p. 302.

CAPE RECIFE, p. 309.

ALGOA BAY:—Port Elizabeth p. 311.—Bird island p. 322.

BUFFALO RIVER (East London) p. 329.

NATAL:—On the Bluff, *Rev.* every *minute:* elevation 292 feet; visible 24 miles in all directions from North, round by East and South to S. 59° W., Lat. 29° 52′ 50″ S., Long. 31° 3′ 35″ E.—A harbour light is also proposed.

MOZAMBIQUE PORT:—St. George or Goa island, *building.*

COMORO ISLANDS:—Mayotta road, on the Jetty, *F.*

REUNION:—St. Paul bay p. 520.—St. Denis p. 520.—Bel-Air point p. 520.

MAURITIUS :—Port Louis, *light-vessel, Fl.* at short intervals, visible 9 miles, moored in 15 fathoms.—Cannonier Point, p. 536.—Flat island, p. 536.—Grand or Bourbon Port, p. 539.

ADEN :—Ras Marshigh, *F.*, elevation 244 feet, visible 20 miles, Lat. 12° 45′ 23″ N., Long. 45° 4′ E.—Also, a *Light-vessel* p. 389.

RED SEA :—Perim island, 1100 yards S.W. of N.E. bluff, *Rev.* every *four minutes*, elevation 241 feet, visible 23 miles, Lat. 12° 40′ 20″ N., Long. 43° 25′ E.—Dædalus shoal, *F.*, elevation 61 feet, visible 14 miles.—Jubal strait, Ashrafi or Ushruffi reef, N.E. part, *Rev.* every *minute*, elevation 125 feet, visible 18 miles.—Zafarana Point, *F.*, elevation 83 feet, visible 14 miles, Lat. 29° 6′ 20″ N., Long. 32° 44′ E.—Suez, *light-vessel* off Gal ul Murkub Point, *F.*, visible 6 miles, Lat. 29° 54′ 50″ N., Long. 32° 33′ E.

KARACHI, p. 404.

CUTCH GULF, p. 407.

CAMBAY GULF, p. 407.

BOMBAY :—Outer *light-vessel, Rev. red* from May 1st 1868.—Inner light-vessel, p. 410.—Kolaba Point, p. 410.—Dolphin rock, p. 410.

KHUNDARI OR KENNERY :—*F.* light established, June 1867, on Khundari island, Lat. 18° 42½′ N., Long. 72° 48′ E.

RATNA GHERI OR RUTNAGHERRY :—on S. bastion of fort, *F. red*, elevation 300 feet, visible 18 miles, Lat. 16° 59′ N., Long. 73° 15′ 47″ E.

SEDASHIGUR :—p. 414. now visible 25 miles.—Also, a *red* light in the bay near Koney hill, from the Post office window.

CÓUMTA :—p. 415.

MANGALORE :—p. 415.

CANNANORE :—p. 416.

TELLICHERRY :—p. 416.

CALICUT :—p. 416.

COCHIN :—p. 416.

ALIPEY :—p. 419.

COLOMBO :—p. 424; also, the Drunken Sailor rock will be marked by a *black* buoy during the N.E. Monsoon.

POINT DE GALLE :—p. 427.

LITTLE BASSAS :—p. 433.

TRINCOMALIE :—Foul point, p. 438.—Round island, p. 438.—

TUTICORIN :—p. 443.

PAUMBEN PASS :—p. 447.

NEGAPATAM :—p. 448.

CARRICALL OR KARIKAL :—p. 448.

PONDICHERRY :—p. 449.

MADRAS :—p. 450.

PULICAT :—p. 453.

ARMEGON SHOAL :—p. 453.

DIVY POINT .—p. 454.

MASULIPATAM :—p. 454.

GORDEWARE OR GODAVERY POINT :—

COCANADA :—p. 456; it is doubtful if this be lighted.

SANTIPILLY ROCKS :—Conada Hill p. 458.

FALSE POINT :—464.

PILOT RIDGE :—*Light-vessel* p. 465.

HOOGLY RIVER :—*Lower light-vessel* p. 465;—*Upper light-vessel* p. 465.

SAUGOR ISLAND :—p. 465.

COWCOLLY OR KAOKALI :—p. 465.

MUTLAH RIVER :—*Light-vessel* p. 470.

CHITTAGONG RIVER—Norman's point, 2 *F.*, elevation 38 & 30 feet, visible 7 or 8 miles, Lat. 22° 20′ N., Long. 91° 47′ 42″ E.—Norman's point by day is marked by a barrel shaped beacon on a tripod 65 feet high; to be approached on a bearing from N.E. to E.N.E., p. 473.

KOOTUBDEAH ISLAND :—p. 473.

SAVAGE ISLAND :—p. 473.

BORONGO :—p. 473, not lighted.

ALGUADA REEF :—p. 478.

RANGOON :—*Light-vessel* p. 483.

AMHERST POINT :—p. 486.

DOUBLE ISLAND—N. point of the island, *F.*, elevation 134 feet, visible 19 miles, Lat. 15° 52′ 30″ N., Long. 97° 36′ 30″ E., a strip of light shows from the Patch buoy, eastward, as far as Amherst point, p. 483.

GREAT COCO ISLAND, ANDAMANS :—Table island, *F.*, elevation 200 feet, visible 20 miles, Lat. 14° 8½′ N., Long. 93° 18′ E., p. 625.

ROTTNEST ISLAND :—p. 656.

SWAN RIVER :—Arthur Head p. 658.

KING GEORGE SOUND :—p. 670 & p. 671.

CAPE BORDA, OR FLINDERS :—p. 672.

TIPARA SHOAL :—*Light-vessel* p. 673.

TROUBRIDGE SHOAL :—p. 684.

PORT ADELAIDE —p. 685.

CAPE WILLOUGHBY :—p. 683.

CAPE NORTHUMBERLAND :—p. 692.

CAPE BRIDGEWATER :—p. 692.

PORTLAND BAY :—p. 694.

PORT FAIRY :—p. 694.

LADY BAY OR WARRNAMBOOL :—p. 695.

CAPE OTWAY :—p. 696.

KING ISLAND :—p. 696.

LONSDALE POINT :—p. 697.—The temporary *fixed red* and *green* light discontinued after the 25th day of February 1867, and a light of the

same character, but of greater power and more extended range exhibited from lighthouse near point Lonsdale Telegraph station.

From seaward the light will appear *green* between the bearings of about N. by W. and N.W. ½ W.; and *red* between N.W. ½ W. and W. by S.; visible 10 miles.

The N.W. ½ W. line passes near the Lonsdale and Lightning rocks, and navigators are therefore cautioned to be on their guard before the colours begin to change, as the blending of the red and green lights will indicate close proximity to the line which passes from the lighthouse over these dangers.

SHORTLAND BLUFF:—p. 697.
CAPE SCHANCK:—p. 698.
WILSON PROMONTORY:—p. 699.
PORT PHILLIP:—p. 701;—p. 702;—p. 703;—p. 704;—p. 705.
GEELONG HARBOUR:—p. 704, *Red* light on first dolphin, in-shore of *light-vessel*.
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PORT DALRYMPLE:—p. 708.
PORT ALBERT:—p. 709.
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AND INSTRUCTIONS TO BINDER.

SHORT NOTES

ON THE

WINDS, WEATHER, & CURRENTS,

TOGETHER WITH GENERAL

SAILING DIRECTIONS

AND

REMARKS ON MAKING PASSAGES:

TO ACCOMPANY CHARTS OF THE

CHINA SEA;

INDIAN ARCHIPELAGO & WESTERN PACIFIC.

WITH ILLUSTRATIONS.

By W. H. ROSSER.

Author of "The Self Instructor in Navigation and Nautical Astronomy"; "The Ship's Position at Sea"; "North and South Atlantic Directory, &c., &c."

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*** The Publishers respectfully invite communications that may tend to the improvement of this or any other of their works.

PREFACE.

THE following pages describe the WINDS, WEATHER, and CURRENTS prevalent in the CHINA SEA and in the WESTERN PACIFIC, at all seasons of the year, compiled from all available sources; then by a natural transition, the subject of MAKING PASSAGES during the two Monsoons and at the Change of the Monsoons receives a fair share of consideration. The navigation of the China Sea by the *direct route* has been greatly facilitated by late Surveys; the result of these is given here in some detail.

The work has been chiefly compiled with reference to *Three Sets of Charts*, recently issued by Messrs. IMRAY AND SON, viz :—

The EAST INDIA ARCHIPELAGO, (Western Route to China) Nos. 1 to 6.

The EAST INDIA ARCHIPELAGO, (Eastern Passages to China) Nos. 1 to 9.

The WESTERN PACIFIC OCEAN, Nos. 1 to 7.

but at the same time, it will be found equally applicable to any set of charts; and it is hoped that the remarks and observations here collected—while they give much information generally useful to all navigators—may be of special service to those making their first voyage to the East.

W. H. R.

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N.B.—For List of Lights and Addenda corrected to December 1st, 1873, see pages vii. and ix.

WINDS AND CURRENTS.

ON MAKING PASSAGES.

CHINA SEA—ROCKS, SHOALS, &c.

Formosa Island—S. & W. Coasts.

TO BINDER.

LIGHTS.

—o—

The following is a brief description of the Lights shown at this date (December 1st, 1873), within the limits of the Navigation described in this work:—

Tylatiap (Java)	*Revolves* every minute; visible 20 miles.
Sunda Strait	On Fourth point. *Fixed;* visible 20 miles.
„ „	Anjer, west pier. *Fixed red;* visible 4 miles.
Menscheneter Island	*Flashing; visible 16 miles. Building.*
Batavia (Java)	West pier. *Fixed*; visible 13 miles.
Boompjes Isles	On Rackit island. *Revolves*; visible 23 miles.
Cheribon (Java)	North mole. *Fixed*; visible 8 miles.
North Watcher	*Revolves* every minute; visible 20 miles.
Pekalongan	West side of river. *Fixed*; visible 8 miles.
Sourabaya Strait	*Lightvessel* at northern entrance. *Fixed*; visible 10 miles.
„ „	Kresik harbour. *Fixed*; visible 8 miles.
Madura Strait	On Zwantyes or Koro reef. *Revolves* in 2 minutes; visible 14 miles. Bell in fog.
Baly Strait	On Duiven island. *Fixed*; visible 15 miles.
Banjoewangie	Utrecht fort. *Fixed*; visible 8 miles.
Delli (Timor)	A small *fixed* light.
Banka Strait	Lucipara *lightvessel. Fixed*; visible 10 miles.
„ „	Mintok pier. *Fixed*; visible 8 miles.
„ „	On Kalian point. *Fixed*; visible 20 miles.
Gaspar Strait	On Jelaka island, off west side of Leat island. *Fixed*; visible 8 miles.
„ „	On east point of Pulo Lepar island. *Fixed*; visible 8 miles.
Rhio Strait	Little Garras island. *Fixed*; visible 8 miles.
„ „	Terkolei island. *Fixed*; visible 6 miles.
„ „	Pulo Sauw island. *Fixed*; visible 8 miles.
Singapore Strait	Raffles. on Coney islet. *Fixed*; visible 12 miles.
„ „	Fort Canning, Singapore. *Fixed*; visible 15 miles.
„ „	Horsburgh light, on Pedra Blanca rock. *Revolves* every minute; visible 15 miles.
Sarawak River (Borneo)	On Tanjong-po, north side of entrance. *Fixed*; visible 15 miles.
Macassar, (Celebes)	Rotterdam fort. Harbour light.
„ „	About ½ mile south of Losari monument. *Fixed* (*red* and *white* sectors).
Balabac Island	South point of Alphonso port. *Fixed*; visible 10 miles. *Indifferent.*
Mindanao Island	On mole of Samboanga. *Fixed*; visible 5 miles.

Philippines	Zebu port, entrance. *Fixed*; visible 4 miles.
,, ,,	Rombon island. A *fixed* light on Sabang point.
,, ,,	Burias island. *Fixed* lights at port Busin and one at Boca Engano. A *fixed blue* light at port Busainga and another at Malaguing-Gilog. *All of doubtful existence.*
,, ,,	Corregidor island. *Revolves* every half minute; visible 20 miles. Also a small *fixed* light on west mole-head.
,, ,,	Caballo island. *Fixed red*; visible 6 miles.
,, ,,	Manilla. *Fixed*; visible 8 miles.
,, ,,	Cavite. *Fixed*; visible 7 miles.
Cape St. James	Lat. 10° 19′ 14″ N., long. 107° 5′ 25″ E. *Fixed* light; visible 28 miles.
Cangiou	*Lightvessel*, in 5 fathoms, lat. 10° 36′ 49″ N., long. 106° 51′ 14″ E. *Fixed*; visible 10 miles.
Macao	On fort Guia. *Revolves* every minute; visible 20 miles.
Canton River	Two lights on the starboard side entering, one on the port side.
Lamock Island	*Lat.* 23° 14′ 50″ N., *long.* 117° 17′ 30″ E., *Fixed*; *visible* 22 miles. *In construction.*
Amoy	Chapel island. *Fixed* (*flash* every half-minute); visible 22 miles.
,, ,,	Taitan island. *Fixed*; visible 10 miles.
Turnabout Islet	Lat. 25° 26′ N., long. 119° 58′ 40″ E. *Fixed*; visible 22 miles.
White Dog Islands	On Middle Dog island, lat. 25° 58° 20″ N., long. 120° 2′ 20″ E. *Fixed* (*flash* every half-minute); visible 22 miles.
Yung River (entrance)	Tse-le island. *Fixed*; visible 9 miles.
,, ,,	Pas Yeu island. *Fixed red*; visible 5 miles.
West Volcano Island	Lat. 30° 18′ 15″ N., long. 121° 55′ 30″ E. *Fixed*; visible 15 miles.
North Saddle Island	Lat. 30° 50′ 20″ N., long. 122° 40′ E. *Revolves* every minute; visible 18 miles.
Gutzlaff Island	Lat. 30° 47′ 38″ N., long. 122° 10′ E. *Fixed*; visible 20 miles.
Yang-tse River	Tungsha *lightvessel*, in 22 feet, outside the entrance. *Revolves* every half-minute; visible 11 miles.
,, ,,	Kiutoan. *Fixed* (*flash* every half-minute); visible 14 miles.
,, ,,	Little Kiutoan. *Fixed* (*red* and *white* sectors), visible 4 and 6 miles.
,, ,,	Woosung, west bank of the river. *Fixed*; visible 12 miles. Shows *white* over the navigable channel, *green* northward, and *red* southward of it.
,, ,,	Langshan *lightvessel*. *Fixed*; visible 6 miles.
Chifu	On largest Kung-Kung islet. *Fixed*; visible 18 miles.
Liau River (Neuchuang)	*Lightvessel* in 5½ fathoms, 10 miles from entrance. *Fixed*; visible 11 miles. Steam fog horn.

CHINA SEA.

[ADDENDA to DECEMBER 1st, 1873.]

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CHINA SEA:—The following information of dangers, in the China and Java seas, discovered during the years 1866-1868, has been published on the authority of the Netherlands Commission for improving and correcting the charts of the Indian Archipelago.

Karimata Sea:—The ship *Scheweningen* struck on an unknown bank in lat. 1° 19′ 12″ S., long. 106° 39′ 48″ E., about 14 leagues E. by N. from Crassock point, the north extremity of Banka island. Immediately after the ship touched, a sounding of 4 fathoms was obtained, and a second sounding showed a depth of 15 fathoms.

North Coast of Banka.—A reef, with only 7½ feet water, lies about 1½ miles from the shore, and nearly midway between Crassock point and cape Tuen. From the shoal, Crassock point bears W. by N. ½ N., Pulo Pongoh off cape Tuen S.E. ¼ S., and Pakoe point S. by E.

Banka Strait.—A rock, with 12 feet over it at low water, lies about 2 cables northward of the Hadjie reef, with Tanjong Bersiap, the eastern point of Banka island, bearing N. ¾ E., and Kalian point lighthouse E. ¼ N.

Gaspar Strait.—A reef has been discovered lying N.N.W. 3¾ miles from the Belvedere rock, also 17 miles distant from Gaspar island, and 28 miles from Brekat point on Banka island. The position given is lat. 2° 8′ S., long. 107° 1′ 15″ E.

A reef, with only 6 feet water, lies off the northern end of Pulo Leat. From a position ¾ of a cable northward of the shoal, the northern point of Pulo Leat bore S.W., and the eastern point of Pulo Anak. or Selagin, S. by E. ½ E.

Karimata Strait.—A reef, situated on the north-east coast of Billiton, and shown as "doubtful" on the charts, has been found to exist. It dries in one spot, and is in lat. 2° 37′ S., long. 108° 18′ E.

A bank that dries has been observed off the east coast of Billiton: from the bank Slandak island bears S.W. ½ W., Gantong island W. by S., and Boesong Madau island N.W. ½ W.; the position given is lat. 2° 59′ S., long. 108° 21′ E.

A reef, with about 6 or 7 feet water, lies near the assigned but doubtful position of a shoal named Admiral Protet; from it Slandak island bears W. ¾ S., and Liendorg, one of the Scharvogel islands, S.S.W.; the position given is lat. 2° 59′ S., long. 108° 38′ E.

Greig Shoal.—Careful examination has shown that the position of the danger, off the western coast of Borneo, is lat. 0° 55′ 30″ S., long. 108° 28′ E.; from the shoal Panambungan island bears E.S.E., and the peak of Karimata island S.S.E. ¾ E. The shoal is circular in shape, about 1¼ cables in diameter, and has 8 feet water over the shoalest part.

Java Sea.—E. ½ N. from the south point of Peblakan or West island, distant about 3¼ miles, is a reef of coral and stone; this reef extends about one cable north and south, and 2½ cables east and west; there is about 4 feet water over the shoalest part, and from 4 to 5 fathoms around the reef; from it the extremes of Rangat island bore N.W. ¼ N. and N.W. by N. respectively.

A reef also, on which the sea breaks heavily, extends the distance of about 2 cables (by estimation) from the north and north-east sides of Rangat island.

Careful examination has shown that the Siren bank, to be found on some charts in lat. 5° 19′ 30″ S., long. 106° 34′ 45″ E., does not exist, and that no danger has been found near the assigned position.

A reef with 15 feet water over it, and 7 to 8 fathoms on its eastern edge, lies about one cable to the southward of the Tambaga rocks in the Sapoedie strait. From the reef the Tambaga rocks bear N.W. by W. and N.E. ¼ N. respectively; the east point of Giliang or Pondy island N. by E. ½ E. and Sarotak point W. ⅔ N.

A reef with 4½ fathoms water lies to the north-east of Kangeang island, and S. ½ E. 4 miles from the southern Kalkun or Turkey island. The position given is lat. 6° 48′ S., long. 115° 44′ E.

Near the north-east Paternosters, in lat. 6° 30′ S., long. 118° 18′ 30″ E., the water was observed to be discoloured, and a coral reef supposed to exist.

The following description of the dangers lying between the Fiery Cross and North Danger reefs, in the main route of the China Sea, and of shoals in the Palawan route, as well as some remarks on the Paracel islands, are by Navigating Lieutenant John W. Reed, R.N., Commanding H.M. surveying vessel *Rifleman*, 1867-1869.

Royal Charlotte Reef, somewhat rectangular in form, is 1⅛ miles in length, N.W. by W. and S.E. by E., and ⅞ mile in breadth. On its south-eastern side are some stones 2 to 4 feet above high water; the highest of them is in lat. 6° 57′ 18″ N., long. 113° 35′ 30″ E.; there are also one or two stones on its north-east edge which just show at high water.

Swallow Reef, formed of a belt of coral surrounding a shallow basin of water, is 3⅜ miles long, E. ⅜ N., and W. ⅜ S., and 1½ miles wide. At its eastern part are some rocks from 5 to 10 feet above high water, the highest of which is in lat. 7° 23′ N., long. 113° 50′ 23″ E.; there are also one or two stones on the south-eastern side which show at high water; the west end terminates in a sharp point.

Sandy Island, reported in 1863 by Mr. W. Andrews, master of the barque *Thames*, to be in about lat. 7° 20′ N., long. 114° 10′ E., was looked for in the *Rifleman*. At noon from lat. 7° 12′ 15″ N., long. 114° 1′ E., a course was shaped for the reputed position of the island, and at 2 hours 30 minutes the vessel was

in the same latitude and one mile to the eastward of its reputed position; from thence a course was steered for the South Ardasier shoal; no appearance of shoal water could be seen from the vessel on either of these courses, and certainly no island exists within 5 or 6 miles on either side of the lines passed over by the ship.

Ardasier Bank, has only been partially explored, but it is very extensive, and it seems probable that the South Ardasier, Gloucester, and North Ardasier breakers, as also the breakers seen by Mr. Dallas in 1860, will prove to be shoal patches on different parts of one large bank. The south-eastern side, which forms one of the northern limits of the approach to the Palawan passage, has been surveyed in the *Rifleman*; the general direction of this part is N.E. by E. ½ E., and S.W. by W. ½ W. for a distance of 20 miles, but the outline of the edge is very irregular. Several shoal patches of 3 to 5 fathoms were found near the edge, and the shoalest part discovered had but 2¼ fathoms over it; this last is in lat. 7° 36′ 37″ N., long. 114° 10′ 10″ E., very close to the position ascribed to the South Ardasier breakers.

Stags Shoal, placed on the charts in lat. 8° 24′ N., long. 112° 57′ E. was reported in 1802 by Mr. Trinder, commanding the brig *Amboyna*. The following is an extract of his report:—"The north end of the shoal extended S.E. and S.W. in form of a triangle, with rocks above water and breakers in various parts, the intermediate space apparently very shoal, and the southern extremity could not be discerned from the masthead."

The *Rifleman*, from a position 5 miles north of that given above, was steered E.S.E. 12 miles, when she was in the latitude of the shoal, and 11 miles east of it; there no bottom was obtained at 200 fathoms; a west course was then steered for 21 miles, and next a S.E. by E. course until the longitude of the shoal was reached; soundings with 40 fathoms of line were tried for, as quickly as possible on the different courses, and on the spot assigned to the danger bottom, dark ooze was brought up from a depth of 1085 fathoms.

The *Rifleman* had previously passed over the position, and H.M.S. *Reynard* in 1862, also steamed about the locality, and it is certain from the result of these searches that no such shoal exists within 10 miles of the position given above.

The soundings obtained in the *Rifleman* in former years, prove that the shoal does not exist to the westward, and it seems probable that the danger seen from the *Amboyna* was part of the Lizzie Webber or Canada shoal,—25 miles E.S.E. of the position ascribed to the Stags—and this is the more probable from the fact of the Amboyna cay being found 11 miles further west than it was reported by Mr. Trinder.

Dhaulle Shoal.—In 1826 the schooner *Dhaulle* anchored at night upon a shoal of 3 fathoms, which, at sunrise the following morning, appeared to be about 1 or 2 miles in circumference. At noon of the preceding day, the vessel passed a mile to the westward of, what was supposed to be, West London reef, and from thence had steered N. by E. ½ E., 42 miles, until she anchored in 3 fathoms on the shoal, which would place it in lat. 9° 32′ N., long. 112° 24′ E.

The *Rifleman* was employed a whole day in searching over and about that locality, under the circumstances of a heavy swell and light breeze, which are very favourable for the discovery of shoals in deep water, but no shoal could be found: on the spot, bottom (dark ooze) was brought up from 1066 fathoms.

The London reefs were, until lately, placed upon the charts very much out of their proper positions, and it seems probable that the reef the schooner passed to the westward of was either the East London or the Cuarteron, and that the shoal she anchored upon was one of the shoal patches of the Fiery Cross reef, which is in the same latitude as that ascribed to the Dhaulle shoal.

Discovery Great Reef.—The south end of this danger is in lat. 10° 0′ 42″ N., long. 113° 51½′ E., and bears E.N.E., 52 miles from the north-east end of the Fiery Cross reef; it is a long narrow coral reef, the greater part of which dries at low tides, with several large rocks upon it which always show above water; in the centre is a lagoon, which appeared to be shallow, and to have no passage through the reef leading into it. From the south point the reef trends first due North, 5 miles, and then N. by E., 5 miles; it is a mile broad at the south end and half a mile at the north. No bottom was found at 100 fathoms within a very short distance of any part of the reef except off its north end, where the *Rifleman* anchored in 42 fathoms, nearly half a mile from the rocks; at ⅓ mile off the south-west point a sounding of 192 fathoms sand and coral was obtained.

The Hainan fishermen report a reef or shoal lying 10 miles north-eastward of Discovery Great reef, but it has not yet been possible to examine that locality, which should for the present be avoided by seamen.

Discovery Small Reef lies E. ½ N., 9¾ miles from Discovery Great reef in lat. 10° 1½′ N., long. 114° 1½′ E.; it is a small round coral patch, ¼ mile in diameter, dry in places at low tides, with very deep water all around. Soundings of 174 and 180 fathoms, sand and coral, were obtained very close to its eastern side, and no bottom at 210 fathoms the same distance off the opposite side.

Western or Flora Temple Reef is a very dangerous reef, having patches of rocks just under water at the south-west part, and but 1 to 3 fathoms in other places; its centre, in lat. 10° 15′ N., long. 113° 37′ E., lies N.W. by W. ½ W., 16½ miles from the north-west end of Discovery Great reef, and is the westernmost danger in this part of the China Sea. It is 1½ miles long N.E. and S.W., and rather more than ½ mile broad at the southern part, decreasing to half that breadth at the opposite end. The *Rifleman*, for the purpose of the survey, anchored in 5 fathoms on the north-eastern extreme of the reef, which had to be approached with great caution, as shoal water was seen at a very short distance inside the edge; soundings of 18 to 74 fathoms were had close-to, but at a short distance off, no bottom at 100 fathoms.

The reef upon which the *Flora Temple* was lost in 1859 was said to lie 6 miles north-westward of the Western reef, but the *Rifleman* passed over that position, and certainly no danger exists there; moreover, the description of the reef given at the time of the wreck applies exactly to the Western reef, where, without doubt, the ship was lost.

Doubtful Reef.—The locality of the reef of doubtful existence, placed on the late charts 10 miles north-eastward of Discovery Great reef, was examined in the *Rifleman*, but no sign of shoal water could be discovered. This danger was placed upon the chart from the rather vague report of some fishermen last year, but the master of a junk and other fishermen met with at Itu-Abaer, this present season (1868), deny that any shoal exists there.

Tizard Bank, with Reefs and Islands.—From Discovery Small reef the

nearest part of this bank bears N.E. by E., and is distant 16 miles. It is very extensive, and like the generality of the large coral banks in the China Sea, consists of a lagoon bordered by shoal patches. Several of the patches upon the Tizard bank are dangerous reefs, dry at low water, two having an island on them, and a third a sand cay. The bank lies in an E.N.E. and opposite direction, and extends nearly 31 miles; its breadth in the middle being 11 miles, at the south-west part 7 miles, and at the opposite end 3½ miles.

Itu-Abaer, the larger of the two islands, is situated at the north-west corner of the bank, and is ¾ of a mile long E. by N. and W. by S., and a ¼ of a mile broad. The reef surrounding it extends in some places to the distance of a short ½ mile, and in others not nearly so far, its limits, however, are generally defined by a line of breakers. The island is covered with small trees and high bushes, with numerous nests of sea birds. Two or three cocoa-nut and a few plantain trees stand near a small well, but the most conspicuous object is a single black clump tree, on the north side of the island, which may be distinctly seen 10 miles off; this tree is in lat. 10° 22′ 25″ N., long. 114° 21′ 45″ E.

Sand Cay.—A little more than 6 miles, East, from Itu-Abaer is a small Sand Cay, nearly in the centre of a round-shaped reef ¾ of a mile in diameter. The island and cay are connected by a line of shoal patches, which form the north-east part of the bank; and nearly midway between, but nearer the island, is a dangerous reef, entirely covered at half-tide, about the same size as that surrounding the cay. Elsewhere on the northern edge of the band there is not less than 4 fathoms, and vessels may safely anchor in from 7 to 11 fathoms about 1½ miles westward of the sand cay, midway between it and the reef just described.

Petley Reef, an oval-shaped patch a little over a mile in extent, lies E. by N. ¾ N., 5½ miles from Sand Cay; it forms the extremity of a remarkable strip of coral 1½ miles wide, projecting like a horn in a N.N.E. direction from the main body of the bank, the edge of which trends E.S.E. from the cay; no less than 6 fathoms was found upon the strip, except within a mile of the southern part of the reef above-mentioned, where it shoals to 4 and 3 fathoms, and no bottom could be obtained with 100 fathoms of line at a short distance on either side of it.

Eldad Reef, the north-east end of which is in lat. 10° 23′ N., long. 114° 42′ E., forms the eastern extreme of Tizard bank. It is a peculiar-shaped reef, 4½ miles long, N.N.E. ½ E. and S.S.W. ½ W., the southern and middle parts being about 1½ miles wide, but of irregular outline; and the northern part tapering away in the form of a long narrow tongue, on either side of which no bottom could be obtained with 100 fathoms of line. A few large rocks are visible at high water, and at low water many smaller ones uncover. Shoal patches extend nearly ¾ of a mile to the westward of the reef.

Namyit Island, lies due South from Itu-Abaer, distant 11½ miles; it is very small being but 3 cables long east and west, and 1 cable broad, and is surrounded by a reef which projects more than a mile to the westward, and about ½ of a mile in other directions.

Gaven Reefs are two dangerous reefs, covered at high water, which lie to the westward of Namyit island; the first is oval-shaped; ¾ of a mile long N.N.W. and S.S.E.,—the island bearing from it E. ⅞ N., distant 6 miles; the second is a

mile long North and South, and nearly ¾ of a mile broad at its northern end, narrowing to a point at the opposite end: this last is the westernmost danger of the Tizard group, and its outer edge is in lat. 10° 13′ 20″ N., long. 114° 18′ 7″ E.

Anchorage.—The above comprise all the dangers found upon this great bank, and, with the exception of a small 3-fathom patch which lies N.E. nearly a mile from Namyit island, nothing less than 4 fathoms was found upon any of the shoal patches surrounding the lagoon; so that vessels of moderate draught can, in cases of necessity and in fine weather, find convenient anchorage on any of them, observing always due care and caution in approaching them, so as to guard against possible danger from some shoal spot having escaped the lead.

Loai-ta Bank and Reefs.—Loai-ta bank extends 21 miles N.E. and S.W.; its southern part is 5½ miles wide, and its centre 7 miles; from thence it gradually narrows to a point at its north-east extreme.

Loai-ta island (south island of Horsburgh) lies N. ¾ E., distant 18 miles, from Itu-Abaer, its north-west extreme being in lat. 10° 40′ 45″ N., long. 114° 24′ 54″ E. It is a low sand island, covered with bushes, and very small, being but 1½ cables in diameter; a reef surrounds it, extending in some places, nearly ½ a mile.

A reef about 1½ miles in extent, dry at low water, and having a small sand cay near the centre, lies 5 miles north-westward of Loai-ta. Another and larger reef lies ¾ of a mile to the south-westward of the one just mentioned, extending in that direction 1¾ miles, its width being about a mile. The south-west extreme of this last reef, which is also the south-west extreme of Loai-ta bank, is in lat. 10° 42′ N., long. 114° 19′ E.; the sand cay bearing N.E., distant nearly 3 miles, and Loai-ta island E. by S. 6 miles.

From the sand cay above mentioned, the north-western edge of the bank trends away E.N.E. 5 miles, and then N.E. 13 miles; no less than 4 fathoms was found anywhere upon this part of the bank.

Lan-keeam Cay and adjacent Reefs.—A coral patch ¼ a mile in extent, which partly drys at low water, lies E. by N. 2 miles from Loai-ta island; and E.N.E. 6¼ miles from the same island is a larger reef, ¾ of a mile in diameter, having a sand cay near its centre; this cay, known to the Hainan fishermen as Lam-keeam, is in lat. 10° 43′ 20″ N., long. 114° 31′ E.

N.E. by E. ½ E. 3 miles from Lan-keeam is a small dry patch which forms the south-east angle of the great Loai-ta bank; and N.E ¼ N., 4¾ miles from that cay is another small reef; this last is the northernmost patch which dries.

From the reef just mentioned the south-eastern edge of the bank trends away N. by E. for about 9 miles, where it meets the north-western edge; nothing less than 4 faihoms was obtained on this part of the bank.

Soubi Reef, the south-west end of which is in lat. 10° 53¼′ N., long. 114° 4′ E., lies about 16 miles north-westward of the Loai-ta reefs, and 8 miles south-westward of Thitu reefs, and is the westernmost danger in the locality; it is an irregular shaped coral reef, nearly 3½ miles long, N.E. and S.W., and 2 miles broad, is dry at low water, and has a lagoon, into which there appears to be no passage.

Thitu Reefs and Island—(the N.W. dangers of Horsburgh) consist of several very dangerous patches grouped upon two coral banks, separated by a narrow deep gut. Thitu island is a low sand island, somewhat round in shape, and not

quite ½ mile in diameter, situated near the centre of the dangers, on the southern part of a reef, which dries at low water, and which extends ¾ mile eastward of the island, forming in that direction the extreme of the western bank. Near its south-west end is a dark clump tree in lat. 11° 3′ 9″ N., long. 114° 16′ 25″ E.; in addition to this clump tree the island has upon it some low bushes and two stunted cocoa-nut trees, near to which is a small well and a few plantain trees.

From the island the western bank widens out in directions N.W. and S.W. for a distance each way of 2½ miles; the north side of this part of the bank is marked by a round coral reef, ¾ mile in diameter, between which and the reef surrounding the island are soundings of 2½ to 7 fathoms, the deep water being nearer the island. The south edge of the bank is also marked by a reef, but this is much smaller than the one just described, and the depths between it and the island are more favourable for anchoring upon than on the opposite side of the bank, being in no place less than 4½ fathoms. From these two reefs the bank gradually narrows, and terminates in a point in lat. 11° 2′ 30″ N., long. 114° 10′ 30″ E., the island bearing E. ¾ N., distant 6 miles.

On the north edge of the bank is a sand cay which bears from the island W. ⅓ N., distant nearly 3½ miles. This is also on a large patch of reef, dry at low water, and between it and the western extreme of the bank are dangerous reefs, nearly always marked by breakers. There is a passage into the lagoon between the sand cay reef and the one 2½ miles N.W. of the island, with depths of 5 to 12 fathoms.

The south side of the bank is not nearly so dangerous as the north side, and vessels may anchor upon it with the sand cay bearing N.E. by N. and N.W. by N., or to the eastward of the patch which lies S.W. 2½ miles from the island, with the cay bearing N.W. by W. ½ W., and the island N.E. ½ E. In the lagoon the depths are 17 to 19 fathoms.

The eastern bank is a mass of dangerous reefs and patches, its western extreme is more than a mile eastward of Thitu island, extending from thence 1½ miles East and 3¼ miles N.E., with an average breadth of 2 miles.

Ni-Lo or North Danger Reef is described on page 86.

Trident Shoal, lying E. by N. 16 miles from North Danger, is a coral bank 7½ miles long and 6 broad, of the shape of a shoulder of mutton, the broad part being to the northward; it is composed of many patches with less than 10 fathoms water over them, two of which are dangerous. These patches lie round the edges of the bank, forming a lagoon, the depths in which are 26 to 37 fathoms; close outside of them, there is no bottom at 100 fathoms.

The most dangerous patch is at the northern extreme of the shoal, and extends 1¾ miles East and West, and ½ mile North and South; near the centre, in lat. 11° 31′ 30″ N., long. 114° 39′ 15″ E., is a small spot which dries at low water springs; the depths on other parts of the patch vary from 1¼ to 6 fathoms: the other is at the eastern extreme of the shoal and bears S.E. ¾ S., distant 3½ miles from that just described; it is a small spot of 2½ fathoms, with depths of 3 to 5 fathoms at the distance of ½ mile around it; some casts of 4 fathoms were had about a mile W. by S. from the dry spot, but no less than 5 fathoms was found on any of the other patches.*

* Captain Lyall, of the *Trident*, who discovered this danger, placed it in 6 miles to the northward of this position, and the *Rifleman* was employed 5 days searching that locality without discovering any danger, and it is certain none exists there.

The Bremen vessels *G. E. Lorenz Meyer*, Captain Moller, reported having at night struck upon a shoal which was said to lie in lat. 11° 25′ N., long. 114° 51′ E.; this position was examined, but no danger discovered, and there is but little doubt that the vessel struck on the eastern patch of the Trident shoal.

Lys Shoal lies 2 miles to the southward of Trident shoal, and like the latter is formed of a number of patches under 10 fathoms, with a lagoon in the centre; only one danger, a small spot of 17 feet, was found, and this lies near the south-west extreme of the bank, in lat. 11° 19′ 40″ N., long. 114° 34′ 24″ E.; around it the depths are 5 fathoms. Some 5-fathom patches were also found near the north-east end of the bank, but nothing under 6 fathoms was met with elsewhere, the general depths on the patches being 7 to 10 fathoms, and a short distance outside of them bottom was not reached with 100 fathoms of line.

Caution.—Seamen should not attempt to pass through the reefs in this part of the China sea, as a line of dangerous shoals, extending many miles, is known to exist to the eastward of the dangers described above.

Macclesfield Bank.—The *Rifleman*, on her way from Hong-Kong to the North Danger crossed this bank in March 1865, and again in April of the present year. On the first occasion, soundings were struck in lat. 16° 11′ N., long. 114° 26′ E., in 115 fathoms, bottom sand and mud; a line of soundings was then carried in a S. by E. direction over the bank, and the least depth of water met with was 12 fathoms, the general depths being from 40 to 50 fathoms; but a patch of 15 fathoms was found near its southern edge in lat. 15° 34′ N., long. 114° 30′ E.: and 5 miles further southward no bottom could be obtained with 307 fathoms of line.

On the second occasion of crossing the bank star observations placed the ship at 5.30 A.M. in lat. 16° 34′ N., long. 114° 13′ E.; from thence steered for the 4-fathom patch, reported to have been passed over in 1867, by Captain Moses, of the Siamese vessel, *Bangkok*, in lat. 16° 2′ 30″ N., long. 114° 2′ 30″ E.; the deep sea lead was kept constantly going, but no bottom was obtained with 50 to 60 fathoms of line. At noon found the ship to be in lat. 15° 59′ N., long. 113° 58′ E., and that she had passed about 2 miles to the westward of the ascribed position of the patch. Proceeding to the southward, soundings of 42 fathoms, coral bottom, were had on the northern edge of the bank in lat. 15° 51′ N., long. 113° 57′ E., regular depths of 42 and 43 fathoms were carried until in lat. 15° 30′ N., long. 113° 57′ E., where 32 fathoms were obtained; 3 miles south of this position no bottom was reached with 100 fathoms.

The *Rifleman*, on her passage from Hong-Kong to the reefs, in May 1868, struck soundings in 40 fathoms on the northern edge of this bank, in lat. 15° 38′ N., long. 113° 40′ E.; from this position a line of soundings—40 to 33 fathoms—was carried across the bank in a S. ½ E. direction for 11 miles, when no bottom with 50, and immediately afterwards, no bottom with 100 fathoms of line, could be obtained.

Coral Bank.—When proceeding from Loai-ta island, round the northern edge of Archipelago, soundings of 47 fathoms were obtained on a coral bank in lat. 11° 28′ N., long. 116° 46′ E.; steering E. by S. ¼ S.; 3 miles farther on 44 fathoms were had, and shortly afterwards 12 fathoms on a small coral patch in lat. 11° 26′ N., long. 116° 53′ E. Continuing the same course, the depths were 42 fathoms for a distance of 5 miles; at 8 miles 125 fathoms, and at 14 miles

175 fathoms; a few miles farther on no bottom was reached with 200 fathoms of line.

Routh Shoal lies at the north-east angle, as Nilo reef lies at the north-west angle, of the archipelago of reefs, and forms the north-east limit of the Palawan passage; it is a pear-shaped coral bank, 8 miles in length N.N.E. $\frac{3}{4}$ E., and it is not dangerous, the least water upon it being $4\frac{1}{2}$ fathoms; this depth is found on a 5-fathoms patch, about three quarters of a mile in extent, at the north extreme of the bank in lat. 10° 50′ N., long. 117° 46′ E. Nothing less than 6 fathoms was found on any of the other patches surrounding the lagoon: the depths in the lagoon vary from 17 to 19 fathoms at the shoal edges to 35 fathoms in the centre.

The northern part of this shoal was passed over by the *Seahorse* many years ago, and the southern part by Captain Routh, of the *Bombay*, in 1835.

Holmes Shoal.—From the Routh shoal, a S.E. $\frac{3}{4}$ S. course was steered to pass over the doubtful Holmes shoal; no bottom at 200 fathoms was obtained on its reputed position, nor was any sign of shoal water seen for a distance of 7 miles further to the south-eastward; from this last position the ship was steered North 8 miles, and then S.S.W. $\frac{1}{4}$ W. 23 miles, with the same result, again crossing over, or near to the position of the shoal. Captain Curling, in the Peninsular and Oriental Company's service, passed over the spot in 1862, without seeing anything like shoal water, and many other commanders of steamers have reported to the same effect.

Although circumstances prevented the usual minute searches being made for this danger, yet it should be removed from the chart; it certainly does not exist where reported, and there are reasons for believing that the *Fairie Queen* shoal, 18 miles to the westward, is the real Holmes shoal.

Luconia Shoals.—Most of the extensive group of dangers known under this name were surveyed in the *Rifleman*, and an account of them published in 1863, but the survey was not, and is not completed to the northward and westward, but additional information is now given.

The northernmost of the shoal patches reached in 1863 was in lat. 5° 48′ 30″ N., long. 112° 32′ 15″ E.: this year the ship was anchored near a $2\frac{3}{4}$ fathoms patch, in lat. 5° 55′ 15″ N., long. 112° 31′ 30″ E., on the northern edge of a coral bank, traced for 2 miles to the southward, but which no doubt extends to the northernmost patch surveyed in 1863, and just referred to; vessels should not pass between these positions.

Friendship Shoal is the northernmost of the Luconia group; the *Rifleman* crossed it without getting less than $4\frac{1}{2}$ fathoms, although there appeared to be less depths in some places. The north part of the shoal is in lat. 5° 59′ 30″ N., long. 112° 31′ 30″ E., and though this position must be considered approximate, it is nevertheless near the truth. Lines of soundings were had in the ship in directions N.E., North, and N.W., from the north end of the shoal for a distance of 4 miles, but no shoal water was found.

General Remarks.—The *Rifleman* left Hong-Kong on the morning of the 9th of April 1868, and arrived at the North Danger reef on the fourth day afterwards sailed down under the favourable conditions of light easterly breezes and smooth water; the weather was exceedingly fine without any of the squalls so frequent

at other times, up till the 23rd of May, when the South-west monsoon set in with great violence, driving the vessel from the Loai-ta reefs. The weather continued unsettled and threatening, with strong south-west winds during day time, falling light towards night, until the 5th of June, when the ship arrived at Labuan. Hainan fishermen, who subsist by collecting trepang and tortoise-shell, were found upon most of these islands, some of whom remain for years amongst the reefs. Junks from Hainan annually visit the islands and reefs of the China Sea with supplies of rice and other necessaries for which the fishermen give trepang and other articles in exchange, and remit their profits home; the junks leave Hainan in December or January, and return with the first of the S.W. monsoon. The fishermen upon Itu Abaer were more comfortably established than the others, and the water found in the well on that island was better than elsewhere.

TIMOR and JAVA.—The following Hydrographic remarks, made during a recent cruise of H.M.S. *Serpent*, Commander Charles J. Bullock, R.N., have been issued by the Admiralty;—

Beatrice Shoal, in lat. 10° 31′ 30″ S., long. 123° 35′ E., was discovered by Commander John Hutchinson, of H.M. surveying vessel, *Beatrice*, and subsequently Mr. Waleson, the Harbour Master of Koepang, succeeded in finding on it a knoll with only 5 feet water, over which the sea almost always breaks. The shoal is an oval-shaped coral bank, lying E.N.E. and W.S.W., half a mile in extent; soundings of 3 to 6 fathoms were found on its central part (where probably the knoll is) deepening to 8 and 10 at either end where there is tolerable anchorage; outside this the reef falls steeply into deep water. The centre of the shoal is on the following bearings:—N.E. point of Oessoe island (the island east of Landu) W. ½ N. 7½ miles; the conspicuous double hill over the point, W. ¼ N.; the high flat-topped hill of Rotti, S.W. ¾ W.; south-west point of Timor (entrance of Semao strait) N.W. ¾ N.; White cliffs of Timor, N.E. northerly.

Rotti Island.—When passing the north-east point of Oessoe the water was suddenly shoaled to 5 fathoms, the point then bearing N.W., 1⅓ miles distant. The shoal was not examined.

An unexamined coral bank, on which the least water obtained whilst crossing it was 15 fathoms, lies 3½ miles W.N.W. of Dana, the southernmost of the islands off Rotti. No examination was made of it.

Castle Rock.—The islands contiguous to the south and west points of Rotti are low, the southern ones particularly so. The exception is a rocky islet with steep cliffs, which is conspicuous at 20 miles distance, when all the neighbouring land except the hills of Rotti has dipped. As it is difficult to recognise this useful landmark on most charts, it may be described as lying off the south-west point of Rotti, in the channel between Dana island and the main.

Anchorage.—The only anchorage recommended about the islands is on the north side of Noesa.

Savu and Penjoin.—H.M.S., *Serpent*, coasted along the south shores of these islands to verify their positions, and found them fairly correct. They are bold,

except that from the east point of Rai Diuwa or Benjoan, an extensive reef was seen on which the sea was breaking heavily.

Hockie or Dana (New island) is of coral, low, and covered with scrub, having a ridge along its north-eastern side of about 120 feet elevation, the western part of which is a detached knoll like a short horn. The latter is in lat. 10° 49′ S., long. 121° 16′ E. Under this ridge and facing the north-east is a broad sand beach, which is the only practicable landing place in fine weather. Off the northern part of this beach is the anchorage in 12 fathoms, sand, with the knoll bearing S.W. and the east point S.S.E. Wild goats abound on the island, but no fresh water could be discovered.

Cape Tafel is a peninsula of table land bordered by a high broken cliff and a few small reefs. Though about 300 feet high it may be styled low in comparison to the adjacent mountainous country. The western part is the higher and bolder, the eastern tapers into a low point off which is a low island. Soundings of 20 fathoms may be found west and south of the west cliff at the distance of a mile.

Badong Bay.—This open bay affords shelter from south-east winds, with anchorage in 8 to 6 fathoms, sand and mud, good holding ground; but there is little or no protection from the heavy ground swell that rolls in from south.

S.E. Cape of Java is the extremity of a low peninsula, on the northern side of which is a range of hills which terminate on the east at cape Sloko. The points of the low land dip at 10 or 12 miles, causing a false point to be seen beyond that distance. An extensive coral reef borders the cape, but north of the Sloko ranges the shore is very steep, and a ship working through may stand in boldly.

Mount Ikan is an isolated flat-topped bluff separated from the Sloko hills by a low isthmus, causing it at a distance to appear like an island. The charts show three hills, which is an error.

Prince of Orange Bank is of an irregular form, broader at its southern part; it lies nearly on the following bearings:—the low east extremity of Java, S. by W.; eastern summit over cape Sloko, S.W. ½ S.; and the summit of mount Ikan, W.N.W.

Banjoewangie on the Java shore of Baly strait is a place of call for refreshments for vessels proceeding by the eastern passages. The water is good when the pipes are clean, otherwise it soon becomes fetid. This is the terminus of the electric telegraph. Banjoewangie is not always readily distinguished in the afternoon, when the sun is behind it; a good guide then is the Bakungan mountains, a triple-topped range on the Baly shore, from which it bears West.

It is not advisable to anchor a sailing vessel close in during the South-east monsoon, for the difficulty in getting out may cause detention. Vessels working through the strait will save time by taking a pilot, for the tides are irregular and require local knowledge.

Anchorage in 7 or 8 fathoms may be found all along the shore from Pakem point to Pampang bay. The extremity of Pakem reef is marked by a black buoy with staff and ball.

PARACEL ISLANDS:—These islands were visited in February, 1865, by H.M.S. *Rifleman* for the purpose of relieving the crew of a wrecked vessel, and the following information was obtained by Mr. Tizard, Master R.N ;—

Lincoln Island.—South-east point in lat. 16° 39′ 34″ N., long. 112° 44′ 23″ E., is 1¼ miles long, N.W. and S.E., three-quarters of a mile wide, and about 20 feet high ; it is covered with brushwood, and surrounded by a coral reef, dry at low water, which extends 1¼ miles from its south-east point, half a mile from its north and east sides, and about a cable from its south-west side. A narrow coral shoal runs off to the southward from the south-east point of the island, which is said by Horsburgh to extend 11 miles ; time did not admit of its being properly examined, but judging from the soundings that were obtained, the dangerous part of this shoal does not appear to extend further than 3 miles from the island. Good anchorage can be obtained in the N.E. monsoon under its lee in 8 to 10 fathoms, coral, about half a mile from the shore.

The spring of excellent water, mentioned by Horsburgh, is merely a well dug by the Hainan fishermen close to a stunted cocoa-nut tree, into which the salt water filters.

Pyramid Rock.—From south-east point of Lincoln island, Pyramid rock bears S.W. ¼ W., distant 7½ miles ; the position of the rock with reference to Lincoln island was ascertained, but no soundings were tried for around it. The coral bank round Lincoln island will, in all probability, be found to extend as far as the Pyramid rock.

Ampitrite Islands.—The two groups of islands designated by this name appear to be situated on the edge of an extensive coral bank, as a reef, 1¾ miles wide with from 6 to 9 fathoms on it, extends 3½ miles to the south-eastward of Woody island, the extremity of which could not be seen from the *Rifleman* when crossing it ; soundings of 25 to 30 fathoms, coral, were carried some miles westward of the group.

The spring of clear water, asserted by Horsburgh to exist on Woody island, is merely a small well dug by the fishermen, the same as that on Lincoln island.

The Crescent Chain.—The islands forming the Crescent Chain appear to be correctly placed as to position on Captain Ross's chart, but are not nearly so large as represented.

Duncan and Drummond Island were more particularly examined, and the passage between them sounded. The two islands called Duncan islands are now joined by a sandy spit which is always uncovered; they extend a mile in an east and west direction, are 4 cables in breadth and surrounded by a coral reef which extends in some places 4 cables from the shore, and dries at low water. On the westernmost of the islands is a cocoa-nut tree.

Drummond island is nearly round, its diameter being about 3 cables ; 2 cables south of it is a rock which never covers. A reef of coral extends a short distance from the west side of the island, but runs for miles to the eastward and northeastward of it. Both Duncan and Drummond islands are covered with brushwood. Between these two islands is a safe channel, upwards of a mile in width, with from 19 to 20 fathoms water ; Horsburgh says this channel should not be taken in large vessels, the passage westward of Duncan island being preferable, but the *Rifleman*, when passing between Duncan and Money islands, suddenly

got into shoal water, which appeared to extend across that channel, and therefore the channel between Duncan and Drummond islands is certainly safer for steamers. Vessels may anchor to the northward of Duncan island in from 16 to 18 fathoms, about half a mile from the shore. *Bearings Magnetic. Variation* 1° 20′ *E. in* 1867.

CHINA:—The following remarks on the homeward route from China through the China Sea and the strait of Sunda are from the log of the British ship *Harkaway*, Captain David W. Stephens:—

Ships from Hong-Kong, bound through the Bashee Channel, or any of the channels between Formosa and Luzon, from March to June inclusive, but more particularly in March and April, during brisk north-east winds and a strong westerly current, frequently take a week beating along shore to reach Breaker point before standing off:

Whereas, if after clearing the Lema channel, the vessel had stood off on a wind clean full to the south-east, they would soon have got out of the westerly current, and on nearing Luzon would experience the wind more from the eastward and sometimes from south-east, enabling them to tack to the N.N.E. with a strong current in their favour, and thus would probably get to the eastward of Formosa in less time than it would have taken to reach Breaker point by keeping along the coast of China.

Vessels leaving the coast of China or Manilla and bound towards Sunda strait in March, April, or in the early part of May, may expect a tedious passage down the China Sea if proceeding by the old route which passes Pulo Sapata, particularly if they do not sail before the 5th or 10th of April:

Whereas if the track be taken along the coast of Luzon, down the Palawan passage, along the coast of Borneo, past Direction island, round Soruetou, and through the Karimata strait, passing close round the North Watcher, and on for St. Nicholas point on Java, they are likely to carry easterly winds, with fine weather, and a smooth sea the whole distance, thus making a direct course, and will avoid calms. The current will also be more favourable than otherwise until May is well advanced.

In approaching Sunda strait the Java side should be steered for, and kept aboard in May, as then the winds are light, those from south-east prevailing at night, and from north-east during the day; this precaution will prevent the vessel being carried by the current to the westward of the Button islet; the current runs constantly to the south-west in the middle of the strait, it is checked by the short flood, but runs strong with a long ebb.

With reference to the above directions for making the passage from China, and to prove the advantages of the eastern route, it may be stated, that in April 1861, two American ships sailed from Fu-chau-fu, one proceeded by Pulo Sapata on the west side of the China Sea, the other by the Palawan passage and Karimata strait: the latter ship passed Anjer 20 days before the other.

The *Harkaway*, on her passage in April and May 1862, carried an easterly wind the whole way down, and had no occasion to anchor.

The following information on shoals and reefs in the Eastern Archipelago is from the Official Netherlands Magazine :—

CELEBES—Gulf of Tomini.—The Commander of the Netherlands steamer *Haarlemmermeer* reports the existence of a reef in the gulf of Tomini, 2 cables in extent, and visible at a distance of 3 miles from the discoloration and breaking of the water; the reef lies in lat. 0° 43′ S., long. 120° 54′ E.

Gulf of Tomorie.—The same officer reports a reef in the gulf of Tomorie, bearing N.E. distant 4 cables from the ship, when point Onee Malubu bore N.W. by W. ½ W., the high point near Amboona S. by E., and a point of land S.W. ¼ W.

From another reef Tukala peak bore N.W. ¾ W., the island under Tukala N.W. ¼ N., Tukala point N.N.W. ¾ W., and the southernmost point of land West.

He further states that at about 16 miles from the shore there are six or seven other reefs and banks which uncover at low tide, and make the waters north of the parallel of Onee Malubu, or 2° S., unnavigable; these dangers may be considered as a continuation of the shoals off point Pasier Lambang.

All the charts of this region are considered defective, and great caution is required in the navigation.

Greyhound Strait.—Captain Chevallier of the Netherlands steam-packet *Macassar* suddenly found his vessel in 6½ fathoms on the western edge of a reef with the following bearings: the south point of Masunie or Middle island West, centre of Lembau or Skelton island N.E. by E., and the centre of Seho or Haycock island S. by E. ¾ E.

Over the middle of the reef, which was about 100 yards in extent, there appeared to be about 12 feet; its approximate position is in lat. 1° 48′ S., long. 124° 16′ E.

Captain A. J. Bas of the Netherlands ship *Hendrika*, reports the existence of a shoal with 5 fathoms, from which Tempau island bore N.N.W. ½ W., and Masunie island N.N.E.; its approximate position is in lat. 1° 57′ S., long. 124° 4′ E., and is about one mile to the eastward of an extensive reef already marked on the chart.

GILLOLO PASSAGE—Erbe Island.—Captain R. von Erbe of the Netherlands barque *Albrecht Beijling*, reports the existence of a small island, with a rock about 1¾ miles distant from its north-west side. From observations agreeing with bearings taken of cape Tabo on Gillolo island, the island is placed in lat. 0° 43′ 30″ N., long. 129° 15′ E., about 7 miles E.N.E. of the Catherine islands; as these islands were also seen they cannot be identical with the reported shoal.

Fitzmaurice Shoal.—The British shipmaster Fitzmaurice reports the existence of a shoal with less than 12 feet over a rocky bottom; from the shoal the summit of Popa island bore N. by W., and the north extreme of the great Canary island S.W. ¼ W. It has been placed on the chart in lat. 1° 38′ S., long. 129° 44′ E.

JAVA SEA—Arends Island.—Captain Prins of the Netherlands barque *Vrijhandel* reports that the reef off the south-west point of Arends island extends 2 miles farther to seaward than shown on the charts.

Arends island lies in lat. 5° 2′ S., long. 114° 36′ E.

Meinders Reef.—The reefs about 4 miles to the westward of Meinders reef, off cape Sedano at the east end of Java, on which the ships *Isis* and *Cornelis Anthony* were reported to have been lost, have been searched for by the Netherlands surveying steamer *Ardjoeno*; not less than 57 to 60 fathoms were obtained in the localities indicated, but both wrecks were found, the *Isis* on the Meinders reef itself, S.S.W. ¾ W. 576 yards from the beacon, and the *Cornelis Anthony* on a reef lying W.N.W. distant 2 miles from Meinders reef.

Baly Strait.—A shoal about 10 yards in extent, having 21 feet on it, and no bottom with 17 fathoms close to, has been discovered to the southward of Banjoewangie by the Netherlands steam-vessel *Bromo*. It lies on the following bearings: the flagstaff of Banjoe-wangie N.W. ¾ N., mount Ikan S. ½ W., and mount Raoe W. by N. ¾ N.

FLORES ISLAND—Reteh Shoal.—The commander of the Netherlands steam-vessel *Reteh* reports the existence of a reef, about 8 yards in circumference, and with only 12 feet on it, in Giliting roads, on the north coast of Flores island. No bearings are given, but the shoal is said to be in lat. 8° 32′ S., long. 122° 18′ E.

STRAIT of SUNDA—S.E. Coast of Sumatra.—The steamer *Duke Bernard* has discovered a reef near the Chungdong islands, Bay of Lampong, Sumatra. The reef is in extent about 650 square feet, with not more than 1 fathom of water on it, and is a scant cable and a half to the eastward of the southern extremity of the Chungdong islands.

GASPAR STRAIT.—Captain Locke of the *Belted Will* reports that after passing Gaspar strait, July 30, during a severe monsoon from E. by S., the ship while plunging heavily struck (as was supposed) the bottom, which was seen to be stirred up in her wake in one spot, as if it were a bank. She grazed over the shoal a second time without striking, and on sounding shortly after, got two casts of the lead 9 fathoms, but to the westward it was thought the water looked shoal. The vessel would not have touched if the water had been smooth. This dangerous spot is in lat. 3° 35′ 35″ S., long. 106° 56′ E.

Sunken Rock.—The ship *Pare Joie* struck on a sunken rock north of Gaspar island, Gaspar strait. From the rock Gaspar island peak bore S. ½ E. distant 5 miles. (1870).

KARIMATA STRAIT.—The Chief of the Marine Department in Netherlands India, reports that the Commander of H.N.M. steamer *Maas en Waal*, has discovered a reef off the Momprang islands (Karimata passage). This reef is placed on the charts of the W. coast of Borneo by Edeling in lat. 2° 32′ 30″ S., long. 108° 24′ 5″ E.

Also, that the commanding officer of the steamer *De Bricl* has seen, in the Karimata passage, an unknown reef with rocks above water, extending about ½ mile, E.S.E. to W.N.W. It is placed in lat. 3° 23′ S., long. 109° 27′ E. (1869).

Grace Shoal.—Capt. Irwin of the *Arica* bound to Hong-Kong through the

Karimata passage, having seen Kebatoe or Shoe island, found Karang Kawat or Grace shoal more extensive than generally placed on the charts: intending to lay-to for the night, southward of Scharvogel islands, came suddenly close to a rock from 50 to 60 feet long, the shoalest part having about 6 feet water, from that to 18 feet over the remainder;—Position, South from the South island and S. by W. ½ W. from the eastern islet, in about lat. 3° 31′ S., long. 108° 25′ E.

Shoals.—The existence of two shoals has been anounced in the Karimata strait, one lying between Billiton island and the Montaran islands, and the other in the fairway of the strait, to the north-east of the Discovery East bank.

The shoal off the Monprang (Montaran) islands, discovered by the steamship *Maas en Waal*, has 18 feet water over it. From the shoal Pulo Sambilan is in line with the south peak of Pulo Nangka, bearing E. ¼ N. distant about 6 miles. The position of this shoal is lat. 2° 32′ 30″ S., long. 108° 27′ E.

The shoal in the fairway of the strait discovered by the steamship *De Briel*, on which the rocks could be seen, extends about 1 mile east and west; the position given is lat. 3° 23′ S., long. 109° 27′ 30″ E., which would place the reef 17 miles N.E. ½ E. of the Discovery East bank. (1870).

Shoal Water.—On the 24th of November 1869, at noon, the *Columbus*, G. Croot, master, in lat. 0° 51′ S., long. 108° 16′ E., struck soundings in 5 fathoms, hard sand or rock; the ship then tacked and stood to the north-west; on standing back again, and when about 5 miles S.S.W. of the first position, soundings in 6 fathoms were again obtained; tacked and stood off to 17 fathoms, after which no shoaler water was found.

The weather at the time was squally, and no land in sight.

Reef.—The Dutch barque *Luctor and Emergo* touched on an unknown reef between Pesemot and Nangka, Montaran islands. From the reef Nangka island bore West, Pesemot island, E. ¾ N., and the westernmost of the Middle group, S. by E. (1870).

China Reef.—The commander of the *China* has reported that his ship, during a voyage from Batavia to Singapore, struck on a reef in the Karimata passage and remained on it ten minutes. This reef, on which there is 10 feet of water, is about a ¼ of a mile long, and stretches out from N.W. to S.E. Position, lat. 1° 1′ 15″ S., long. 108° 30′ E. (1871).

Willem Bank was discovered by H.N.M.S. *Willem* at the southern entrance of the strait. It is about ½ a mile in extent north and south, and about a cable broad, and has 3 fathoms water on it with 6 to 8 fathoms close-to. Position, lat. 3° 52′ 40″ S., long. 109° 42′ 40″ E. (1871).

Condor Bank.—The ship *Condor* struck on this shoal, but did not stop to examine it; the ship, however, made water immediately after she struck. It lies N. by E. ¼ E. 8½ miles from Nangka island. Position, lat. 2° 22′ 20″ S., long. 108° 37′ 15″ E. (1871).

Tallack Shoal.—On the 2nd of March 1871, the British barque *Mary Tatham*, Capt. M. D. Tallack, on her passage through the Karimata strait, struck on a shoal not shown on the charts; this shoal is steep-to, as a cast of 22 fathoms was obtained just before the vessel struck, and when aground there was a depth of 15 fathoms under the main chains. On examination of the danger 20 feet was the least water found, with 20 fathoms close-to on all sides.

The following bearings were observed from the shoals, Socka, the southern of the Melapies group of islands, N.W. ¾ N., distant about 2 miles, Pyramid island, S.W ¾ S., and Zattak point half open of the north side of Meledan or Button island. The position of this danger is therefore lat. 1° 21′ S., and long. 109° 6′ E. *Variation* 1° 15′ *E.* (1871).

Rocks.—The captain of the French barque *Hooghly* has reported that, during a voyage from Saigon to Batavia, he ran very close to three rocks which are not marked in the existing charts. They lie very nearly in a straight line east to west, and are respectively, beginning from the west, the shape of a hay-stack, a sugar-loaf, and a little tree. The hay-stack rock which is the highest of the three, rises about 16 feet above the water. By accurate observation for longitude and latitude, as well as the bearing of the peak of Karimata, the danger is placed in lat. 1° 35′ S., and long. 108° 12′ E.

N.B.—This notice comes through the authorities at Batavia: a notice previously published, owing to an error in the longitude, placed the islets in Banka strait. (1873).

JAVA SEA—Jason Rock.—A rock, probably that formerly known as the *Jason rock*, lying to the north-westward of Thousand islands, has been sounded on by the master of the English ship *Tewkesbury*.

The rock is described as being 40 feet in diameter with 13 feet on its shoalest part and 10 fathoms around it. The following bearings were taken from it, viz.:—Pulo Peblakan, S.E. by E. ½ E.; Pulo Doea, E. ½ N.; and North Watcher, N.E. ¾ N.; these bearings place the danger in lat 5° 25′ 30″ S., long. 106° 17′ 20″ E., or 2 miles from the position formerly assigned to it.

The Netherlands government steamer *Borneo* when examining the position of this rock, took from it the following bearings:—North Watcher N. 40° E.; W. Pulo Doea S. 89° E.; and W. island of Pulo Peblakan S. 62° E. (1870)

The following dangers off the S.E. coast of Sumatra appear on a Dutch chart (Java Zee en aangrenzende vaarwaters, blad 1. 1870), published by the Hydrographic Department, Batavia:—

Ocean Mail, marked with 18 feet and 7 and 8 fathoms all round, is situated 11 leagues to the eastward of the Toelang or Tulang river on the coast of Sumatra, in lat. 4° 18′ S., long. 106° 26′ E.

Comara, a shoal danger of doubtful existence with 7 fathoms close to, placed about 9 leagues to the north-west of the North Watcher, and 7 leagues from the coast of Sumatra, in lat. 4° 49′ 30″ S., long. 106° 14′ 30″ E.

Clifton, marked with 18 feet and 24 to 27 feet to seaward, is situated about 9 miles to the eastward of cape Scopong or Supong on the coast of Sumatra, in lat. 4° 56′ S., long. 106° 3′ E.

Coral Reef.—Capt. Orchard of the *Peterborough*, reports that on Feb. 7th 1871, in passing through the Java sea, she struck on a coral reef not laid down on the chart, lat. 6° 37′ S., long. 115° 58′ E., the northernmost small island of the Kangeang group, N.W. by N., distant about 10 or 12 miles, just visible. The shoal appeared to be very narrow in a north and south direction, but to extend some distance east and west. The water appeared much shoaler to the eastward. The vessel at the time was going 9 knots, and was off the reef before a cast of the lead could be got; no bottom, with 25 fathoms close to the reef.

Coral Reef.—Captain Looper of the Netherlands vessel of war *Wijk aan Zee* has discovered, near Kangeang island, a coral reef with only 16 feet water on it. Position given, lat. 6° 28′ S., long. 115° 58′ E. (1873).

STRAIT OF MACASSAR.—The Laurel reefs extend from lat. 4° 20′ S. to lat. 4° 36′ S., the shoalest part, with 17 feet water on it, lying near the southern extreme.

The ship *Sea Serpent*, in lat. 3° 56′ S., long. 117° 28′ E. passed over a bank about ¼ mile long, in from 4 to 6 fathoms.

A bank that dries, with a reef extending southward of it for about 1 mile, was discovered in lat. 3° 31′ 50″ S., long. 117° 29′ 40″ E. Careful investigation has shown that the shoals marked on the charts of the Macassar strait, in lat. 3° 20′ S., long. 117° 32′ 30″ E., and lat. 3° 50′ 10″ S., long. 117° 45′ 15″ E., do not exist.

A rocky shoal with 15 feet water on it lies to the north-west of Tanjong Kaniongan, on the coast of Borneo. From this shoal Pulo Kaniongan Kb. bears S.E. ½ S., and the east and west points of Pulo Kaniongan Bz., S. ¾ E. and South respectively.

A small detached reef with only 4 feet water, and about 15 square feet in extent, lies in lat. 1° 23′ 30″ N., with Pulo Bilangbilangan bearing N.N.E. ½ E.

Shoal.—Capt. White of the *Sea Serpent* gives the following particulars of a shoal in lat. 3° 56′ S., long. 117° 28′ E., not mentioned in sailing directions, nor inserted on charts; "I drifted on it on a dark night during a dead calm and lay at anchor on it 15 hours; got the boats out and sounded all around the ship, found the extent of the shoal to be about 1200 feet, with 10 and 12 fathoms in the middle, and 4½ to 6 fathoms all around the edges; and composed of dark coral; there was no discoloration of the water whatever; the position assigned this shoal was ascertained by two observations of two well adjusted sextants and two well rated chronometers.

Shoals.—The existence of two shoals near the east coast of Borneo, at the northern part of the Macassar strait, has been announced.

A shoal with less than 18 feet water was observed by the steamship *Onrust*. The ship when anchored with Tanjong Dumaring bearing West, and Goenong Paddie W.N.W., considered the shoal to lie to the south-east about 8 miles distant. The position thus assigned to the shoal is in lat. 1° 40′ N., long. 118° 28′ E.

The Dutch barque *Johannah Anthonia*, in passing through the Macassar strait, touched on a shoal with depths varying from 10 fathoms to 18 feet, to the southward of cape Kaniongan. This shoal lies 6 miles E.S.E. from Bira Birahan island (Pulo Bira), and is in lat. 0° 42′ N., long. 118° 35′ E. (1870).

FLORES SEA—Tiger Islands.—The ship *Duc Bernard* on the passage East of Saleyer, in search of the wreck of the American whaler *Xantho* reconnoitred the group of comparatively unknown islets called Tiger islands.

The group consists of a great number of coral islets, almost all clothed with vegetation, and surrounded by reefs: the islets are visible from 8 to 12 miles. The largest (North Tiger island) is well to the N.E.-ward of the group in lat. 6° 21′ S., long. 121° 3′ E.

Leaving the north island, a chain of reefs stretches in a S.S.E. direction as far as Kaloa Toua: eastward of the reefs, which rise abruptly from depths of 100 fathoms, there is no anchorage. The *Xantho* was lost eastward of the reefs in lat. 6° 30′ S., long. 121° 17′ E. The captain states that there is a safe passage eastward of the reefs, between the isles of Kaloa Toua and Postpaard island, in a N.N.W. direction.

BANDA SEA.—The captain of the Dutch brig *Doesborgh* has reported a shoal lying N.W., distant 5½ miles from Nila, one of the Serwatty islands; particulars not stated. (1870).

ZEMANDRO STRAIT.—Zemandro strait lies between the islands of Solor and Adenara on the west, and Lomblen (or Kawella) island on the east: in old editions of Horsburgh's "Directory" the following description of it is given:—

"ZEMANDRO GUT, formed between the N.E. part of Solor island and the S.W. end of Lomblen, is 3 or 4 miles wide, and seems to be a safe passage. On the east side of the entrance, there is an islet with some shrubs on it, situated about ¾ mile from the S.W. point of Lomblen, called Sangi, Soangie or the Devil's rock; and a hole is seen through it, when bearing N.W. ½ N. or N.W. by N. The northern part of this passage, called the Dutch gut, is formed between the N.W. end of Lomblen and the eastern part of Adenara. Islets and shoals project from the N.E. point of Adenara, and bound the west side of the channel in passing out to northward. There are soundings in some parts of the Zemandro and Dutch guts, but although this passage is said to be frequented by large Dutch ships, it is little known to English navigators, the *Jane* being the only ship of this country, known to have passed twice through Zemandro gut, in her route to, and from Timor.

The N.E. point of Solor and S.W. point of Lomblen, which form the gut of Zemandro, bear N. ½ W., and S. ½ E. from each other, distant about 2½ leagues."

We mention this strait (and give Horsburgh's remarks on it) because though narrow it may, with a little caution and judgment, become useful to those compelled to take the Eastern Passages to China. In March 1868, from 20 to 30 vessels had been over three weeks endeavouring to get through Ombay passage,—with the usual luck of losing by day what was gained at night. At length the masters of the *Lord Macauley* (drawing 20 feet), and the *Westminster* (drawing 22 feet), resolved to turn back and try what could be done at Zemandro strait; after two days they reached the entrance: at noon Sangi island bore East of them, and with the strong current and the assistance of a 4-knot breeze they were clear through, and past the dangers at the northern end of the strait in 2½ hours.

In passing through, it is of the utmost importance to keep in mid-channel, and to have a strict look out from aloft for green water, especially when approaching the north end.

The *Gossamer* on this occasion passed through the Allor strait.

The dangerous part of Zemandro strait is its north end where the Makobani or Boleng islets and reefs narrow the opening between Adenara and Lomblen. The Boleng or Dutch gat lies between these islets and Lomblen, 28 miles S. 25° W. from Komba island. Boleng islets are about 2⅓ miles west of the N.W. point of Lomblen, and are surrounded by a reef: the N.W. end of Lomblen is

also fringed with a reef, but in mid-channel the depth appears to be good,—no bottom at 50 fathoms. Dutch charts show but an exceedingly narrow passage between the Boleng islets and Adenara. The Lomblen side of Zemandro strait appears the safest, and it is said that there is anchorage in Lomblen bay in 19 to 9 and 6 fathoms.

The information contained in these remarks on Zemandro strait has been in a great measure furnished by Capt. Berryman of the *Westminster*.

TORRES STRAIT—Sunken Rock near **Saddle Island.**—A sunken rock has been discovered near the fairway track in the Great North-east channel, Torres strait. It is described as being about 20 yards in diameter, with 6 feet water over it at low water. It lies E. ½ S. 1½ miles from Saddle island. Position, lat. 10° 10′ 30″ S., long. 142° 42′ 30″ E. *Variation* 5° *E. in* 1872.

Note.—To avoid this danger, vessels, after passing Bet island, should haul well to the southward, giving Saddle island a wide berth before steering for Ninepin rock, which latter is steep-to and may be passed on either hand.

COAST OF BORNEO:—The Commanding officer of the Dutch steamship *Coehoorn* reports that during her passage along the S.E. coast of Borneo, the vessel struck on a sand-bank hitherto unknown. There is 12 feet of water on the bank, and the position given is Lat. 3° 57′ 30′ S., Long. 115° 25′ E.

Also, the Commander of the steamship *Betsey* reports having struck on a reef with 15 feet water, near the southern entrance of Pulo Laut. strait. From the reef the point of Patagan bore N.E. ¼ E., and cape Kandang W. ½ S.; the position given is in Lat. 3° 47′ 45″ S., Long. 115° 42′ E. (1870).

Sarawak River:—The following information relative to a sunken rock in the Mortabas entrance of the Sarawak river has been received at the Hydrographic Office from Commander W. Chimmo, R.N., of H.M. surveying vessel *Nassau*, 1871.

The barque *Otter*, on her way down from Quop anchorage, struck and remained some hours on a pinnacle rock, with only 3 feet on it at low water springs, and deep water all round.

The rock lies nearly in the middle of the river, 1¾ miles within the entrance points, and E.N.E. about 9 cables from the Belcher rock.

The Pilots and small steamers navigating the river always pass to the southward of the rock.

Commander Chimmo farther gives notice of the following beacons near the town of Sarawak:—

The "Rocks—hug this shore" beacon, abreast of Samarang rocks, has been blown down.

A beacon, "kept mid river," is placed in the water nearly opposite the Sago factory, and W. ½ S. about 4¾ cables from the western Samarang rock. This direction beacon is to clear a ledge of rocks running off the southern shore, having only 9 feet at low water. *Variation* 1° 23′ *E.* (1871).

BINTULU:—The following Notes on Bintulu, N.W Coast of Borneo, Lat. 3° 11½′ N., Long. 113° 2′ E., are from a recent number of the *Sarawak Gazette*:—

Bintulu stands on the banks of a river which is easily navigated by vessels of the size generally employed on our coast. There are 9 or 10 feet on the bar at

the top of the tide, and the entrance is about 60 yards across. The gunboat *Heartsease* and the schooner *Courier* have come in two or three times during the last year. From one branch at the head of the Bintulu river the upper part of the Rejang can be easily reached by a short journey overland. This route is constantly used by traders during the N.E. monsoon. They find it easier to come from Baloi to Bintulu at that season than to descend the dangerous rapids in the Rejang which must be passed to reach Sibu. Another branch of the upper Bintulu river runs in the direction of the Tinga. The journey overland between the streams only consumes a day and a half for loaded men. Tinga traders occasionally bring produce to Bintulu by this route. Vessels, as they enter the Bintulu river, have to pass the fort, and then reach the bazaar, off which all traders anchor. This bazaar is chiefly built of wood, with bilian ataps, though some of the houses are still roofed and walled with nipa leaves. The Kampong is further up, above the bazaar. New houses are being built here at the edge of the river on bilian posts 9 or 10 feet high, with plank or bark walls and leaf ataps. These new houses are long buildings with a double row of rooms and a passage between, the people living on either side of this corridor. In front of the house are the platforms on which the raw sago is worked, built on posts or floating on the river, for the sake of getting the water used in the process of making without difficulty.

The fort, bazaar, and principal part of the Kampong are built on the right bank of the river; there are, however, three smaller kampongs on the opposite bank. The trade of Bintulu last year was greatly in excess of 1869, the value of its exports being 172,946 dollars. This increase was mainly owing to the advance in the price of gutta. For some months almost all the men were absent in the jungle seeking this commodity; Bintulu was almost empty, and the amount of sago exported suddenly decreased from 20 to 17 koyans per month. Since the demand for gutta has grown less, and its price in consequence has fallen, the people have returned to their usual employment, and the sago workers are again in full operation.

The exports, besides gutta and raw sago, consist of camphor, india-rubber, bezoar-stones, and the various sorts of canes. The country up the river is laid out in large plantations of the sago palm. There are very few paddy fields, the inhabitants not growing rice enough for their own consumption. Bilian wood grows abundantly on the banks. A carpenter in Bintulu has lately sent three men to work bilian ataps; last year he tried to get men from Sarawak to work bilian, but failed, it is believed, through being unable to make them advances. Large quantities might be worked on the river and floated down on rafts, as the trees are growing close to the water's edge.

During the N.E. monsoon there is generally much less sea at the mouth of the Bintulu river than at other places on the coast, as it is protected by Kidurong point, and Kidurong bay is completely sheltered from the north-east wind. The steamer *Heartsease* and *Far East* both anchored in this bay last year, in a position quite sheltered from this wind.

The greatest obstacle to improvement is the want of population. Rice might well be grown on the banks of the river, the soil being well adapted for that crop, if there were people to plant it and make farms. Tobacco might also be cultivated. The Kyans now grow it for their own consumption, the quality of which

is very fair, being thought by many people at Bintulu to be superior to the ordinary Java tobacco.

The people are well disposed and peaceable. Small Chinese traders continually go up the river to the villages with their wives without being molested, and a murder has not been committed on the river for three years. (1871).

Outlying Shoals :—The following account of some outlying shoals on the north-west coast of Borneo has been received from Captain W. Arthur, R. N., of H.M.S. *Iron Duke*, 1872.

During the passage of H.M.S. *Iron Duke* from Singapore to Labuan. soundings were obtained in 5 fathoms in lat. 5° 5′ N.' long. 114° 40′ E., about 4½ miles N. N.W. of the Bruni patches, with the eastern extreme of the Bruni cliffs, bearing S.E. ¾ E.

Information was also received from the Captain of the vessel trading between Labuan and Singapore, of a similar patch about 16 miles to the north-east of that found by the *Iron Duke*, reported to be in Lat. 5° 13′ N., Long. 114° 53′ E. This position was determined from cross bearings of Kuraman island and mount Pisang.

Commander George Robinson, of H.M.S. *Rinaldo* also reports, that during the passage from Labuan to Manila, when about 21 miles from the coast of Borneo, the leadsman suddenly got soundings in 7 fathoms decreasing to 5 fathoms, the bottom being distinctly visible, and discoloured water seen from the masthead to the northward.

From this shoal water the west extreme of Gaya island bore S. ½ E., and the mountain of Kini Balu S.E. by E. ½ E., the depth of 5 fathoms being in Lat. 6° 26′ N. Long. 115° 56′ E. *Variation* 1° 20′ *E.*

Kidurong Bay.—Kidurong bay possesses the only well-sheltered harbour in the N.E. monsoon along a coast line of over 300 miles, that is to say, between the Rajang river and the mouth of the Bruni, or Labuan island.

With such a safe anchorage as this bay affords, where vessels can ship their cargoes without difficulty, and where an abundant supply of water is found close at hand, it may safely be expected that produce will quickly accumulate.

The bay has been sounded, and the Captain G. Helyer of H.M. Gunboat *Heartsease* communicates the following:—

Kidurong bay is the only place of shelter along the whole coast from Tanejong Sirik to Labuan.

In the N.E. monsoon small vessels could run in here, and lie safely at anchor, sheltered from E.N.E. and N.W. gales. The anchorage is good, being soft mud and sand; the soundings vary from 2 to 8½ fathoms; good anchorage could be obtained about a quarter of a mile off the inside point in 3 fathoms of water.

Directions for entering Kidurong Bay:—In entering the bay from the northward stand down till the point bears E. ¾ N. about one mile distant; then stand in E. ¼ N. to 2½ or 3 fathoms of water, and let go about a quarter of a mile from the inside point with the outside point bearing N.W. by N.

Entering from the southward or Bintulu side stand out into 5 fathoms, then stand for the point about N.E. by N., but do not come closer than half a mile off the point, then stand in for the anchorage.

Good fresh water may be obtained here in abundance.

The following are the bearings of the proposed lighthouse: Mount Tatu N.N.E. and Kidurong hill S.S.E.—*China Mail.*

CELEBES.—A reef, on the eastern edge of which a sounding of 6 feet was obtained, has been discovered near Togean island in the gulf Tomini. From the shoal the following bearings were taken, the hill at the western extreme of little Waleah island N. by W. ¼ W., south point of great Waleah island E. by N. ½ N., Teloga island E. ½ S., north point of Pu-ah island E. by S., south point of Pu-ah island E. by S. ¾ S., Palala point on Togean island, W. by S. ½ S., and Toro Batu W. ¾ S. *Variation* 1° *E.* (1870).

Reef off Siompoe island:—Capt. Henry Proctor of the *Aunt Lizzie*, bound to Yokohama, through the Eastern Passages, Jan. 3rd, 1870, passed close to a reef of black rocks showing many heads 20 to 30 feet above water, and about 2 miles to the northward of the west end of Siompoe or South island, lying off the S.E. end of Celebes. The reef was probably connected with Siompoe; it is dangerous—extending, as it does, so far from the land, but with a good look-out can be plainly discerned at the distance of 3 or 4 miles.

Quintet Bank.—The Netherland vessel *Quintet* touched on a shoal in the eastern part of the Greyhound channel, East of the island of Celebes. When on it Pulo Massuni bore N. 59° W.; Pulo Lembau E.N.E.; and Pulo Seho S. 28° E. There are 3 fathoms water on the edge of the reef, S.E. of Pulo Massuni, and it is 3 miles east of any danger marked on the chart.

GILLOLO—Dodingo Bay;—The Netherlands war-steamer *Timor* has discovered a reef, with only 7 to 2 fathoms water on it in the eastern part of the navigable channel between Ternate and Gillolo (Halmaheira). The position is given as, Lat. 0° 52′ N., Long. 127° 37′ E.

Gillolo Passage:—Capt. Collins, of the American vessel *Brewster* reports as follows:—

At the southern entrance of Gillolo passage, 5 miles south of the "Black rocks" I was becalmed, and experienced a three knot current, setting about S.S.E,, which drifted the ship towards Toppershead or Button island. When within 4 miles of it, saw bottom plainly; let go my kedge anchor in 14 fathoms—Toppershead island bearing S. by E., distant 3½ to 4 miles.

This bank extends east and west, how far I was not able to ascertain, but, another vessel anchored about 3 miles east of me, on the same bank, therefore I think it extends as far as from Lawn island to Kekik island; found 50 fathoms between the bank and the islands, and 15 fathoms within a cable of Toppershead island.

There were nine other vessels in company, and had they known of this anchorage, they could all have availed themselves of its convenience, and thus escaped the anxiety and trouble incidental to being drifted about at the mercy of the tides and currents. In my own case, I think I should have lost the ship on Toppershead island, had it not been for the anchorage on the bank.

I am sorry that I cannot give a more accurate description of it. I lay at anchor 24 hours (2nd of December 1868), after which the current changed, setting strong to the N.W., enabling me to proceed on my passage. The vessel

anchored with me had 12 fathoms; it may possibly be much shoaler in some parts.

Reef South of Gillolo Passage:—The master of the ship *Talbot* reports that his vessel grounded on, and passed over, a reef immediately south of Gillolo Passage, in lat. 1° 51′ 30″ S., long. 128° 8′ E., with the East side of Gasses bearing N.N.E., and High Peak on Gomona W.N.W.; where the latest charts mark no bottom at 70 fathoms. The sea was nearly smooth, and ship sailing from five to six knots per hour, steering S.S.W. She grated over for about three times her own length. The extent of the shoal S.S.W. and N.N.E. would be about 500 feet. Before we had time to pass the lead we were in deep water. This shoal lies directly in the fairway between Manipa Straits and the entrance to Gillolo Passage. The bottom must be of dark-coloured rocks, as there was not the slightest discolouration of water, or any appearance whatever to indicate danger. Time of accident, 3·30 p.m. Tide, half ebb. (1873).

Ormsbees Shoal:—Capt. J. W. Roy of the *Chusan* writes as follows to Lloyd's Agent at Iloilo:—As some doubt appears to exist as to the extent of the Ormsbees shoal, North of the entrance of Gillolo passage, I beg to hand to you a few remarks made while passing the south end of the above shoal on my passage from London to Shanghai.

On the 30th December, 1872, at 8.30 a.m. centre of Syang island bore due South; steered due East 7½ miles by patent log; the centre of the island then bore S.S.W. These angles place the ship at the last bearing N.N.E. 17 miles from Syang island. At the same time saw rocks under the ship's bottom; sounded immediately; had 7 and 9 fathoms; then no ground.

This appears to be the southern extremity of the shoal, lat. 0° 38′ N., long. 129° 58′ E., the bank to the North of the ship at that time appeared to have much less water, and very smooth. I am sorry that I cannot give a more accurate description, as I had to take advantage of the light breeze then blowing.

SULA SEA—Sandakan Harbour:—A rock has been discovered by the commander of the Italian corvette *Princess Clotilde* off the entrance of Sandakan harbour N.E. coast of Borneo.

This rock (*Clotilde rock*) rises about 10 feet above the level of low water, and is about 100 yards long N.N.W. and S.S.E. and about 20 yards broad. From the rock Baguan island bears S.E. by S. southerly 9¼ miles, and Taganac island, S. by W. ½ W. 9 miles: these bearings place it in lat. 6° 9′ 50″ N., long. 118° 25′ E.

At about 100 yards round the rock a depth of from 8 to 11 fathoms was found. (1870).

Laurel Rock:—The position of the Laurel rock is 4 miles E. by N. ¼ N from that assigned to it on the charts, and from it Baguan island bears S.W. by S. westerly 4 miles.

This rock is about double the height and size of Clotilde rock. (1870).

The following information relative to shoals in the Sulu Sea has been received at the Hydrographic Office from Commander William Chimmo, R.N., of H.M. surveying vessel *Nassau*, 1871:—

Jessie Beazley.—The danger under this name has been found; it is a small sand islet on coral, the approximate position being in lat. 9° 2′ N., long. 119° 48′ 30″ E.

Tub Bataha.—A reef, 16 miles long, extending in a south-west and north-east direction, has been examined near the locality assigned to the Tub Bataha. On the reef are many sandy cays, and blocks of dark rock on a base of coral, and at the northern extreme is a sandy islet about 15 feet high, covered with scrub, and visible at a distance of 5 or 6 miles in clear weather; this islet lies in lat. 8° 53′ 48″ N., long. 120° 0′ 45″ E.

As within the distance of 2 miles from this islet there is no bottom at 1000 fathoms, sounding would give no indication of the vicinity of the danger at night or in thick weather.

St. Michael Shoal is a large coral bank, lying E.S.E. and W.S.W., 8 miles long by 2 broad, having regular soundings of from 10 to 15 fathoms on it. The western extreme of the shoal is in lat. 7° 40′ N., long. 118° 17′ 30″ E., and from it the peak of Cagayan Sulu can be seen in clear weather bearing S. by E. ½ E., distant 38 miles.

Vessels may pass over or anchor on the shoal; the *Nassau* lay at anchor here four days in 10½ fathoms, sand and coral, but there is no safe anchorage about the St. Michael islands to the north-east of the shoal.

There are deep channels between the shoal and St. Michael islands, and between the islands, but care must be taken to avoid the reefs that run off them, especially that off Manuk Manukan, which extends 3½ miles to the north-west.

Java Reef was carefully sounded, and not less than 16 feet water found on it: the reef is about a mile in extent, and lies nearly midway between the islands of Bancuran and Bancawang, in lat. 7° 50′ 10″ N., long. 118° 35′ E.

Bancuran has a dangerous reef extending from it to the westward for about 2 miles.

Strong tide rips were observed in the neighbourhood of Java reef; these rips disturb the surface of the sea without any apparent cause, and are generally in the deepest water.

Pudsey Dawson.—An extensive mass of coral patches running about 12 miles in an E.N.E. direction, with as little as 15 feet water on them, has been found in the neighbourhood of this shoal. The western patch lies E. ½ S., distant 20 miles from the eastern point of Mallawallé island. The position of Pudsey Dawson is lat. 7° 4′ N., long. 117° 46′ 30″ E.

The Muleegee Patches, having 5, 6, and 7 fathoms, and probably less water over them, lie W. ½ N., 20 to 25 miles from Muleegee islands.

In addition to the above-named dangers many patches of from 3 to 7 fathoms have been found: mariners are therefore cautioned to be vigilant when navigating this part of the Sulu sea. There is a clear and safe passage from the Main channel, Balabac strait, to Cagayan Sulu.

A reef with 4 fathoms has been found lying N.E. by E., about 3 miles from Keenapoussan island, to the northward of Cagayan Sulu.

The space north of Cagayan Sulu, marked "many shoals here," has been examined, and deep water found in its neighbourhood.

Sulu Archipelago.—A dangerous reef of rocks awash at high water has been found in the fairway between the Sulu and Tawi-Tawi groups. It lies S.W. by W., 2½ miles from Parangaan island, and appears to be connected with Cacataan island by a 4½-fathom patch of coral.

An extensive sand bank, over which the sea breaks at low water, lies S.W. ½ S., 3½ miles from Parangaan.

The tides run with great velocity in this locality, the flood setting to the south-east, and the ebb to the west.

These localities are in the course of examination by H.M.S. *Nassau*; the present notice is therefore only to be considered as preliminary.

Cagayan Sulu.—The following account of Cagayan Sulu, by Capt. W. Chimmo, R.N., is reprinted from the Proceedings of the Royal Geographical Society:—

Cagayan Sulu is situated on the north coast of Borneo, about 60 miles, being in lat. 7° N., long. 118° 27′ E., and conveniently situated for a port on entering the Sulu Sea from China, India, or Australia through the Balabac strait.

It is about 25 miles in circumference, nearly on every point surrounded by a fringe reef of coral, in a very active and progressive state, and which affords protection to canoes, and rafts made of bamboo, to travel from one point to another in smooth lanes of water, enabling the natives to pursue their fishing, on which they chiefly exist, without being subject to heavy seas.

The general elevations of the hills are from 300 feet to 1000 feet above the sea, some covered with long grass, others with trees and coco palms. The natives are mostly Malays from Borneo, and are independent. The whole island, as well as the group of small islets off it, is evidently volcanic.

The men fish, while the women do all laborious work, such as carrying water, pounding rice, &c. We found them very friendly all round the island, constantly coming on board, and accompanying us when on shore, and very useful as guides (for a trifle) in cutting down trees and clearing away bushes.

The climate is healthy, and the soil fertile; in the north-east monsoon cool, but bringing heavy showers of rain, sometimes lasting all day or night, the temperature on an average 78°. Thunder, lightning, and heavy clouds form in the south-east over Borneo, and, working up to windward, fall over Cagayan Sulu as heavy rains.

There are safe anchorages around the island in both monsoons; that in the north-east is safe and good on the south-west side in from 8 to 10 fathoms; another good ancherage on the south-west side of Keenaponsau in 10 fathoms; a third about a mile south of the little islet at the entrance to the crater on the south-east side in 12 fathoms—but all coral bottom.

The water on the east side of the island is the deepest, having 240 fathoms one mile off the land, and strong tide-rips around here often frighten the mariner; but they are about the deepest water.

The south-east side of the island is by far the most picturesque and interesting, but not the best anchorage; the land here slopes to the south, is richly wooded, and many parts cleared, having plantations of Bananas and sweet potatoes; but no dwellings were visible from the ship, nor did any natives visit us, as they so readily did at the south-west end on our first arrival.

I do not know any island I have seen over the world more favourably situated or trade, or more suitably adapted for cultivation. Rice, sugar, coffee, maize, potatoes, and vegetables, would all grow if cultivated.* The soil is excellent,

* Cotton-tree and tobacco-leaf were already growing there.

rich, of trap formation, with sufficient sand to make it loose and friable. Cattle of all sorts—horses, cows, sheep, pigs, and poultry—would fatten and thrive here. Enterprising men, with some Chinese labourers, would soon make it a valuable island, and not a disagreeable one, to live on. (1872).

Basilan Group.—Wilhelmina rock, discovered by the Captain of the Dutch barque *Wilhelmina Frederika*, in the passage between the Basilan and Sulu groups, is partially covered with sand, and is awash at high water, with no bottom at 30 fathoms near it. Position, lat. 6° 25′ N., long. 121° 22′ E.

The ship *Wild Rover*, at the western entrance of Basilan strait, in lat. 6° 55′ N., long. 121° 43′ E., passed over a bank on which soundings in from 6 to 10 fathoms were obtained.

Teomabal Island.—It is said that the island of Teomabal, of the Pangutarang group, lies N. by E. 7 miles from the position assigned to it on the chart, and that the reefs on the north side of the island extend 12 miles in a N.N.E. direction. *Variation* 1¼° *E.* (1872).

Bank near Sandakan.—The Commander of the Prussian corvette *Nymphe*, bound from Bangao to Sandakan, March 31st, 1873, discovered a shoal which is thus described:—This danger, which extends half a mile east and west, broke heavily, while a mile northward of it we found no bottom at 30 fathoms. Position given, lat. 5° 43′ N., long. 118° 41′ E.

MINDORO SEA—Santa Lucia Bank.—The Spanish corvette *Santa Lucia*, and gunboat *Mindoro* have discovered a bank on the coast of Sulu, the centre of which is in lat. 6° 24′ 30″ N., long. 121° 13′ 34″ E.

It extends N.N.W. and S.S.E. 2½ miles, and is 1½ miles wide. The two vessels crossed it from east to west; the corvette had soundings of 6½, 5½, 5, 5½, and 6½ fathoms; the gunboat half a mile further north had 3½ fathoms.

Palawan, E. Coast.—A shoal has lately been discovered by the Spanish steam-vessel *Constancia* off Bold point, east coast of Palawan. The shoal (*Constancia shoal*), the general extent of which is unknown, had 3½ fathoms on it, sand and coral, where first sounded on, but the depth increased to 11 fathoms about 1 mile to the N.W., and again decreased from that depth in a W.S.W. direction. The shoal part lies about E. by S., 15 miles from Bold point, which places it in lat. 9° 58½′ N., long. 119° 24½′ E. (1871).

San Bernardino Strait.—The *Antipodes* from Zebu, reports:—July 29th, at 7 P.M. calm, tide setting the ship to S.E.; 9.30 P.M. ship struck on a bank, and stuck about ten minutes; sounded all round the ship, 3¼ fathoms aft, and the water deepened as the lead was passed forward: took the bearings of Puercoa islands N.E., Capul island N. by W., and Destacado S.W. ½ W.

The Spanish and other charts mark a shoal under water, "El Diamante," a short distance N.E. of the one reported by the *Antipodes:* they may be one and the same.

MALACCA STRAIT—Breakers—The *Province* of the "Messageries Nationales" when passing through the Malacca strait on a S.E. ¾ E. course, saw, on the starboard side, at the distance of 3 miles, breakers extending rather more than a cable in a S.E.-ly direction. The *Province* was then south of Bukit Salamat, 2½ miles from the shore, and 2 miles from the beacon on Batoe Mandie,

which places this danger near a spot marked 8½ fathoms on the chart, in lat. 2° 19′ N., long. 101° 56′ E.

NATUNA ISLANDS.—The *Devenport* was lost on September 27th, 1869, on an unknown rock 10 to 17 feet under water, about 10 miles eastward of the east coast of Great Natuna island.

The bearings taken were Senoang islet N.W., and Kamodi islet S.W. by W., which place the rock in lat. 3° 54′ N., long. 108° 30′ E. *The geographical position is approximate.*

The *Louise et Marguerite*, drawing 14½ feet, when passing to the northward of the Natunas, during the N.E. monsoon, with fine weather, moderate breeze, and smooth sea, making 5 knots, touched on a shoal. The depth, on sounding, was 11 fathoms, hard bottom. The rocky islet 2½ miles south of the S.E. end of Pulo Laut bore N. ⅛ W.; and the S.W- end of Pulo Laut N.N.W. ⅓ W., placing the shoal in lat. 4° 34¼′ N., long. 107° 59¼′ E.

Milton Shoal.—Capt. Le Boutillier of the *John Milton*, reports a shoal in the Koti passage as follows —

On the 22nd September, 1869, passed over a shoal, where on the chart is marked about 20 fathoms water. This shoal is about a quarter of a mile in breadth, the bottom of large round soft coral stones; found no less than 28 feet of water, being very smooth at the time, seeing the bottom quite plain, vessel going at the rate 1 mile per hour. At the same time took several cross bearings, and found the said shoal to be in lat. 2° 37′ N., long. 108° 50′ E.

SIAM GULF—Position of the Condor Reef.—Master Thompson, of the brig *Katinka* reports as follows:—

March 29th, 1872—The ship heading W.S.W. directly towards the reported position of the Condor reef; light breeze from the south and smooth water; at 9 a.m. saw from the fore yard-arm, directly ahead, a light rippling on the surface of discoloured water, extending N. and S. about 600 feet; put helm a-lee, bottom being plainly visible. Lowered a boat and sounded W.N.W. from the ship, about 300 feet distant from it, in $5\frac{8}{10}$ fathoms water; there could not have been more than 1 foot water where the rippling was seen.

While sounding in the above spot the southern corner of the high table-land on the northern end of Koh-Rong bore East, which would place it in lat. 10° 43′ N., long. (by three good sets of sights) 102° 51′ E. of Greenwich. This would be about 3 miles E.N.E. ½ E. from the place on which the Condor reef is placed on Imray's chart of 1869, and the British Admiralty chart of 1858.

A further examination of this shoal has been made by Lieutenant Veron, commanding the dispatch steamer *Le Frelon*, French Navy, with the following results:—

Condor reef is a rocky plateau half a cable in extent, and from 16 to 20 feet below the surface, except at six points which rise above the general level of the reef to within 6 to 1½ feet of the surface. The shoalest point is on the S.W. part of the reef; from this point the depth increases in the same proportion toward north and south; that is, 5½ fathoms at 110 yards, and 13 fathoms at 220 yards. Toward the east the depth increases gradually to 13 fathoms at half a mile from the same point, but it changes rapidly to 16½ fathoms outside of that distance. On the west side the change is more rapid; 6 fathoms of water is found at 55 yards, from thence it increases rapidly to 16½ fathoms, and 22 fathoms water

is found at 3 cables west of the shoalest point. From the head of the reef or shoalest spot the bearings are as follows :—

The westernmost island of the Koh-Samit group, N. 37° E. The islet situated between the Koh-Rong and Middle island, N. 76° E. The highest peak of Koh-Rong S. 88° E. These bearings give the position of the reef: lat. 10° 43′ 40″ N., long. 102° 53′ 19″ E. Bearings true. *Variation* 2° *E.* (1872).

The following information relating to the rivers Bangkok and Tachin at the head of the gulf of Siam has been received from Navigating Sub-Lieutenant James S. Barrett, of H.M.S. *Teazer*. Commander Richard M. Blomfield, R.N.

Bangkok River.—The look-out house on the west point, and red house in the river, given as leading marks, have disappeared. The course given from the fishing stakes on Admiralty chart No. 999, is stated by the pilots to be one which would now lead a vessel on shore, the course steered by the pilots is about N.E. ¾ N., instead of N.E. by E., hauling gradually to the northward as soon as the west point bears N.W.

Tachin River.—The mouth of this river lies about 20 miles to the westward of the Bangkok river; it was navigated for about 35 miles by H.M.S. *Teazer*, in November 1871; this river has a similar bar to that of the Bangkok river, but the entrance is more difficult to distinguish, the land in the neighbourhood being low, and covered with trees.

In clear weather the high land of Bang-pasoi brought to bear E. by S. will lead to a position off the bar, which may be crossed on a N.N.W. course. Tachin river has about the same general depth and is of the same general width as Bangkok river.

The *Teazer* anchored off Maconchisi in lat. 13° 39′ N., long. 100° 11′ E., nearly 35 miles from the mouth of the Tachin. At Maconchisi are the new mills of the Indo-Chinese Sugar Company; the sugar is at present sent in barges by canal to Bangkok, but it is expected that vessels will shortly navigate the Tachin river as easily as they now do the river Bangkok, whereby an expensive freight will be saved. *Variation* 2° 10′ *E.*

Anchorage off Bangkok River.—The following remarks are by Lieut. H. E. Nichols, U.S.N., navigator of the U.S.S. *Lackawanna* :—

A screw pile lighthouse has been erected at the mouth of Bangkok river, but the light has not yet been shown, and it is uncertain when it will be. The foundation having given way slightly, it is probable that the lighthouse may be removed from its present position and placed in some other. In running for the anchorage off Bangkok river make Koh Lüem, and from that departure steer boldly up, allowing for a westerly set, according to the strength of the N.E. monsoon. The lighthouse, in its present position, will be seen before the land is made, and is an excellent guide for running in; bring it to bear north and run for it, keeping the lead going, and anchor according to the draught of the ship. During the N.E. monsoon the land is generally obscured by smoke, so that the lighthouse will be the only mark to show the mouth of the river.

Anchorage during N.E. monsoon, lighthouse bearing N. 35° W.

Anchorage during S.W. monsoon, lighthouse bearing N. 17° E.

Pilot boats cruise between Koh Lüem and the bar, having competent European pilots on board; they generally anchor vessels in about 6 fathoms water, with the lighthouse bearing as above, according to the season, and distant about 5 miles. (1873).

Navigation of the West Coast of Siam Gulf.—The following information of the navigation of the west coast of the gulf of Siam is from an abstract from the Bangkok Calendar, 1873; and derived from the surveys of H.M.S. surveying brig "Enemy Chaser", Capt. A. J. Loftus.

From Hilly cape to Ligor, vessels may safely approach the shore to a distance of 4 miles, giving cape Patani a berth of at least 3 miles, as there are shoal sand patches having 10 feet of water in that neighbourhood. Patani bay is quite choked up, and navigable only for small boats at high water. There is no island existing off the end of cape Patani as shown on the old charts. The mouth of Patani river lies a little to the westward of the meridian of the cape.

Midway between Patani and Row island, and about 3 miles from the shore, is a hard patch of ground having 10 feet of water on it. Pulo Ticos and Pulo Kewshan may be approached on their *eastern* side as close as convenient, there being plenty of water and no hidden dangers near them. Inside these islands the water is shoal and not navigable for sailing vessels of any size. Small vessels will find snug anchorage in 2½ fathoms water, bottom of mud, one-quarter of a mile off the S.W. end of Pulo Ticos. When coming in or leaving the inner roadstead, keep the south end of the island (Ticos) close aboard. Large vessels will ride comfortably in 5 fathoms water, with the south end of Pulo Ticos bearing westerly.

The coast from here to the extreme north end of Pulo Tantalam is quite clear, with good depth of water close to, mud bottom. The coast line is not, however, as represented on the old charts; the extreme end of the Lamcolam Pook being about 4 miles further south, and 8½ miles further east, than is there represented. The Pook itself is a narrow curved spit of coarse sand, being about 6 miles in length, and 300 feet at its greatest breadth, and having a compact cluster of young fir trees on its extremity, which may be seen at a distance of 12 miles from the deck.

The water is shoal off and around this point, and continues so to the mouth of Ligor river, which bears from the Pook about W. ½ N., distant 5½ miles, when it gradually deepens to the northward. No hidden dangers have been discovered from thence to lat. 10° 7′ N.

Between the Pook and Ligor creek the land forms a deep bight to the southward, where a river named Pakinham, 1¼ miles wide at its mouth, leads to the inland sea in the same direction. This bight, like that of Patani, is navigable only for small boats at high tide. To anchor in Ligor roads, round the Pook at a distance of 4 miles, steer to the westward, and bring up according to draught. If coming from the northward keep inshore, and anchor in suitable water near the inner fishing stakes. Circumstances are frequently favourable near the shore for vessels to beat down against the S.W. monsoon.

Sailing directions in detail will follow the publishing of the charts now in progress, which comprise the coast between Lem Chong Pra and Hilly cape.

Kusrovie Rock.—The commander of the Netherlands India barque *Ellen Bangka*, reports that his vessel, whilst under sail on the 12th November 1870, in the neighbourhood of the Kusrovie rock, struck twice on a shoal on which there was only 11 feet water.

The vessel was at that time North 5 or 6 miles from the Kusrovie rock, which was visible from the deck. The danger has accordingly been placed in lat. 11° 11′ N., long. 102° 47′ E.

COAST OF CHINA:—Banks Almazon and Althea.—The French sloop

of war *l' Aspic*, Lieut. M. Banare, while on a cruise from Hong-Kong to Saigon, examined the Banks Almazon and Althea, near cape Padaran, on the route of ships from cape St. Jacques to Hong-Kong. Lieut. Banare, after a rapid examination, believes that the two are in fact only one bank, making out from the north point of Cecir Island bay, surrounding the latter; thence trending out to the S.W. and terminating at about 14 miles distance from the southern point of the bay.

Over an extent of about 16 miles, in a N.E. and S.W. direction, he found but shallow water, at times being able to see distinctly the sandy bottom covered with coral heads.

Although having obtained not less than 5¼ fathoms water, he is not positive that there may not be less.

Before a more thorough examination has been made, large vessels should keep clear of these banks, and not approach the coast south of the parallel of cape Padaran.

Hong-Kong—Bokhara Rock.—The following information has been received respecting the existence of a sunken rock on the S.W. side of the entrance of the Tathong channel, Hong-Kong, on which the Peninsular and Oriental Company's steam-ship *Bokhara* lately struck.

This danger is a pinnacle rock with 3 fathoms on it at low water springs; it has 7 fathoms close to on all sides and 10 fathoms around. From it, the extreme of cape d'Aguilar bears S.W. ⅔ W. 7 cables; Tathong rock N. by W. ⅓ W. nearly 13 cables; and the extreme of Lochau island 3° open of the islets off cape d'Aguilar.

Navigating-Lieut. T. W. Webster, adds:—"I anchored the launch on the rock with 5 fathoms under the bow, and found the same depths in the quarters of the boat, with shoal water between.

"By accurate and careful soundings, I found the rock to run 30 feet north and south, and 36 feet east and west, inside a depth of 5 fathoms.

"At 10 feet from the east extreme of 5 fathoms, I found a sharp pinnacle rock, with only 18 feet 9 inches on it; and extending nearly due west of this is a narrow ridge 13 feet long, and not more than 4 feet wide, with several pinnacles so sharp that the lead would not rest on them. The extreme west pinnacle has 21 feet on it, and there are several of 22 to 26 feet.

"At the east extreme of 5 fathoms the lead descends suddenly to 7 and 10 fathoms, and there are 10 fathoms 20 yards outside the 5-fathom line all round the rock.

"The examination was made at low water spring tides."

It is intended to place a buoy on the rock with as little delay as possible.

Note.—Ships from Hong-Kong bound southward, and passing through Tathong channel are recommended to keep in mid-channel: if intending to proceed through the Shing-shi-moon pass Tathong rock should not be brought to bear to the northward of N.N.W. (or with cape Collinson seen well open to the eastward of it) until Tytham head comes open of the southernmost islet off cape d'Aguilar. (1873).

Sunken Rock in the Capsingmoon Passage.—Information has been received of the discovery of a sunken rock off Lantao, in the Capsingmoon passage, Hong-Kong. This danger (Passage rock) has not more than one foot water on it at low water springs, and is only about 10 yards in circumference; from it, the summit of Green island bears S.E. easterly; South extreme of Chunghae island

in line with Chunghae rock E. ⅜ N.; South-east extreme of Lantao W. by S. ½ S. 8 cables; Victoria peak S.E. by E. (1873).

Shoal off Turtle Rock.—Lieut. Rockwell, U.S.S. *Palos*, relating to a dangerous shoal off Turtle rock, near Cupchi point, reports as follows:—

The U.S.S. *Palos*, when on her passage from Hong-Kong to Wusung discovered a shoal off Turtle rock (near Cupchi point), with a number of soft lumps on it having only 2 fathoms water on them. From the shoal Cupchi point bore N. ¾ E. 3 miles, and the hill marked on the chart as 726 feet high, N.W. ¾ W. 7¼ miles. According to these bearings the shoal is in lat. 22° 46′ N., long. 116° 3′ 30″ E.

As this danger lies in the track of navigation vessels should be cautious to give it a wide berth, when passing the Turtle rock.

Danger off Breaker Point.—Information has been received that the Ocean Steamship Company's vessel *Ulysses* on her passage from Hong-Kong to Shanghai, struck on a wreck, or rock, off Breaker point, carrying away her rudder. From a position near, in 13½ fathoms water, the following bearings were taken:—

White rock W.N.W.; Flat rock N. by W. ½ W.; Dome hill North. These bearings place the danger in lat. 22° 52′ 20″ N., long. 116° 27′ 50″ E.

Sunken Rock near Tungao.—A sunken rock has been discovered near Tungao bay and lying directly in the track of vessels proceeding from the anchorage in Tungao roads round Breaker point, as also when keeping in-shore to avoid the north-east monsoon, and on which the steam-ship *Hai-Loong* struck.

The sunken danger, *Hai-Loong rock*, lies a mile off shore, on rocky ground which is about ½ mile in extent with from 5 to 10 fathoms; near the centre of this rocky ground are two pinnacles lying north and south 50 yards apart, with only 11 feet water on them at low water, the lead slipping off into 6 fathoms on either side of each pinnacle. From the north pinnacle the islet inside Breaker point bears E. by N. northerly, distant 5½ miles; White rock N. by E. ⅔ E., one mile; North Pagoda N.N.W. ¼ W., 5½ miles. These bearings place the rock in lat. 22° 54′ 30″ N., long. 116° 19′ 30″ E.

Sunken Rock near Chinchu.—H.M. ship *Juno*, when standing for an anchorage in Tongbu bay, between Chinchu harbour and Port Matheson, struck on an unknown sunken rock.

Juno rock appeared to be a cluster of coral heads, with 12 feet at low water and 6 fathoms around. From the rock, the west corner of Tongbu wall bears N.E. $1\frac{5}{10}$ miles, the summit of the islet in the bay N.W. ½ N. $1\frac{6}{10}$ miles, Tahkut island fort W. ⅓ N. $3\frac{7}{10}$ miles, and east point of Passage island W. by S. ½ S. nearly 4 miles. These bearings place the danger in lat. 24° 51′ N., long. 118° 53′ E. (1873).

Haitan Strait—Ashuelot Shoal.—This sunken danger upon which the American steam-vessel *Suwo-Nada* struck in January 1872, (the position of which was ascertained by the officers of the United States ship *Ashuelot*, under the orders of Rear-Admiral John Rodgers,) and which has been named the "Ashuelot rock." lies nearly in the centre of the southern part of Haitan strait about 3 cables to the westward of Low island; it has 10 feet on it at low water springs, and 6 to 7½ fathoms were found at two boat's lengths from the rock.

From the rock, Low island bears E. ¼ N., Junk Sail rock S.E. by S., and the middle of Pass island S. by W. ½ W.

The position of this rock narrows the southern part of Haitan strait to 2½ cables at low water, and renders this part unsafe at that time of tide for vessels drawing more than 9 or 10 feet. (1872).

SHORT NOTES

AND

SAILING DIRECTIONS

FOR THE

CHINA SEA

AND

INDIAN ARCHIPELAGO.

WINDS AND WEATHER IN THE INDIAN ARCHIPELAGO.

In the **Java Sea,** and among the islands of the INDIAN ARCHIPELAGO, S. of the Equator, S.-Easterly winds prevail while the sun is in the Northern Hemisphere, and these are replaced by N.-Westerly during the stay of that luminary in the Southern Hemisphere; the former are known as the East Monsoon and the latter as the West Monsoon—and are characteristic of all that region by which the South Pacific communicates with the Indian Ocean. Comparing together the seasons of the two tropics, the West Monsoon (S. of the Equator) corresponds to the N.E. Monsoon of the Indian Ocean and China Sea,—the East Monsoon corresponds to the S.W. Monsoon.

Sunda Strait.—From April to October the Easterly Monsoon is prevalent—variable between S.S.E. and E.S.E. The Westerly Monsoon, variable between W.N.W. and N.W., prevails from November to May, and is generally accompanied with bad weather.

From the **Strait of Sunda to Timor Island** the Easterly Monsoon, variable between E. and S.S.E., commences in May, and is at its height in June and July. The Westerly Monsoon commences in November, and is at its height in January; bad and squally weather sets in with this Monsoon, and gales are not uncommon from November to the middle of February; this is also the rainy season, especially December and January. In March the Monsoon is dying out; April is tolerably fine, and the wind variable. The ordinary strength of the E. Monsoon is fresher than that from the W.

South Coast of Java—Sumbawa, &c.—In April the winds are variable, after which (in May) the E. Monsoon begins, bringing with it fine weather, and being at its height from June to August. In October this Monsoon is about to terminate, and after variable winds the N.W. Monsoon commences, lasting till the middle of February.

During February and March, and also in October—months when the Monsoons change—land and sea breezes are prevalent, stronger in October than at the former period. In February, March. and even in April, the land breeze often sets in with a strong gust, or in a squall, speedily moderating. The weather is also apt to be squally and puffy with the sea breeze in April and May, but only when it first springs up. During May and November the rain is very abundant on this coast.

In the Strait of **Baly** the wind often blows with great strength from the N. In the other straits to the east of Java a breeze from the S. very often blows during the morning and forenoon, when, after a calm, towards 2 P.M., it changes to N.

On the N.W. side of the island of **Timor,** from October to February, the N.W. Monsoon, variable between N. and W., is fully established, but is at its height only in December and January, when the rains fall, which, however, last till February; this is a season of overcast, squally weather, and the wind is often very strong, from W. to N.N.E. Towards the end of April the easterly Monsoon, variable between E. and S.S.E., brings fine weather, and is stronger than on the south side of the island. On both coasts land and sea breezes set in with the fine season, the land breeze on the south coast being from N.E. to N., the sea breeze from S.S.E. to S.S.W.

Gales may be expected on the south coast in October, on the north coast not before December.

In that part of the **Ocean between the Indian Archipelago and the North Coast of Australia** calms are very frequent at all seasons of the year, and Monsoon-like weather is always more or less prevalent. The westerly Monsoon, variable between S.W. and N.W., begins in October and ends in April, blowing with considerable strength and in squalls during December, January, and February. The E. and S.E. Monsoon, from May to September, is the fine season. These remarks apply also to the Ocean as far west as the meridian of Christmas Island.

The Java Sea.—The following observations are by Captain Jansen, of the Dutch Royal Navy: *—"In the Java Sea, during the month of February, the W. Monsoon blows strong almost continually; in March it blows intermittingly, and with hard squalls; but in April the squalls become less frequent and very severe. Now the changing commences; all at once gusts begin to spring up from the E.; they are often followed by calms. The clouds which crowd themselves on the clear sky give warning of the combat in the upper air which the currents there are about to wage with each other. The electricity, driven thereby out of its natural channels, in which, unobserved, it has been performing silently, but with the full consciousness of its power, the mysterious task appointed to it, now displays

* Bijdrage Natuurkündige Beschrijving der Zeën, vertaald door M. H. Jansen, Luitenant ter see.

itself with dazzling majesty; its sheen and its voice fill with astonishment and deep reverence the mind of the sailor—so susceptible, in the presence of storm and darkness, to impressions that inspire feelings both of dread and anxiety, which by pretended occupations he strives in vain to conceal.* Day and night we now have thunderstorms. The clouds are in continual movement, and the darkened air, laden with vapour, flies in all directions through the skies. The combat which the clouds seem to court and to dread appears to make them more thirsty than ever. They resort to extraordinary means to refresh themselves; in tunnel form, when time and opportunity fail to allow them to quench their thirst from the surrounding atmosphere in the usual manner, they descend near the surface of the sea, and appear to lap the water directly up with their black mouths. Water-spouts thus created are often seen in the changing season, especially among small groups of islands, which appear to facilitate their formation.† The water-spouts are not always accompanied by strong winds; frequently more than one is seen at a time, whereupon the clouds whence they proceed disperse in various directions, and the ends of the water-spouts bending over, finally cause them to break in the middle, although the water which is now seen forming around their base has suffered little or no movement laterally."

Water-spouts.—"Yet the wind often prevents the formation of water-spouts. In their stead the wind-spout shoots up like an arrow, and the sea seems to try in vain to keep it back. The sea, lashed into fury, marks with foam the path along which the conflict rages, and roars with the noise of its water-spouts; and woe to the rash mariner who ventures therein!‡ The height of the spouts is usually somewhat less than 600 feet, and their diameter not more than 20 feet, yet they are often taller and thicker; when the opportunity of correctly measuring them has been favourable, however, as it generally was when they passed between the islands, so that the distance of their bases could be accurately determined, I have never found them higher than 2100 feet, nor thicker than 150 feet. In October, in the Archipelago of Rhio, they travel from N.W. to S.E. They seldom last longer than five minutes; generally they are dissipated in less time. As they are going away, the bulbous tube, which is as palpable as that of a thermometer, becomes broader at the base, and little clouds, like steam from the pipe of a locomotive, are continually thrown off from the circumference of the spout, and gradually the water is released, and the cloud whence the spout came again closes its mouth."

The East Monsoon in the Java Sea.—"During the changing of the Monsoons it is mostly calm or cool, with gentle breezes, varied with rain-storms and light gales from all points of the compass. They are harassing to the crew, who, with

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* No phenomena in nature make a deeper impression upon the sailor than a dark thunderstorm in a calm at sea.—JANSEN.

+ I never saw more water-spouts than in the Archipelago of Bioun Singen during the changing. Almost daily we saw one or more.—JANSEN.

‡ The air-spouts near the Equator always appear to me to be more dangerous than the water-spouts. I have had one of the latter pass a ship's length ahead of me, but I perceived little else than a waterfall towards which I was approaching yet no wind. Still, the water-spouts are not to be trusted. I have seen such spouts go up out of the water upon the shore, where they overthrew strong isolated frame-houses. I have, however, never been in a situation to observe in what direction they revolved.—JANSEN.

burning faces under the clouded skies,* impatiently trim the sails to the changing winds. However, the atmosphere generally becomes clear, and, contrary to expectation, the N.E. wind comes from a clear sky; about the coming of the Monsoon it is northerly. Now the clouds are again packed together; the wind dies away, but it will soon be waked up to come again from another point. Finally, the regular land and sea breezes gradually replace rain, and tempests, calms, and gentle gales. The rain holds up during the day, and in the Java Sea we have the E. Monsoon. It is then May. Farther to the south than the Java Sea the E. Monsoon commences in April.† This Monsoon prevails till September or October, when it turns to become the W. Monsoon. It has seemed to me that the E. Monsoon does not blow the same in every month, that its direction becomes more southerly, and its power greater after it has prevailed for some time. ‡

"As the sea makes the coming of the southern summer known to the inhabitants of the Java coast,§ the turning of the E. Monsoon into the W. Monsoon commences. After the sun has finished his yearly task in the northern hemisphere, and brings his powerful influence to operate in the southern hemisphere, a change is at once perceived in the constant fine weather of the E. Monsoon of the Java Sea. As soon as he is at his height upon the Java Sea (Lat. 6° S.), then the true turning of the Monsoon begins, and is accomplished much more rapidly than the spring turning. The calms then are not so continuous. The combat in the upper atmosphere appears to be less violent; the S.E. Trade, which has blown as the E. Monsoon, does not seem to have sufficient strength to resist the aggressors, which with wild storms from the N.W. and W., make their superiority known. Upon and in the neighbourhood of the land thunderstorms occur, but at sea they are less frequent.

"The atmosphere, alternately clear and cloudy, moves more difinitely over from the N.W., so that it appears as if no combat was there waged, and the S.E. gives place without a contest. The land breezes become less frequent, and the phenomena by day and night become, in a certain sense, more accordant with each other. Storms of wind and rain beneath a clouded sky alternate with severe gales and steady winds. In the last of November the W. Monsoon is permanent.

"Such are the shiftings. But what have they to do with the general system of the circulation of the atmosphere? Whenever we read attentively the beautiful

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* At sea the face and hands burn (change the skin) much quicker under a clouded than under a clear sky.—JANSEN.

† In the north-east part of the Archipelago, the E. Monsoon is the rainy Monsoon. The phenomena in the north-east part are thus wholly different from those in the Java Sea.—JANSEN.

‡ As is well known, the Strait of Sourabaya forms an elbow whose easterly outlet opens to the E., while the westerly outlet opens to the N. In the beginning of the E. Monsoon the sea wind (E. Monsoon) blows through the westerly entrance as far as Mt. Gievie (in the elbow); in the latter part of this Monsoon the sea wind blows, on the contrary, through the easterly entrance as far as Sambilangan (the narrow passage where the westerly outlet opens into the sea).—JANSEN.

§ In the Archipelago we have generally high water but once a day, and with the Equinoxes the tides also turn. The places which have high water by day in one Monsoon get it at night in the other.—JANSEN.

meditations of the founder of the Meteorology of the sea, and follow him in the development of his hypothesis, which lays open to view the wheels whereby the atmosphere performs its varied and comprehensive task with order and regularity, then it will not be necessary to furnish proof that these turnings are nothing else than the passing of a belt of calms which separates the Monsoons from each other, and which, as we know, goes annually with the sun from the S. to the N., and back over the torrid zone to and fro.

"So also the calms, which precede the land and sea winds, are turned back. If, at the coming of the land wind in the hills, we go with it to the coast, to the sea, we shall perceive that it shoves away the calms which preceded it from the hills to the coast, and so far upon the sea as the land wind extends. Here, upon the limits of the permanent Monsoon, the place for the calms remain for the night, to be turned back to the land and to the hills the following day by the sea wind. In every place where these calms go the land and sea wind turns back. If various observers placed between the hill and the sea, and between the coast and the farthest limit of the land wind, noted the moment when they perceived the calms, and that when they perceived the land wind, then by this means they would learn how broad the belt of calms had been, and with what rapidity they are pushed over the sea and over the land. And even if the results of one day should be found not to agree very well with those of another, they would at least attain an average thereof which would be of value. So, on a larger scale, the belt of calms which separates the Monsoons from each other presses in the spring from the S. to the N., and in the fall from the N. to the S., and changes the Monsoons in every place where it presses."

Banka, Gaspar, and Karimata Straits.—Observations made at PALEMBANG (Lat. 6° 52′ S., Long. 105° 16′ E.), on the east side of Sumatra, during 1850–1856, show that from November to March the prevailing winds blow from W. and N.W.; this is also the rainy season—usually attendant on the W. Monsoon. In April the Monsoon changes, and, during the month, storms accompanied with thunder are very frequent. From May to September the prevalent winds are from E. to S.E., and the change occurs in September and October; during the year the veering of the wind is regular through S., W., N., E., to S.

In STANTON Channel the wind in the N.W. Monsoon blows off the Banka coast, and throughout the year land breezes generally occur during the night. A strong land breeze from the N.E. has been experienced in Stanton Channel during the S.E. Monsoon, when the wind was blowing directly through the Lucipara from the S.W.

In **Rhio** Strait the southerly Monsoon is generally strong in September, with rain and heavy squalls at the Equinox. In October calms alternate with light southerly airs, during which the atmosphere is damp and close; Sumatra squalls, or south-westers, also occur at night, with thunder and lightning. In November the northerly monsoon sets in with heavy gusts.

In **Singapore** Strait the winds during the S.W. Monsoon prevail from W. to S.E. In December, January, and February, the N.E. Monsoon is in full force, and generally very strong.

In GASPAR Strait and the KARIMATA Passage N.W. winds are generally prevalent when N.E. and N. winds are found north of the Equator.

Borneo, cut by the Equator, and extending through 11½° of lat.—from 7° N. to 4½° S.—exhibits a great diversity of seasons and of climate: in fact, the northern part of the island is characterized by the N.E and S.W. Monsoons of the Indian Ocean and China Sea, while the southern part experiences the S.E. and N.W., or E. and W. Monsoons of the Java Sea. From May to October the S.W. Monsoon is prevalent on the N.W. coast, while the S.E. Monsoon extends over the west and south parts of the island. Similarly, from October to May, the N.E. Monsoon blows on the N.W. coast, while the N.W. Monsoon is the prevalent wind on the west and south coasts.

"The climate is damp and sultry, the thermometer at the level of the sea seldom falling below 80°, or rising above 90°. . . . . The whole island is one huge primeval forest; but it has not been charged with peculiar insalubrity, although to the European constitution it must be both uncomfortable and debilitating.

"The coast of Borneo would be a dangerous one to navigate from the absence of the shelter of harbours, of which it can hardly be said to have any, if it did not lie in the latitudes exempt from the storms and typhoons which prevail in the northern part of the China Sea, and which, although they extend to the Philippine group, never reach it. Heavy squalls are experienced at the changes of the Monsoons, and this is all." (Jour. Roy. Geo. Soc., Vol. XXIII. p. 71.)

Respecting the SOUTHERN PART OF **Borneo,** the remarks already made on the Java Sea appertain to this coast and the neighbouring waters. From October to April, with the W. Monsoon, it rains continuously, and often brings heavy and stormy weather. During the E. Monsoon the weather is still very damp and misty, though there is less rain. In Borneo it probably rains during ten months of the year.

KRECKE observes that at BANJERMASSIG, ON THE SOUTH COAST OF **Borneo,** a S.W. Monsoon blows from December to March, and a S.E. Monsoon from April to October. The remaining months are periods of change. The rainfall is most copious from July to October, while storms, with thunder, are most frequent in November, December, and May, though in this respect there is considerable difference, for while eighteen such storms occurred in 1851, no less than eighty-three took place in 1857. The following is the prevalent direction of the wind for the different months;—In December, S.W. to W.S.W.; in January, W.S.W. to W.; in March, variable; in April the wind changes to S.E., and augments in strength till August and September; in October it hauls more to the S.; in November, during the morning it is southerly, but changes to S.S.W. and S.W. in the afternoon; when in December, the S.W. wind is again fully established.

The N.W. COAST from Lat. 2° N., Long. 109° E., to Lat. 7° N., Long. 117° E., a distance of 600 miles, was visited by Captain C. D. BETHUNE, R.N., who says;—"The N.E. Monsoon prevails on the coast from November to April and the S.W. Monsoon for the other six months. The months of November, December, and January, may perhaps be called the rainy season, but considerable quantities of rain usually occur about the change of each Monsoon; the finest weather is during the S.W. Monsoon. I am, however, inclined to think there is no decidedly dry season. Land and sea breezes alternate near the shore; the nights are always cool. The temperature assimilates to that of Singapore, which for India is considered a temperate climate; a shower of rain often makes a difference of 10° at each place."

Celebes.—The position of the Island of Celebes approximates to that of Sumatra and Borneo in being cut by the Equator; but with respect to Celebes, the larger portion of the island is to the *southward* of the Line, and to this part we here refer. The S.E. Monsoon is the fine season, and lasts from May to September. The N.W. Monsoon, from October to April, is often very strong, with heavy rain at all times. In March, and again in September, when the sun is near the Equator, the winds are northerly, with rain.

Strait of Macassar and Molucca Passage.—In the northern part of Macassar Strait, from May to October, the easterly Monsoon is prevalent on the east coast of Borneo; the same Monsoon occurs also in the Molucca Passage. From November to April is the period of the westerly Monsoon.

In the middle and southern part of the Macassar Strait, the wind is N.E. during April, May, and June. after which it becomes more variable and light from E.N.E. to E.S.E. Fresh breezes from W.S.W. to W.N.W. prevail in October, November, and December, sometimes during January also.

As regards the wind near the land, it would appear that from May to October the wind is tolerably steady from the southward on the east side of Borneo, while at the same time there are regular land and sea breezes off the west side of Celebes.

Off the west coast of Celebes, the fresh S.W. Monsoon generally veers to W.N.W. and N.W. on approaching the opposite shore of Borneo.

During the S.E. Monsoon there is no strong land breeze on the low shores of Borneo, while on the coast of Celebes, owing to the interior being more elevated, a very fresh breeze comes from the land during the night, followed by the regular sea breeze; these winds are very beneficial in December. During August and September the wind is always light, with calms, at times alternating with a squall or two, which may rise to a storm.

Seas of Celebes and Sulu, or Mindoro.—The easterly Monsoon begins in October, but is not fully established before November, and terminates in April: this is the fine season. The westerly Monsoon, beginning in May, is in full strength in June, and ends in September; the weather is now gloomy and overcast, with rain; it is also very squally during this season, and in some of the heavy showers the wind veers round to E., especially in July and August; heavy gales are not uncommon, and occasionally a hurricane; between the islands of Celebes and Mindanao very strong squalls, in gusts, from the N.W. are prevalent. On the coast of Mindanao a heavy mist is not uncommon in September, and westerly winds have been known to last till November.

The N.E. or E. wind in the fine season, and especially in the Sulu Sea, is rarely fresh—more generally variable with calms; such, at least, is the case in December and January.

Similar seasons and winds prevail as far north as Manilla.

On the WEST COAST of **New Guinea** the S.E. Monsoon lasts from April to October, and the rainy season is from June to September, when dark, gloomy weather may be expected with frequent fogs. The N.W. Monsoon begins early in November (sometimes in October), and terminates in April, which is the fine season; during January the winds are variable between N.N.E. and N.E.; in March, April, and May, heavy squalls occur at times, with an occasional gale.

The Molucca Islands AND NEIGHBOURING SEAS.—Northward of the islands of Boero and Ceram the S.E. Monsoon from April to October varies from S.S.E. to S.S.W., at Amboina from E. to S.E. The N.W. Monsoon, from November to March, is variable between W.S.W. and N.W., and occasionally a heavy storm occurs near the islands just mentioned. Generally, in the vicinity of the Moluccas, the easterly Monsoon brings bad weather and heavy rain, with hard gales at times; but it cannot be said that either Monsoon is very regular and for two months at least, between the establishment of each, the wind and weather are more variable and uncertain than at any other time of the year.

Arafura Sea.—In the Arafura and Timor Seas the E. or S.E. Monsoon blows with the greatest regularity; at its height, from May to August, it is fresh from E.S.E. to S.E.; earlier and later it hangs more to E., and often veers to E.N.E.; at full and change of the moon calms and variable squally weather may be expected, as is also the case on the east coast of Australia.

In **Torres Strait** E. winds are most prevalent. The W. Monsoon is never very steady, but is often checked by easterly winds, when light and variable airs continue for several days, until it comes up again with fresh strength. In that portion of the sea between New Guinea and Australia, during January and the commencement of the W. Monsoon, winds from N.E. and N. are greatly prevalent, backing to W. at times. In the inner passage, winds from N.E. to W.N.W. may be expected as far as Lat. 14° S., beyond which they haul to E. and S.E.

Between the Monsoons there are often long calms, and the sea at that time abounds with water-snakes: the period when the S.E. changes to the N.W. Monsoon is most liable to these calms. At the approach of the Monsoon, W. winds often blow for five or six days, and then dying away are succeeded for a week or so by light, variable airs; at full or change the true Monsoon sets in, with thick, rainy, and squally weather; this lasts a few days, after which it clears up and the breeze is moderate, bringing finer weather than the E. Monsoon, and certainly the land is more distinctly visible. At the limit of this Monsoon, in 15° S., I have always found rainy and squally weather. The mean direction of the wind is from W.N.W. to W.S.W., hauling to N.W. and S.W.

General Remarks on the Malay Archipelago.—The following additional remarks on the Archipelago, from a paper recently read at the Royal Geographical Society, are at once interesting and instructive, and convey an excellent general summary of the seasons of this region:*—

"The contrasts of vegetation and of climate in the Archipelago may be best considered together, the one being to some extent dependent on the other.

"Placed immediately upon the Equator, and surrounded by extensive oceans, it is not surprising that the various islands of the Archipelago should be almost always clothed with a forest vegetation from the level of the sea to the summits of the loftiest mountains. This is the general rule. Sumatra, New Guinea, Borneo, the Philippines, and the Moluccas, and the uncultivated parts of Java and Celebes, are all forest countries, except a few small and unimportant tracts, due perhaps, in some cases to ancient cultivation or accidental fires. To this, however, there

* "Jour. Roy. Geog. Soc.," vol. xxxiii, p. 224. "WALLACE on the Physical Geography of the Malay Archipelago."

is one important exception in the island of Timor and all the smaller islands opposite, in which there is absolutely no forest such as exists in the other islands, and this character extends in a lesser degree to Flores, Sumbawa, Lombock, and Bali.

"In Timor the most common trees are *Eucalypti* of several species, so characteristic of Australia, with sandalwood, acacia, and other sorts in less abundance. These are scattered over the country more or less thickly, but never so as to deserve the name of a forest. Coarse and scanty grasses grow beneath them on the more barren hills, and a luxuriant herbage in the moister localities. In the islands between Timor and Java there is often a more thickly wooded-country, but thorny and prickly trees abound. They seldom reach any great height, and during the force of the dry season they almost completely lose their leaves, allowing the ground to be parched beneath them, and contrasting strongly with the damp, gloomy, ever-verdant forest of the other islands. This peculiar character, which extends in a less degree to the southern peninsula of Celebes and the east end of Java, is most probably owing to the proximity of Australia. The S.E. Monsoon, which lasts for about two-thirds of the year (from March to November), blowing over the northern parts of the country, produces a degree of heat and dryness which assimilates the vegetation and physical aspect of the adjacent islands to its own. A little further eastward in Timor-laut and the Ke islands, a moister climate prevails, the S.E. winds blowing from the Pacific through Torres Straits, and, as a consequence, every rocky islet is clothed with verdure to its very summit. Further west again, as the same winds blow over a wider and wider extent of ocean, they have time to absorb fresh moisture, and we accordingly find the island of Java possessing a less and less arid climate in the dry season, till, in the extreme west, near Batavia, rain occurs more or less all the year round, and the mountains are everywhere clothed with forests of unexampled luxuriance.

"The changes of the Monsoons and of the wet and dry seasons in some parts of the Archipelago are very puzzling; and an accurate series of observations in numerous localities is required to elucidate them.

"Speaking generally," says Mr. Wallace, "the whole south-western part of the Archipelago, including the whole range of islands from Sumatra to Timor with the larger half of Borneo and the Southern peninsula of Celebes, has a dry season from April to November, with the S.E. Monsoon. The same wind, however, bends round Borneo, becoming the S.W. Monsoon in the China Sea, and bringing the rainy season to northern Borneo and the Philippines.

"In the Moluccas and New Guinea the seasons are most uncertain. In the S.E. Monsoon, from April to November, it is often stormy at sea, while on the islands it is very fine weather. There is generally not more than two or three months of dry, hot weather, about August and September. This is the case in the northern extremity of Celebes and in Boero, whereas in Amboina July and August are the worst months in the year. In Ternate, where I resided at intervals for three years, I never could find out which was the wet and which the dry season. The same is the case at Banda, and a similar uncertainty prevails at Menado, showing probably that the proximity of active volcanoes has a great disturbing meteorological influence. In New Guinea a great amount of rain falls more or less, all the year round. On the whole the only general statement we can make seems to be that the countries within about 3° on each side of the

Equator have much rain and not very strongly contrasted seasons; while those with more south or north latitudes, have daily rains during about four months in the year, while for five or six months there is almost always a cloudless sky and a continual drought."

WINDS AND WEATHER IN THE CHINA SEA.

In the **CHINA SEA** the Monsoon periods are not as regular as in the Indian Ocean.

The following Table from MAURY's "Nautical Monographs," gives the *average winds and calms in the* CHINA SEA, *the total number of observations in each band of latitude, the mean direction of the wind from each quarter, and the average annual duration of each wind in days* :—

BANDS IN LATITUDE.	MEAN DIRECTION OF THE WINDS.				No. of days of Calm.	No. OF OBSERVATIONS.
Lat. 30° to 25° N.	N. 28° E.	S. 44° E.	S. 34° W.	N. 36° W.		
No. of days. . .	189	43	72	60	1	318
Lat. 25° to 20° N.	N. 47° E.	S. 47° E.	S. 59° W.	N. 32° W.		
No. of days. . .	199	80	56	26	4	2564
Lat. 20° to 15° N.	N. 47° E.	S. 47° E.	S. 32 W.	S. 33° W.		
No. of days. . .	175	84	73	29	4	4298
Lat. 15° to 10° N.	N. 46° E.	S. 45° E.	S. 51° W.	S. 49° W.		
No. of days. . .	135	68	116	42	4	5358
Lat. 10° to 5° N.	N. 43° E.	S. 42° E.	S. 42° W.	S. 51° W.		
No. of days. . .	125	54	134	45	7	4672
Lat. 5° N. to Eq.	N. 38° E.	S. 37° E.	S. 34° W.	S. 46° W.		
No. of days. . .	106	85	113	48	13	3834

In the NORTH-WESTERN PART OF THE CHINA SEA the N.E. Monsoon commences about the middle of October; in the SOUTHERN PART it rarely appears before November. It generally sets in with a sudden storm in which the wind increases in force very rapidly, and produces a great swell; consequently, exposed anchorages should be avoided. This outburst lasts a week or more; occasionally, however, the Monsoon sets in without any storm. It is at its height in December and January. The whole period is one of dark, cloudy weather, and heavy rain; and usually a high turbulent sea is experienced when the wind has been strong for a few days, especially near PULO-SAPATA, and thence to the STRAIT OF SINGAPORE. Off the COAST OF LUZON, although the winds are generally from N. and N.E. during the N.E. Monsoon, still they often veer to N.W. and W., blowing strong with cloudy weather and a copious rainfall. During February the Wind in the China Sea moderates and blows steadily, bringing fine weather. On the LUZON coast, land and sea breezes are not uncommon during this month, and during March and April become more or less prevalent over the whole China Sea. (CHART DIAGRAMS I. and II.)

Towards the end of April the S.W. Monsoon sets in; but notwithstanding this, the winds are still light and variable at sea in May, with land and sea breezes near the coast. The Monsoon is at its height during June, July, and August, when the weather is cloudy and rainy; but the wind, though generally fresh, is rarely stormy except near the entrance to the Gulf of SIAM, whence hard squalls sometimes descend very suddenly. In September, winds from N. and E. are

occasionally encountered in any part of the China Sea, but they are especially to be expected near Formosa in July, August, and September, though the prevailing wind is S.W. In October, wind and weather are very unsettled; from S.W. and W. to N.W. the wind shifts to N. and E.N.E., puffy and strong, after which the N.E. Monsoon sets in. (CHART DIAGRAMS III. IV.)

During the period of the S.W. Monsoon the winds are never as strong, nor the weather so gloomy as during the prevalence of the N.E. Monsoon; it is difficult to beat against the latter, but it is very common to make good progress against the former, especially by taking advantage of the breezes near the coast.

SEVERE GALES, commencing at N.N.W. or N.W., and accompanied by a gloomy weather and a deluge of rain, occur in some seasons during May, June, July, and August; veering to W. and S.W., they still blow with great violence, and finally abate at S. During the same time strong S.W. or S. gales prevail in the middle of the China Sea.

Strong N.E. gales have occurred in the China Sea during the S.W. Monsoon; but this is very rare.

On the SOUTH COAST OF CHINA steady gales from N.E. or E.N.E., lasting several days, may be expected in September or October; at the same time, on the WEST COAST OF LUZON, they commence at N. or N.W., veering by W. to S.W. and S., with heavy rain and a heavy cross sea.

Strait of Malacca.—The Monsoons are very irregular in the Strait of Malacca, and the winds variable; that of the N.E. (the fine season) lasts from November to April, the S.W. from May to October. During the S.W. Monsoon the sky is cloudy, and the weather squally, with rain.

In October and November the winds are from N.W. to W.; however, the N.E. Monsoon—from N.E. to E.N.E.—has generally set in towards the middle of November, and it blows with force in December and January, moderating in March; N. and N.W. winds are not uncommon during the season; and westerly winds at times last for a day or two. The Monsoon may be expected to draw to the N. any time between the latter end of February and beginning of April, in which case it becomes light and variable; at this time fresh land and sea breezes prevail, with calms towards mid-day. These calms are more frequent along the Sumatra coast than along that of the peninsula of Malacca.

The S.W. Monsoon is at its height in June and July; and for four months, between May and September, it is variable, from S.W. to S., but never very strong except at the northern entrance to the strait. Calms are now more prevalent along the Malacca than the Sumatra shore, but they are of short duration, generally occurring near mid-day; but the breeze is tolerably fresh during the night and at sunrise. The rainy season is from the end of August to the beginning of December, when in some parts as at the N.W. entrance to the strait the fall is very great, with the wind from N.W. and W., and squally weather.

During the S.W. monsoon the winds on the N.E. COAST OF SUMATRA frequently haul to S.S.E. and S.E.; but during the night when in the vicinity of the high land between Cape Pedir and the Carimon Isles, during June, July, and August, heavy and dangerous gusts from S.W. to S.—called *Sumatras*—are often experienced between midnight and 2 or 3 A.M. In some places they commence at 6 P.M. and last till 8 P.M., alternately squally and calm, strong and moderate. In the

roadstead of Malacca they commence at 7 P.M. and last till midnight, and are dangerous if no precaution is taken against their approach.

Heavy squalls from the N.W. may also be expected at times off the north coast of Sumatra, as well as in the vicinity of the Carimon Isles and the Strait of Singapore; their approach is indicated by the rapid rising of a black and arched cloud, scarcely leaving time to take in sail; the first gust is the strongest, and as is the case with the *Sumatras*, they are attended with rain, thunder, and lightning.

The Monsoons are more regular near Singapore.

Malacca.—On the east coast of Malacca, heavy, continuous rain falls during the N.E. Monsoon. During the change to the S.W. Monsoon strong gales may be expected, after which the wind is moderate or light for some time.

With the S.W. Monsoon from April to October, the weather is fine on the east coast, but squally and generally bad on the west coast of the peninsula.

On the east coast in June the wind is from S.E. during the day, veering to westward towards the evening, whence it blows until 10 or 11 A.M.

Between Pulo-Timoan and Pulo-Condore the N.E. Monsoon has set in towards the middle or end of October; at Pulo-Timoan the winds are exceedingly variable from September, and the change of the Monsoon brings at times very bad weather.

The N.E. Monsoon is the fine season, and is generally established by November; nevertheless, during this month, storms with rain do occur, and perhaps a hurricane. The S.W. Monsoon brings the rainy season, and frequently lasts seven months; at Pulo-Condore it rains for a month after the N.E. Monsoon has set in.

Gulf of Siam.—Owing to the position of the Gulf of Siam the Monsoons are irregular,—generally commencing and terminating earlier than in other parts of the China Sea; the directions of the wind are also more variable.

At sea the S.W. Monsoon begins in April with rain, which lasts during May and June. From June to September the winds are more westerly, but still with rain.

On the coast southerly winds prevail from March to May, but from June to September they are from S.W.,—generally very strong near Pulo-Oby. During September they are variable.

In October the Monsoon changes and the weather is squally; in November, December, and January the wind is N. and the weather fine. During February variable winds between S. and E. are prevalent; and now, as well as in March, land and sea breezes are tolerably regular.

On the west coast of the Gulf of Siam, during May, and thence to July, when the S.W. Monsoon is at its height, a land wind sometimes prevails, lasting from three to ten days.

Cambodia.—On the coast of Cambodia the Monsoons are irregular, and land and sea breezes are more or less constant, those during the N.E. Monsoon being generally much fresher than at the period of the S.W. Monsoon, and lasting longer. In June, July, and August, heavy rain falls, and the wind is strong from the S.W.

On that part of the **Coast between the Gulf of Siam and Cape Padaran** the N.E. Monsoon begins with October, and ends during April. When the S.W. Monsoon sets in it blows parallel with the coast; ships approaching the land at night frequently experience a light land breeze, which dying away terminates in a brief calm, after which the Monsoon is fresh during the day.

Cochin China.—Near the coast the Monsoons are never strong and the winds are more or less variable throughout the year. Heavy rain falls in September, October, and November, with the N.E. Monsoon; and from December to February there is a kind of winter, with northerly winds and occasional rain.

During the N.E. Monsoon the wind is often easterly between the coast and the Paracels, and thence to Cape Varela; calms are often prevalent in the vicinity of the Paracels, while to seaward the Monsoon is fresh.

During the S.W. Monsoon land and sea breezes are prevalent along the coast; the land breeze is irregular in the time of setting in, although it is sure to come at some hour during the night: after a calm or gentle light air till mid-day, a fresh S.E. wind sets up.

Gulf of Tong-Quin.—With the S.W. Monsoon comes the rainy and hot season, which, beginning in April, lasts till August; in September and October the weather is moderately fine. In November, when the N.E. Monsoon sets in, fresh northerly winds may be expected, veering to E. and E.S.E. towards the end of the month; in December N.N.E. to E. winds bring foggy weather; in January and February fresh N.E. and N.N.E. breezes are prevalent, with cold weather. In March the N.E. Monsoon has died out, and warmer weather is approaching. Typhoons occasionally enter the gulf.

Hainan and the South Coast of China.—The N.E. Monsoon from E.N.E. very generally blows along the land; at times, however, it hauls to S.E.

During the S.W. Monsoon S. and S.E. winds are prevalent; in June, July, and August, heavy rain falls, and the weather is usually overcast and gloomy.

From the entrance of the **Canton River to the Chusan Islands** the N. E. Monsoon usually blows from the beginning of October to the end of April. It sets in strongest in the months of November, December, and January, its medium force being a double-reefed-topsail breeze fer a frigate when close-hauled; but frequently, owing to the heavy sea running, a press of sail cannot be carried, and it is therefore necessary at all times to keep as close in-shore as possible, where, owing to the conformation of the land, the rapidity of the tide, and other local circumstances, smoother water will always be found.

During the period of this Monsoon severe gales, lasting for two or three consecutive days, occur at times; it is then supposed that a Typhoon is blowing not far distant, and when the gale breaks the wind usually becomes light and to the southward of E. for a few days. It will again freshen up for a week or ten days together to a steady breeze, for treble-reefed topsails and reefed courses, with a high, short, cross sea particularly at the entrance of the Formosa Channel.

In October, November, and December, the atmosphere is moderately clear, rain and thick weather seldom lasting without a break for twenty-four hours. In January, February, and March, hazy weather with thick mist is not unfrequent. In April the Monsoon begins to slacken, light southerly winds for a day or two

occasionally blow, and foggy, dirty weather, with returning heavy squalls and rain from N.E. will again set in and continue to the middle of May.

These remarks only apply to that part of the China Sea to the northward of the Canton River.

The S.W. Monsoon, variable between S.S.W. and S., begins in June and ends in October; this is the season when squally weather prevails, and when Typhoons occur.

In the **Formosa Channel** bad weather may be experienced at any season of the year. During the S.W. Monsoon heavy squalls with rain are common.

Off the **Bashees** the N.E. Monsoon, from N.E. to E.N.E., blows strong and raises a high sea.

Among the **Philippines** the N.E. Monsoon commences in October; fine weather may then be expected until April, with winds variable between N. and N.E.; if they veer to N.W. they generally blow hard.

The S.W. Monsoon may be expected at the end of May, but is not regularly established until June. During this season the weather is dark and gloomy, exceedingly wet and foggy. In September the rain abates, but fogs still prevail, lasting till midday. The worst Typhoons occur in July and August.

Palawan.—On the coast of Palawan the winds are variable during October, November, and December, offering no obstruction to vessels proceeding either to the N.E. or S.W.; but the weather is often cloudy and rainy. Near the southern part of the island, however, strong S.W. winds, with overcast sky may be expected in September and during the early part of October.

The Monsoons are, however, so subject to interruption from local causes that it is difficult to say at what period either fairly sets in. The following is the experience of the late Commander W. T. Bate, R.N., when employed surveying the coast in the *Royalist:*

"In November and December the weather is variable; N.E. and easterly winds, changing at times to S.E. more frequently prevail. In the former month a south-westerly blow, with dark, cloudy weather and rain, is not unusual, and one of the heaviest gales experienced shifted to N.W. just before the change of moon, and lasted till the end of the quarter.

"In January when the N.E. Monsoon is blowing steadily, and sometimes with great violence, in the China Sea, moderate N.E. and easterly winds prevail on the coast of Palawan, and on the coast of Luzon land and sea breezes have been experienced with considerable regularity.

"In April, when light N.E. and frequently S.E. winds prevail in the China Sea, N.E. and easterly winds usually blow steadily on the coast of Palawan, freshening considerably after daylight, and dying away towards sunset.

"May and the early part of June, appear to be the finest period of the year on the coast of Palawan, when land and sea breezes prevail with tolerable regularity, the former coming fresh from the S. and S.E. in the morning, and the latter from the N. and N.E. in the afternoon.

"Towards the end of June, and throughout July, unsettled weather, generally commencing about the change of moon, may be expected. A slight depression of the mercury, after a succession of fine weather, frequently indicates the approach

of strong W.S.W.-ly squalls, which are usually accompanied by dark, cloudy weather and much rain, lasting a week or ten days. These are generally succeeded by a period of fine weather, with N.W. and S.W. winds, which draw to the southward and eastward in the mornings. If June or July has been unsettled, it may be expected that August generally will be fine, with moderate S.W. but more frequently westerly winds, particularly in the afternoon.

"If, on the contrary, June or July has been tolerably fine, very unsettled weather may be expected in August. In either of these months, when strong S.W. squalls have succeeded a period of fine weather, vessels will not unfrequently in the S.W. part of the passage, experience a weatherly set of the current.

"In September and October the wind generally blows strong from W.S.W., with dark, cloudy weather; and off the S.W. end of Palawan, squalls which veer to W.N.W. and N.W., sometimes blowing with great violence, succeed each other rapidly, and are accompanied by rain. Between the squalls the wind very often shifts to S.E.

"The barometer is of little use in prognosticating the changes; the difference in the column of mercury for the whole year, except in cases where the condition of the atmosphere has been disturbed by some physical cause, such as the approach of one of those violent cyclones known in the China Sea by the name of Typhoon, seldom exceeding $\frac{2}{10}$ths of an inch. In general the mercury rises to N.E. and easterly winds, and falls to S.W. and westerly; but in some instances we have known the reverse of this occur, doubtless from some such disturbing cause as above-metioned, when the barometer by falling or rising indicates as usual the approach and recession of the vortex.

Japan, and the Sea around Japan.—During the expedition of the American squadron to Japan the following observations were gathered:—

"The S.W. Monsoon sweeps over the Loo-Choo group and reaches the southern shcres of Japan and the Bonin Islands.

"At Napha, Loo-Choo, we found it prevailing steadily in May and June, and veering to the southward and eastward in July. In August the wind was very changeable, and blew at times quite strong, with squally, rainy weather.

"The N.E. Monsoon set in about the 1st of September, and continued until the departure of the squadron on the 7th February, being, however interrupted during the winter months by fresh gales from the northward and westward, which were generally accompanied by heavy rain.

"The climate of Loo-Choo is as free from the severities of winter's cold or summers heat as any in the world; and the island is nearly, if not quite, as healthy as any on the bosom of the sea. Droughts are spoken of in an official Loo-Choo document, and we know that the country is in the direct range of Typhoons or hurricanes. These drawbacks are not frequent.

"At the Bonin Islands, in April, the wind was variable; in June it was from the southward and westward, and in October from the northward and eastward. The passage from Loo-Choo, in October, was found to be exceedingly boisterous by the United States ship *Plymouth*.

"On the coast of Japan northerly winds were most prevalent in February, March and April; and during this period we had occasionally strong gales, which most frequently commenced at S.W., hauling to the northward and westward

and were accompanied with heavy rain. In May and July we had south-westerly winds, and in June they were variable.

"During our stay in JAPAN, from February to June, the weather was generally pleasant. In the Bay of Yedo the mean temperature for February was 44° Fahr. and the apricot and camelia japonica were in full bloom.

"*Typhoons.*—The whole region from Formosa to the Bonins is within the track of these storms, though we believe they seldom reach the coast of Japan. The season during which they may be expected is from May to November, inclusive; but in the neighbourhood of the Bonins they seem to occur more frequently in October.

Fogs.—We had but few fogs on the coast of Japan. They commenced at Hakodadi about the 1st of June, but did not extend as far south as Simoda."

The winds that generally prevail on the **East Coast of Japan** are:—January to May, W. and N.W.; May, variable; June to August, E. to E.N.E., and sometimes S.E.; September to December, W. and N.W. October is a bad month for navigation, and from the middle of August to the middle of October is the worst season for the cyclones, which blow with great fury, and give but little warning. From December to June the climate is delightful—clear, cool, and bracing. The mean range of the barometer throughout the year is from 29·70 to 30·06 inches. The range of the thermometer, mean 26° to 70°, extreme 14° to 74°.

In the months of August and September, 1858—the period of H.M.S. *Furious* remained in **Yedo** Bay—heavy gales from the E.N.E., shifting round to the S.W., and increasing in force, were frequent. Winds from W. round northerly to E.N.E. generally brought fine weather, and rain when between S.E. and S.W.

During H.M.S. *Saracen's* survey of the **Strait of Tsugar**—May, June, July and August, 1855—the prevailing winds were from the S., with much fine, clear weather. The wind was less frequent from the N.W. than any other quarter. Dense fogs prevailed in May and June; after that period they were comparatively rare. The wind, in shifting, usually followed the course of the sun. After a few days of light southerly wind and fine weather it freshened, and veered to the westward, accompanied by fine, clear, and cold weather. At N.W. it usually died away, or flew round suddenly to the eastward; in the latter case it was always followed by a dense fog or a gale, the weather getting fine again as the wind veered to the southward.

The following additional remarks on the WIND AND WEATHER in the **Sea of Japan** are by Captain D. Scott; they are the result of observations made during several voyages between Shanghai and Hakodadi:—

Commencing with the end of April, we found the prevailing wind to be from the eastward, in the Sea of Japan; such was the case also in May—at least as far as 37° N.—beyond which it began to haul to the southward, drawing round gradually to the westward, as we neared the strait of Tsugar; and so in fact we generally found the wind veering, during the whole year.

Throughout June, the wind blows pretty steadily from the S.W.;—the monsoon reaching as far as 37° N., but it is very light, and seldom exceeds a three-knot breeze. Fogs are common during this month, in and near the strait of Korea, and right across as far as the coast of China; but in my opinion, they are not so dense as those on our own coast, and nothing at all like a Newfoundland fog.

In July we also found the S.W. wind to reach as far north as 38°, while to the northward of that, the wind met us from N. to N.E.—at times blowing stiff from the eastward, as we drew near the strait of Tsugar.

The winds in August are between northerly and easterly in the northern parts of this sea, hauling to S.E. and South, as you advance to the southward. During this month we had no rain. Easterly winds are also prevalent in September. Heavy S.E. gales are of frequent occurrence on the eastern coast of Japan during the autumn months, and are the cause of much damage to, and loss of, shipping; but the wind having to cross the high mountains of Japan before it can reach the Inland sea, we have not heard of any accidents there, at that season; nor do we think that any of the typhoons which pass along the eastern coast ever extend into the Sea of Japan.

Westerly winds may be looked for in and near the strait of Korea, during October, beyond which, changing to the eastward, until you get up to 38° N., the wind begins to haul to the westward as usual. The weather during this and the two preceding months, we found to be the finest throughout the year, the air being dry and crisp, particularly in October—when every thing about a vessel gets almost too dry to be pleasant. In November the westerly winds begin to set in steadily; out of 17 days we passed here, in this month, we had 14 of westerly wind,—it being from the eastward during the other 3 days.

During December, in the southern part of the sea, we had easterly winds; but as we increased the latitude, stiff breezes met us from the North and N.N.E., then again veering with the sun to W.N.W. on nearing the strait. Snow storms usually commences early in this month—north of 39°—and are a drawback to ships navigating this sea; but all winters are not alike in this respect. The winds in January are generally from the westward, varied occasionally by northerly and easterly breezes; but here I ought to mention, that the winter of 1861-62, was very much milder than it usually is to the northward—heavy gales being common, while we met with none of any consequence; neither had we any snow to speak of, until we approached the coast of Korea, about which place, and all along the north coast of China, the winter was much severer than at Hakodadi; for up to the time we left that port on the 16th January 1862, very little snow had fallen—the low grounds at that time being bare; whereas, on our arrival at Shanghai on the 1st of February, we found the ground covered with snow to the depth of 5 feet; and the river abreast the town full of ice, so that boats could not pass through it.

We were not in the Sea of Japan during any part of the months of February and March, but from the report of others, the weather at that period seems to be the most stormy throughout the year, the wind blowing generally from the westward.

In nearly every instance we found the wind to veer with the sun, generally commencing after a lull, somewhere between north and east, and gradually hauling to the southward, often accompanied with rain; it would sometimes blow from S.S.E. to S.S.W. for a time, and ultimately draw round to W.N.W. as it began to clear, or as the rain ceased,—the sky being generally heavy, with southerly winds. Occasionally the wind continues to blow from the westward for 24 or 30 hours, after which it veers to the northward again to make a similar circuit. Gales are not of frequent occurrence in the centre of the Sea of Japan—and those we had, lasted but a short time, although during the early months of

the year, from December to the end of March, some heavy gales from the south-westward are likely to be met with about the strait of Korea,—while in the northern parts the gales blow mostly from the W. to N.W. during the same season.

The heaviest breezes we had, during the summer, were from the S.S.W.; but late in the autumn and during the winter, such usually commence at E.N.E., working round by the S. to W.N.W. Dirty weather may be expected during the summer and autumn, near either strait, but it seldom lasts long, and may be partly occasioned by the high temperature of the water, and partly by the lofty mountains in the vicinity.

As might be expected, from the form and direction of the land which encloses the Sea of Japan, the steadiest winds are from N.E. and S.W.; and these last the longest—seldom, however, rising to a gale.

Near the northern coast the barometer gives timely warning of the approach of a gale; but I did not find it act so well to the southward—at least before southerly and S.W. gales.

A short cross sea gets up here, particularly with the wind any way from the northward, as it then blows against the prevailing current.

The most *rain* we had in the open sea, fell during November, December, and January,—it being generally confined to the vicinity of either strait during the rest of the year; and very heavy rain falls occasionally in both places, with all winds. We had a good deal of rain in January, 1862, in the strait of Tsugar, but this was on account of the unusually mild winter,—for very heavy snow storms are frequent thereabout, in December, January and February of most years; according to a register kept by Dr. Albrecht, of the Russian Consulate, in Hakodadi, there fell at that place during the winter of 1860-61, during the aforesaid months, respectively, 2·190, 1·641 and 2·089 inches of snow.

We only once had lightning, accompanied by thunder—near the strait of Tsugar, in the month of November—and that was but light; and the only calms we had, were about the Oki islands, and in both straits, but never of long duration; in the open sea, we never had any calm weather whatever.

The Ladrones, or Mariana Islands.—The N.E. and S.W. Monsoons of the China Sea extend to these islands, notwithstanding their distance from the Asiatic continent. The strongest winds blow in August, September, October, and November, from N.W. to S.W., sometimes from S. to S.E.; in December, January, and February, wind and weather are variable; during March, April, May and June, when the wind is from N.E. and E., the season is extremely fine. Storms, with rain and thunder, as well as general bad weather, may be expected from July to November. Typhoons are not unknown, but they occur only at intervals of a few years.

Winds and Weather on the Coasts of Australia and Tasmania.

West Coast of Australia.—The prevalent winds are from S.S.W. and S.S.E., especially from October to April—the summer season. From April to October—winter—the regularity of the southerly winds is interrupted by strong breezes from the north-westward, accompanied by cloudy weather, and rain or

mist. Land and sea breezes are experienced near the coast; the former from S.E. and E., gradually die out towards noon, and after a calm the sea breeze from W. to S.S.W. gradually draws round to S. towards sunset. The westerly Monsoon of the N.W. coast—generally prevalent from N.W. to S.W.—blows from W. and W.N.W. in November and December, but it is scarcely more than a sea breeze. N.W. gales are not frequent, but hurricane squalls from E.S.E. to N.E., lasting about two hours during the night, are very terrific; they give ample warning by a bank of clouds and much lightning in the quarter whence they come.

The prevailing winds at **Swan River** are as follows:—In December, January, and February, S. and S.S.W. winds during the day, and S.S.E. to S.E. winds at night; these are occasionally interrupted by strong and oppressive gusts from the E. In March and April the sea breeze is moderate, and the land breeze more perceptible; calms are frequent, as well as light airs from the northward: when the sea breeze is strong the land breeze is light, and *vice versâ*. May brings winter and rain; the wind beginning at N.N.E., veers to the westward with increasing strength; but the rain is not continuous, for there are intervals of fine weather, when the climate is beautiful, and when the land and sea breezes are as regular as during the summer. The N.W. gales of winter are very violent, and the weather is then gloomy and rainy; the west coast is then a lee-shore, for commencing at N.N.E., and shifting to the westward, it blows hardest between W.N.W. and W.S.W. Sudden squalls of a hurricane character, shifting round the compass, may be occasionally expected, but they are of short duration. The barometer generally fortells all these gales a day or so before they commence.

South Coast of Australia.—In the vicinity of Cape Leeuwin the winds are generally from the westward throughout the year: frequently during the summer from N.W. in the night, and from S.W. in the latter part of the day, but with no regularity.

Between the Archipelago of the Recherche and Cape Northumberland the prevalent winds from the middle of January to the middle of April are between S.E. and E.N.E., moderate, and generally fine; they partake of the nature of land and sea breezes: W. and S.W. gales, should they occur at this season, seldom blow home on the coast.

Along the whole southern coast of Australia, and as far as Bass Strait, the strongest and most durable winds are from the south-westward, frequently rising to heavy gales varying between S. by W. and N. by E.; they produce at all times a long, rolling swell, which, however, is almost incessant from April to November. Captain Flinders remarks* "that the progress of the gales is usually this: the barometer falls to 29½ inches, or lower, and the wind rises from the north-westward, with thick weather, commonly with rain; it then veers gradually to the westward, increasing in strength, and generally clearing up as soon as it obtains any southing. At S.W. the gale blows hardest, and the barometer rises; and by the time it reaches S. or S.S.E., it becomes moderate, with fine weather, and the barometer above 30 inches. Sometimes the wind may back round to W. or

* "A Voyage to Terra Australis," by Mathew Flinders, Commander of the *Investigator*, 1814. Vol. i. p. 241, et seq.

something to the northward, with a fall in the mercury, and with diminishing strength, or perhaps die away; but the gale is not over, although a cessation of a day or two may take place. In some cases the wind flies round suddenly from N.W. to S.W.; and the rainy, thick weather then continues a longer time.

"Such is the usual course of the gales along the south coast and in Bass Strait, but on the east side of the strait the winds partake of the nature of those on the east coast, where the gale often blows hardest between S. and S.E., and is accompanied with thick weather, and frequently with heavy rain."

These observations are further corrobcrated by Commander Henry L. Cox, R.N., from an experience of four years on the coast of Victoria; and he adds, that "gales sometimes commence from N.E., thence round by N. to N.W., and continue as above described; they are experienced at all seasons of the year, and their usual duration is from three to four days, causing a furious sea on the coast. July, August, and September, are usually the wettest months; but this is uncertain, the largest floods recorded being in December."

Bass Strait.—The prevailing winds are S.W. for nine months in the year. During January, February, and March, N.E. winds, with clear weather, are not unfrequent, but they do not last for many days in succession.

Squalls from S.W. and S.E. may be expected on the east side of the strait, as well as on the coast of Tasmania; the latter are very strong, and when blowing from the coast, between Cape Howe and Wilson Promontory, should be avoided.

Tasmania.—From April to October W.N.W. and N.W. winds prevail; these are interrupted at times by S.E. winds from October to March. Moderate breezes from N.E. are not uncommon on the east coast. Approaching Tasmania from the southward and westward, carefully avoid falling in with its rocky and dangerous coast at night, for you may be out in your reckoning, or may be caught in a S.W. Gale. During February, March, and the beginning of April, winds from S.E. to S. are very common off the South Cape.

East Coast of Australia.—Northward of the Tropic the S.E. Trade-wind is regular from the end of April until September; this is the fine season. From October to April N.W. winds are prevalent, with rain and general bad weather.

In the vicinity of the Tropic, and thence to Sydney, there is considerable variation; here the S.E. Trade only blows home during the summer, but may be interrupted by N.W. breezes at any time; gales from the S.E. may be expected in December, January, February, and March, especially during the two latter months. From May to September—the winter—westerly winds bring fine weather; gales at this period come from N.E. and S., always bringing rain.

At Sandy Cape the S.E. Trade prevails at least nine months in the year.

South and south-easterly breezes are generally prevalent at Port Stephens during the summer, as well as land and sea breezes; the sea breeze sets in at S.E., and veers to N.E. as the day advances; during the winter strong westerly winds are very common.

On the N.E. coast the hot N.W. wind of summer is almost always followed by sudden squalls varying from S.E. to S.S.W.

Northward of Sandy Cape, at the **entrance to Torres Strait,** and in the **Coral Sea,** the winds, though generally from N.W., are not persistent during the period of the N.W. Monsoon—from November to March—and are interrupted by

calms and rain, as well as by occasional heavy gales—with rain, thunder, and lightning. These Westerly winds are steadier and stronger 200 to 400 miles to seaward than nearer the coast, but beyond that they become light, and finally give place to the S.E. Trade.

From April to September the S.E. Trade is the prevalent wind along the N.E. coast, with land and sea breezes near the shore; the weather is generally fine, though squalls and gales may be expected at the commencement of the season—during March and May. Captain DENHAM, while surveying the CORAL SEA, found the S.E. Trade frequently interrupted by variable winds and calms, and by occasional heavy gales.

Sydney.—Land and sea breezes are regular at Sydney from October to April, the former lasting only from midnight to 8 A.M.; these are occasionally interrupted by hot winds from N.W., which last from twelve hours to three days, and are always followed by heavy breezes from the southward, which come on without much warning. From April to October winds from N.W. to S.W. rule, with fine weather; occasionally there may be gales from the N. or S., with gloomy weather and rain. At the spring equinox the wind generally freshens to a gale from S.E. to E., with rain and a high barometer; as the wind veers to S. and S.W. the strength of the gale declines; they last from one to three days.

The following is a general synopsis of the wind and weather, for the different months:—

January—Light Easterly winds and calms; stormy if the wind shifts to S.W.

February—Winds between N.E. and S.E. prevail; at times from N.W. to S.W. by the W., and then bringing heavy rain.

March—S.E. and S. winds; the latter bring rain.

April and May—Winds between N.W. and S.W. are predominant, and they often blow strong.

June, July, and August—Westerly winds prevail, variable between N.N.W. and S.S.W.; in general moderate, and with fine weather. Winds from S. and E. in August are accompanied with cloudy weather and rain.

September—The prevalent winds are from W.N.W. to W.S.W., but occasionally from the eastward.

October—Easterly winds, variable between N.E. and S.E.

November—The prevailing winds are S.S.E., veering to S. and S.S.W. occasionally.

December—E.N.E. to S.S.E. are the usual winds, which, however, at times veer to S. and S.S.W.

REMARKS ON THE CURRENTS.

Currents in the Straits of the Indian Archipelago.

Currents in the Indian Archipelago—South of the Equator.—Among the **Islands of the Indian Archipelago,** the waters of the ocean being subdivided into a number of comparatively limited areas, there is no space for the development of the Equatorial Current; hence whatever currents prevail are under the control of the prevalent wind of the season, being westerly with northing during the E. and S.E. Monsoon,—easterly with southing during the W. and N.W. Monsoon—modified at all times by the tidal streams.

The current is easterly in the **Strait of Sunda** from January to April, and westerly during the remainder of the year—setting sometimes at the rate of 60 or 80 miles a day.

In the **Java Sea** both the easterly and westerly currents are influenced by the set of those in the straits of Sunda, Banka, and Gaspar. Jansen, speaking of the currents in this region, says:—"It is sufficiently important to fix the attention, seeing that these circumstances have great influence upon the winds in the many straits of the Archipelago, in which strong currents run most of the time. Especially in the straits to the east of Java these currents are very strong. I have been unable to stem the current with eight-mile speed. However, they do not always flow equally strong, nor always in the same direction. They are probably the strongest when the tidal current and the Equatorial current meet together. It is said that the currents in the straits during the E. Monsoon run eighteen hours to the N. and six hours to the S.; and the reverse during the W. Monsoon. The passing of the meridian by the moon appears to be the fixed point of time for the turning of the currents. It is probable that the heated water of the Archipelago is discharged to the N. during the E. Monsoon, and to the S. during the W. Monsoon.

In the **Gaspar, Karimata** and other straits in this part of the Archipelago, the currents set southerly with the N.E. Monsoon, and northerly with the S.W. Monsoon, but their direction greatly depends on the lay of the land and on the tidal stream; in fact, the latter are very strong throughout the whole Archipelago and in the China Sea, where the in-draughts between the islands produce strong eddies; and overfalls—resulting from the meeting of the streams over an uneven bottom—are very common. It should also be remembered that the time of high water at F. and C. varies in the two Monsoons, not being a *constant* as in other parts of the ocean.

In the Strait of **Macassar** the current is more frequently southerly than northerly throughout the year; it is always strong during the N.E. Monsoon, but especially so in December, January, and February; during the S.W. Monsoon if there is any current it as often sets gently to the S. as to the N.

Into the **Sea of Celebes** and the **Sulu Sea** there is generally a weak W. or S.W. current from the Pacific in both Monsoons, subject, however, at times,

to a strong easterly set along the north shore of Celebes and the south shore of Mindanao. Hereabouts the currents are always remarkable for their variability—for from this part of the sea originates the Easterly Counter Current of the Pacific Ocean.

Java to Timor:—The currents are very rapid at all times in the narrow channels separating the chain of islands extending from Java to Timor.

In the **Arafura Sea** the set is still with the prevalent Monsoon, and its velocity depends on the force of the wind—seldom, however, exceeding 20 or 30 miles a day.

In the **Banda Sea and Molucca Channels** the strength of the current is greater during the N.W. Monsoon than when the S.E. Monsoon is prevalent; but as the direction of the wind is less regular here than in the neighbouring seas, so is the direction of the current.

On the **N.W Coast of Australia** a north-easterly current prevails, derived from the northerly current which, from Cape Leeuwin, sets along the west coast of the continent to join the Equatorial current of the Indian Ocean. It is met with all the year round, but its velocity is very uncertain—probably never more than 12 to 18 miles a day, except in the Westerly Monsoon, when a strong easterly current sets through that part of the ocean southward of Java and the Sunda islands, and with this unites to pass into the Arafura Sea. It may also be a prolongation of this north-easterly current which, on the north side of the Serwatty islands, sets to the eastward during the S.E. Monsoon, while in the Arafura Sea the current is westerly.

The Currents of the China Sea.

The currents of the China Sea are uncertain, depending for direction and velocity on the general prevalence and strength of the Monsoons—varying as they vary.

1. *During the N.E. Monsoon*:—

In the south-western part of the China Sea, along the east side of Malacca and the south coast of Cochin China, the current generally sets to the southward about the middle of October, and continues in that direction till the month of April. In march it sets constantly southward between the Anamba Islands and Singapore, with the light easterly winds and calms prevalent during that month.

On the **east coast of Cochin China**, and near the island of Hainan, the current, variable between S. and S.W., commences about the middle of September; it is strongest near the coast from 15° to 11° N. Lat., and becomes weaker in proportion as it flows to the southward.

During the strength of the N.E. Monsoon, from the parallel of 14° N. to Cape Padaran, the current near the coast frequently runs at the rate of 40, 50, and even 60 miles a day; this velocity, however, is not persistant, and it is certainly weaker near Cape Padaran, as well as across the entrance of the Gulf of Siam where its direction is S.W.

Near the south coast of China, at this season, the current generally takes a W.S.W. direction, nearly parallel with the coast, and it is especially rapid after strong winds or a typhoon. At about 25 leagues from the land it is never so strong as inshore and between the islands; it is also stronger in shoal water than where the soundings are 30 or 40 fathoms.

In the **Formosa Channel**—between the island and the main—the current sets south. When the wind is strong, it takes a S.W. or a southerly direction in the strait between the **south end of Formosa** and the north side of Luzon; here, however, when the wind is variable, the set is often northerly.

On the **west coast of Luzon** the current is very variable—sometimes southerly and sometimes northerly, as is the case on the **coast of Palawan** where it depends entirely on the wind, and only becomes strong in proportion as it is driven by the gale.

2. *During the S.W. Monsoon.*

In the **middle of the China Sea** a northerly set begins in May, or sometimes at the end of April. When the S.W. Monsoon is strong, the current sometimes maintains a northerly and S.E. set until September; but when the Monsoon is light or moderate, the current is variable; thus there is no constancy during this season, and after the first burst is over, if there is any set it is as likely to be to the S. as to the N.E.

Off the **Coast of Cochin China,** north of Cape Padaran, the current is always weak during the S.W. Monsoon; and between this Cape and the Gulf of Tong-Quin it sometimes sets to the northward and sometimes to the southward.

With a N.W. gale prevailing in the Gulf of Tong-Quin, as well as to seaward, the current, near the **Paracels** (and in that part of the sea over which these winds extend) generally set S.W. or S., producing a high sea,—for the direction of the current in that case is oblique to that of the wind.

On the **south coast of China** the current, during strong S.W. winds, sets to the eastward with the trend of the coast. The freshes generally produce a westerly current, and its rate between Macao and the island of St. John is from 1 to 2 miles an hour—its direction varying between W.S.W. and W.N.W.; this is but a temporary set, not lasting throughout the Monsoon.

Off the **coasts of Luzon and Palawan** the current sets to the northward during the whole of the S.W. Monsoon; but close inshore it is weak and scarcely felt.

Strong westerly winds near the **Bashee Isles** produce an easterly current; the set is more frequently, however, to the northward, varying at times from N.N.W. to N.E., and strong.

The late Commander W. T. Bate R.N., referring to the vicinity of **Palawan** where he had been employed surveying, says :—

"In the **Palawan Passage,** or **Balabac Strait** the currents are influenced by the prevailing winds, the set being found to be in the direction in which it is blowing, with a velocity proportionate to the wind's force. Westerly winds are remarked as forcing through the strait a *strong* current to the eastward.

"In the **North Balabac Strait** the currents also depend greatly on the prevailing winds. It has been observed in both straits, that in the months of

November and December, after a succession of westerly winds, the current sets constantly to the eastward, slackening only on the ebb tide; while in July, after a continuance of unusually fine weather, with light E. and S.E. winds, it sets with the same velocity,—viz., from ¾ to 2½ knots—in the opposite direction. The mean velocity observed for thirteen consecutive hours was 1¾ miles.

"In **Oologan Bay** no perceptible current has been observed, except after heavy rains, or when westerly winds have prevailed, when there is a slight out-draught.

"On the **East Coast of Palawan** the currents appear to depend chiefly on the prevailing wind. In the Pasco Channel, in the month of June, the current was observed running at the rate of 3½ knots an hour to the northward."

Gulf of Siam.—In both Monsoons, the China Sea current barely enters the Gulf of Siam, but rather sets across its entrance between Pulo Obi and the Redang islands. At the head of the Gulf, during the N.E. Monsoon, a strong westerly current is frequently found, against which it is necessary to guard when making the Bangkok river, to avoid being set to leeward. From Cape Chong P'ra to Cui (or Sano-roi-yot) Point a northerly current may be expected during the S.W. Monsoon. The set near the land is generally with the prevalent Monsoon, and strong in proportion to the force of the wind; but in the middle of the gulf the current is weak and variable.

Along the **East Coast of China** the current is northerly during the S.W. Monsoon, and southerly during the N.E. Monsoon; varying in velocity from 1 to 3 or 4 knots an hour, according to the strength and duration of the wind and frequently throwing ships out of their reckoning.

Off the **Pescadores** a northerly set of four knots an hour has been experienced during the Southerly Monsoon, with the flood to the northward; slacking, however, with the ebb, but not ceasing entirely: the "China Pilot" says that navigators "may safely allow that the effect of the current and tidal stream together, will set a ship, according to the prevailing Monsoon, seventeen miles in one tide."

To the eastward of Formosa, about **Botel-Tobago,** the currents are also changeable with the Monsoons.

Currents of the Western Pacific.

The **Great Equatorial Current** of the Pacific flows steadily from the American Continent towards the Islands of the Indian Archipelago, at the average rate of from 30 to 24 miles a day; slightly stronger, however, in its northern than its southern area,—and on the western side of this ocean presenting many anomalies.

The **Equatorial Counter Current** in the Pacific sets to the eastward, between the parallel of 6° north and the Equator, separating the Great Equatorial Current into two distinct bodies of water; it is probably due, in the first instance, to the *drift* of the Monsoon, and then augmented by a set from the North and South Equatorial Currents, as they are turned aside by the opposing shores of New

Guinea and the Philippines; it sometimes attains a velocity of 48 to 60 miles a day, at other times it does not exceed 12 or 13 miles, perhaps less. This easterly current in the Pacific, near the Equator, has been recognised by all navigators, and is well known to all whalers, but the limits of its extention are by no means certain: Captain Wilkes attributes its origin to the set from the Indian Ocean along the north-west coast of Australia, but this is more than doubtful.

The **South Equatorial Current** flows to the westward, between the Equator and Lat. 26° S.; but near the meridian of 175° W. it probably begins to feel the effect of the obstructions to its westerly progress, and a branch under the name of the **Rossel Current,** takes a N.W.ly direction, passing between the New Hebrides and the Solomon group, and thence by the south coast of New Guinea towards Torres Strait. Its average velocity is 8 to 10 miles a day. Within the Barrier reefs it is not so much the current as the tidal streams which require attention.

About the meridian of 170° E. another branch declines to the southward, and on the parallel of Sandy Cape is well marked as the **Current of the East Coast of Australia.** Its course is successively W.S.W., S.W., and S.S.W., and finally becomes South, running along the eastern coast of Tasmania. Its velocity is very irregular, varying from 24 to 60 miles a day, and is persistant in its southerly course all the year round off the Australian coast, often strongest during S.E.ly gales, when it takes a westerly direction towards the land; close inshore and in the bights there is generally an eddy current setting to the northward at the rate of 10 to 20 miles a day.

The **North Equatorial Current,** in the vicinity of the Caroline Archipelago, is partially under the influence of the Monsoons which prevail there; from May to October, the westerly set is greatly diminished, and during the strength of the S.W. Monsoon the current occasionally flows very slowly (six miles a day) to the E.N.E. and N.E.; from October to May, the general westerly set of the equatorial current is prevalent, but it inclines to W.S.W. and even S.W., and probably at this season a portion of it may be deflected into the easterly counter current. To the northward and westward of the Ladrones, the Equatorial stream pursues its course steadily towards W.N.W., becoming more and more northerly as it approaches the opposing shores of Luzon and Formosa; decreasing in breadth, but at the same time acquiring increased velocity; eventually it curves to the N. and N.E., and passes the Loo.Choo group and the Japan Islands as the **Japan Current,** or **Kuro Siwo**—a considerable body of warm water resembling in many respects the Gulf Stream of the Atlantic.

The following remarks on the Japan current are from the observations of Lieut. Silas Bent, U.S.N., made during the period of the American expedition to Japan in 1852-54:—

"The existence of a N.E. current on the coast of Japan, was noticed by Cook, Kruzenstern, and other explorers, and has of course not escaped the attention of more recent intelligent navigators; but I believe that no systematic series of observations upon it have hitherto been made.

"The Japanese are well aware of its existence, and have given it the name of 'Kuro Siwo,' or Black Stream, which is undoubtedly derived from the deep blue colour of its water when compared with that of the adjacent ocean.

"The fountain from which this stream springs is the great Equatorial Current

of the Pacific, which, in magnitude, is in proportion to the vast extent of that ocean when compared with the Atlantic.

"Extending from the Tropic of Cancer, on the north to Capricorn (in all probability) on the south, it has a width of near three thousand miles, and with a velocity of from 20 to 60 miles per day, it sweeps to the westward in uninterrupted grandeur, around three-eights of the circumference of the globe, until diverted by the continent of Asia, and split into innumerable streams by the Polynesian Islands: it spreads the genial influence of its warmth over regions of the earth, some of which—now teeming in prolific abundance—would otherwise be but barren wastes.

"One of the most remarkable of these offshoots is this **Kuro-Siwo** or **Japan Stream,** which, separated from the parent current by the Bashee Islands, and south end of Formosa, in Lat. 22° N., Long. 122° E., is deflected to the northward along the coast of Formosa, where its strength and character are as decidedly marked as those of the Gulf Stream on the coast of Florida. This northwardly course continues to the parallel of 26° N., when it bears off to the northward and eastward, washing the whole S.E. coast of Japan, as far as the strait of Tsugar, and increasing in strength as it advances, until reaching the chain of islands to the southward of the Gulf of Yedo, about the meridian of 140° E., where its maximum velocity, as shown by our observations on one occasion, was 72, 74, and 80 miles respectively per day. Its average strength from the south end of Formosa to the strait of Tsugar is found to be from 35 to 40 miles per twenty-four hours, at all seasons that we traversed it.

"Near its origin, the Kuro-Siwo, like the Gulf Stream, is contracted, and is usually confined between Formosa and the Majico-sima group, with a width of one hundred miles. But to the northward of this group it rapidly expands on its southern limits, and reaches the Loo Choo and Bonin Islands, giving it a width to the northward of the latter of about five hundred miles.

"To the eastward of the meridian of 143° E., in latitude 40° N., the stream takes a more easterly direction, allowing a cold current to intervene between it and the southern coast of Yesso, where the thermal change in the water on leaving the stream is from 16° to 20°. But from the harassing prevalence of fogs during the limited stay of the squadron in that vicinity, the reports and tables do not furnish sufficient data to prove *conclusively* the predominant direction of the cold current through the strait of Tsugar, particularly as the tide ebbs and flows through them with great rapidity. Yet from what we have, I am inclined to believe that it is a current from the Arctic Ocean, running counter to the Kuro-Siwo, and which passes to the westward through the strait of Tsugar, down through the Japan Sea, between Korea and the Japanese islands, and forms the hyperborean current on the east coast of China, which is known to flow to the southward, through the Formosa Channel into the China Sea. For to the westward of a line, connecting the north end of Formosa and the south-western extremity of Japan, there is no flow of tropical waters to the northward; but, on the contrary, a cold counter current filling the space between the Kuro-Siwo and the coast of China. As far as this cold water extends off the coast, the soundings are regular, and increase gradually in depth; but simultaneous with the increase of temperature in the water, the plummet falls into a trough similar to the bed of the Gulf Stream, as ascertained by the United States' Coast Survey.

"The surface of this counter current is, no doubt, influenced in some measure by the S.W. Monsoon, and during the season of that wind a portion of it is forced out between Formosa and Japan, to mingle its waters with the Kuro-Siwo; but so well is its existence known to vessels trading on the coast of China, that they very rarely, if ever, attempt to *beat* to the northward through the Formosa channel, but almost invariably make the passage to the eastward of Formosa during the prevalence of adverse winds, though those winds may be stronger there than in the Formosa channel.

"Of the power of these two currents I can speak from experience, in addition to the facts disclosed by the observations now under consideration; for in the winter of 1848, when attached to the U.S. ship *Preble*, commander James Glynn, and bound from Hong-Kong to Japan, we struggled for three days, after leaving the port, against this south-west current, setting down through the Formosa channel, without making a single mile on our course to the eastward, and were compelled to resort to the expedient of working along in-shore, and anchoring whenever the tide was combined with the current against us. A number of days were thus toilsomely spent before reaching Breaker point, on the coast of China. We then stretched across the channel, in the middle of which we felt the full strength of the south-west or counter current. But on doubling the south end of Formosa, we immediately fell into the Kuro-Siwo, and were borne by it ninety-two miles, dead to windward, in less than three days, whilst lying-to, under storm-sails, in a stiff gale from the northward and eastward.

"There is an increased temperature of both the air and the water the moment this stream is entered, but a predominant thermal change in the water, which almost invariably continues superior in temperature to that of the air until leaving the stream again. On the north-western edge of the stream the transitions are sudden and extreme, varying, according to the latitude, from 10° to 20°. On the south-eastern side, the change is less abrupt, and from the gradual approximation of the thermal ranges of the air and water, its outline is rendered less distinct and definite.

"Along the borders of the stream where it chafes against the torpid waters of the ocean and counter currents, as also in its midst, where whirls and eddies are produced by islands and the inequalities in its bed, strong tide-rips are constantly encountered which often resemble heavy breakers on shoals and reefs, and become finger-boards, as it were, to warn the seaman of the otherwise unseen influence which may be bearing his ship far from the intended track, and, perchance, upon some of the many fearful dangers that sprinkle that region of the sea.

"The Gulf Stream, as delineated in the Coast Survey Report of Professor A. D. Bache, for 1854, has a striking resemblance to the Kuro-Siwo. The thermal changes in the Kuro-Siwo indicate a depression of only a few degrees in the water thermometer, and should more properly, perhaps, be termed *cool* strata, as compared with the rest of the stream, for in all instances these strata maintain a superior temperature to the atmosphere above them; and if the hyperborean current is, as I have supposed, entirely separated from the Kuro-Siwo by its passage through the strait of Tsugar to the westward of Japan, I am inclined to think that there is no counter current *underlying* the Kuro-Siwo, as is the case with the Gulf Stream. This, however, can be determined only by experiments with the deep-sea thermometer, and the usual apparatus for determining sub-

surface currents, none of which were made by the expedition, as its special object was of primary importance, and all other subjects within the field of our observations were necessarily of subordinate consideration, and were obliged to be made as opportunity and the ordinary facilities of our situation would permit.

"Capt. M. F. Maury says, that 'the maximum temperature of the Gulf Stream is 86° or about 9° above the ocean temperature due to the latitude.' This maximum temperature coincides pretty nearly with that of the Kuro-Siwo, as shown by the daily means of our observations; but the difference between the temperature of the Kuro-Siwo and the 'ocean temperature due to the latitude, is, by the same observations, shown to be greater than that of the Gulf Stream, —amounting on an average to about 12°.

"There is a floating sea-weed found in the Kuro-Siwo, similar in appearance to the *fucus natans* of the Gulf Stream; but the specimens collected by the expedition were unfortunately lost before being submitted to botanists for examination, and it is therefore yet undetermined whether they are identical or not.

"It may not be uninteresting to state, that Lieut. W. L. Maury found sprigs of coral while surveying off the harbour of Simoda, in latitude 35° N.

"There is a striking coincidence not only in the *recurvation* of these oceanic streams, but of the general coincidence in *their* recurvation with that of the storms of the Northern Hemisphere. Mr. Redfield is of the opinion that the recurvation of storms between the parallels of 20° and 30° north and south latitude, in all parts of the world, as shown by observations, is but partially dependent upon the influence of land, and is 'to be ascribed mainly to the mechanical gravitation of the atmospheric strata as connected with the rotative and orbital movements of the different parts of the earth's surface.'

"These atmospheric meteors, originating generally about the tenth parallel of latitude, north and south, are impelled by this influence directly towards the poles, but are at the same time borne to the westward by the Trade-winds. This compound force gives them an oblique direction to the north-west and south-west, until arriving at the outer limits of these winds, about the parallels of 25° or 30°, where the storms become released from their influence, and continuing their course to the north and south towards portions of the earth's surface, having less rotative velocity than that from whence they came, they gradually *recurve*, and soon assume a path to the north-east and south-east, which they pursue until dissipated by expansion, or have fulfilled their mission by a restoration of the atmospheric equilibrium, a disturbance of which had probably given rise to them. The converse of this rotatory influence of the earth is thus described by Dr. Hadley and Dr. Franklin:—"The air under the Equator and between the tropics being constantly heated and rarefied by the sun, rises; its place is supplied by air from the higher and polar latitudes, which, coming from parts of the earth that has less motion, and not suddenly acquiring the quicker motion of the equatorial earth, becomes an east wind blowing westward, the earth moving from west to east and *slipping under* the air.' This general law of nature operates in the same manner upon the waters of the ocean as upon the atmosphere, when, by any disturbing cause, portions of the former are set in motion from about the Equator, modified, of course, by such local obstructions of continents, islands, &c., as may be encountered in their path.

"Redfield furthermore says:—'The Gulf Stream from Florida to Newfound-

land is for the most part imbedded or stratified upon a current which is setting in the opposite direction in its progress from the polar regions. By this action the great stream of drift ice from the polar basin is brought within the dissolving influence of the Gulf Stream; and the Grand Bank itself, perhaps, owes its origin to the deposits which have resulted from this process during a long course of ages. The icebergs being carried southward by the deeper Polar Current, their rapid destruction is here effected by the tepid water of the Gulf Stream. These two streams of current, like other currents, both atmospheric and aqueous, pursue each its determinate course, the Gulf Stream being thrown eastward by the greater rotative velocity which it acquired in latitudes nearest the Equator, and the Polar Current being thrown westward along the shores and soundings of the American continent and its contiguous ocean-depths by the tardy rotation which is derived in higher latitudes. Were the influence of winds wholly unfelt upon the ocean, it is probable that the same system would still be maintained in all its essential features by the mechanical influence of the earth's rotation, combined with an unstable state of equilibrium.'

"Maury, in a paper 'On the Gulf Stream and Currents of the Sea,' read before the National Institute (U.S.,) April 1844, says:—'A geodetic examination as to the course of the Gulf Stream does not render it by any means certain that it is turned aside by the Grand Banks of Newfoundland at all, but that in its route from the coast of Georgia, as far towards the shores of Europe as its path has been distinctly ascertained, it describes the arc of a great circle as nearly as may be. Following the line of direction given to it after clearing the straits of Florida, its course would be nearly on a great circle, passing through the poles of the earth. That it should be turned from this, and forced along one inclining more to the east, requires after it leaves these straits the presence of a new force to give it this eastward tendency. And have we not precisely such a force in the rate at which different parallels perform their daily rounds about their axis? In consequence of this the stream, when it first enters the Atlantic from the Gulf, is carried with the earth around its axis at the rate of about two miles and a half a minute faster towards the east than it is when it sweeps by the Grand Banks of Newfoundland.

"'That this explanation as to eastward tendency should hold good, a current setting from the north towards the south should have a westward tendency. Accordingly, and in obedience to the propelling power derived from the rate at which different parallels are whirled around in diurnal motion, we find the current from the north which meets the Gulf Stream on the Grand Banks taking a south-westerly direction, as already described. It runs down to the Tropics by the side of the Gulf Stream, and stretches as far to the west as our shores will allow.'

"That this theory of rotative influence may or may not be correct, it is not my province to discuss; but I was forcibly struck with these coincidences of recurvation when the tracks of the Gulf Stream and Kuro-Siwo, together with the paths of the hurricanes, were traced upon the same chart; and I have made these quotations to show what hypotheses are entertained by some of the eminent men who have given much attention and study to the subject, and from a conviction that they are in some measure, at least, sustained by the results of our observations upon the Kuro-Siwo; for, notwithstanding the configuration of the eastern

shores of the continents of America and Asia are undoubtedly the original cause of the deflection to the northward of the whole of the Equatorial Current of the Atlantic by the Gulf Stream, and of a portion of that of the Pacific by the Kuro-Siwo, or Japan Stream, yet were no influences, such as Mr. Redfield and Captain Maury refer to, operating upon these streams, would not their natural inclination from the inertia of their westward flow be to hug the coast and wash their whole length to the Arctic Sea, or until that inertia was overcome by their friction against the continents? Yet this is not the case in either instance, for it has been well established by Mr. Bache that a counter current flowing to the southward and westward intervenes between the Gulf Stream and the coast of the United States as far as the peninsula of Florida; and, as I have before stated, as far as our observations extend, they prove conclusively that there is a very important counter current intervening between the Kuro-Siwo and the main coast of Asia.

"The influence of the Kuro-Siwo upon the climate of Japan and the west coast of North America is, as might be expected, as striking as that of the Gulf Stream on the coasts bordering the North Atlantic. From the insular position of Japan, with the intervening sea between it and the continent of Asia, it has a more equable climate than we enjoy in the United States: and since the counter current of the Kuro-Siwo does not make its appearance on the eastern shores of the islands south of the strait of Sangar, and as these islands, in their geographical position, have a more eastwardly direction than our coast, the Kuro-Siwo, unlike the Gulf Stream, sweeps close along this shore, giving a milder climate to that portion of the empire than is enjoyed in corresponding latitudes in the United States.

"The softening influence of the Kuro-Siwo is felt on the coasts of Oregon and California, but in a less degree, perhaps, than that of the Gulf Stream on the coasts of Europe, owing to the greater width of the Pacific Ocean over the Atlantic.

"Still, the winters are so mild in Puget's Sound, in latitude 48° N., that snow rarely falls there, and the inhabitants are never enabled to fill their ice-houses for the summer; and vessels trading to Petropaulowski and the coast of Kamtschatka, when becoming unwieldy from accumulation of ice on their hulls and rigging, run over to a higher latitude on the American coast and thaw out, in the same manner that vessels frozen up on our own coast retreat again into the Gulf Stream until favoured by an easterly wind.

"And in a late address before the American Geographical Society, by Dr. Hawks, when speaking of the routes for a railroad to connect the Atlantic States with the Pacific coast, he cites the remarks of Mr. Johnson and other eminent surveyors, to show that the precipitation of moisture to the westward of the Rocky Mountains, in Oregon territory, is, with rare exceptions, in the form of rain throughout the year, and seldom as snow; and as the prevailing winds on that coast are from the westward, they are unquestionably ameliorated by the warm waters of the Kuro-Siwo, which, impinging upon the Aleutian islands, are thence thrown against the shores of Oregon and California, and form the southerly current on those coasts, to again fall into the great Equatorial Current of the Pacific.

"The whole of the Kuro-Siwo is not, however, obstructed by the Aleutian islands, for experience shows that there is a current flowing to the northward

through Behrings Straits, which is no doubt derived from this stream. This is, perhaps, underlaid by an Arctic Current flowing to the southward, which, rising to the surface after passing the narrow defile of the Straits, supplies the counter current to the Kuro-Siwo before spoken of.

"In studying this subject, in connection with others having a bearing upon it, the hypothesis has forced itself upon the mind that that portion of the Kuro-Siwo which finds an outlet into the Arctic Ocean through Behring's Straits, continues its course to the northward and eastward, after clearing Icy Cape, and is the cause of that open sea, with its high temperature, seen to the northward of Greenland by Dr. KANE; and from the *unity* of its flow in a given path, it leaves the vast fields of ice lying to the southward and eastward, between that path and the north coast of America and west coast of Melville Island, in a great measure unaffected by its dissolving influence; for it is in that direction that our enterprising whale-men who resort to those seas find their most open cruizing-ground, and I have heard of no instance in which that open water has been explored to its limits in a north-east direction from Behring's Straits. The same physical laws operating upon the Gulf Stream produce similar results upon it after passing Spitzbergen, and the mass of water from these two streams thus accumulated about the pole (after parting with their warmth) find no outlets except those to the southward, between Spitzbergen and the east coast of Greenland, and through the passages among the islands leading into Baffin's Bay, and thus form the streams known as the Greenland and Labrador currents; these, uniting in the North Atlantic, become the counter current to the Gulf Stream after passing Newfoundland.

"In the passage of the United States' steam frigate *Mississippi* from Simoda, Japan, to the Sandwich Islands, in October 1854, the thermometer manifested a cold aqueous space between the meridians of 155° E. and 170° W., and the parallels of 30° and 35° N., which bears a general correspondence, in the Pacific Ocean, to the position of the Sargossa Sea in the Atlantic."

Current near Japan.—Captain D. SCOTT, (p. 16) from whom we have already quoted says—"we invariably found the current in the offing setting between E.N.E. and N.N.E., from clearing the coast of China to 40° N., beyond which it branches off—one to the North towards Saghalin and the strait of La Perouse, and the other trending towards the strait of Tsugar. Through Korea strait, during the S.W. Monsoon, it will sometimes exceed 3 miles an hour; while through the strait of Tsugar, with strong westerly winds, it often attains a rate of 5 miles an hour. The only place where we had anything like a southerly current, was in the bight between Sado and the Oki islands, and along the coast to the southward of the latter islands,—where we at times experienced, during northerly winds, a light indraught, which never exceeded 15 miles a day. I am quite sure we never had any southerly current in the offing at all. This is to be looked for from the high temperature of the water throughout the year;—it was as high as 89° in the strait of Korea, during August and September,—while it was only 82° in the strait of Tsugar, during the same months.

TYPHOONS AND GALES IN THE CHINA SEA.

The general subject of Hurricanes and Cyclones is fully discussed and explained in "Short Notes and Sailing Directions" for the North Atlantic p. 18-29, and for the Indian Ocean p. 25-33: it is unnecessary therefore to recapitulate in this place what has already been given in considerable detail. These rotatory storms are known as Typhoons in the China Sea.

The following cautions however may be useful:—

1. Rule for determining the Bearing of the Centre of the Storm from the Ship—Look to the wind's eye and set its bearing by compass, the *eighth* point to the *right* thereof, when in the Northern Hemisphere, but to the *left* of the wind's direction when in the Southern Hemisphere, will be the bearing of the storm's centre.

2. The Barometer often stands unusually high before the commencement of a cyclone, and frequently (if not always) just *around* the storm; and conceiving the cyclone to be divided into two parts by a diameter at right-angles to its path, it may be noted that—

(*a*) The barometer always *falls* during the passage of the *advancing* semicircle of a revolving storm.

(*b*) The barometer always *rises* during the passage of the *receding* semicircle of a revolving storm.

3. As regards the Season of Typhoons in the China Sea, the following record showing their frequency in the different months, will be the best guide as to keeping a look out for such unwelcome visitors:—

China Sea, and W. part of North Pacific:—February 1; May 2; June 2; July 12; August 5; September 18; October 14; November 12; December 1.

Java Sea and N.W. Coast of Australia:—December 2; January 3; February 5; March 1; April 1; May 2.

4. The Localities in which Typhoons are most frequent are:—the Northern part of the Philippines; in the Bashee channel; in the channel between Formosa and Japan; and generally off the east coast of China excepting in the Formosa channel,—the high land of Formosa seeming to influence the direction of the path of the storm, and determine it so as to pass north or south of the island, *not across it*. Typhoons are also by no means infrequent in the Western part of the N. Pacific.

Harbours of Refuge during a Typhoon:—Vessels overtaken by a Typhoon, when near the east coast of China, will find secure anchorage in the following places:—Tam-tu island; Mirsbay; Ty-sami inlet (E. $\frac{3}{4}$ N. 9 miles from Hong-hai island)—if the vessel's draft is not over 12 feet; Namoa island—abreast Stewart's house; Tongsang harbour; Amoy harbour; Quemoy island; Makung harbour (at the S.W. part of Ponghou, the largest of the Pescadores);

Chin-chu harbour—within the Boot sand; Hungwha sound; Haetan strait,—southern entrance; Pih-quan harbour; Bullock harbour; Ke-lung harbour (N. end of Formosa); Ting-hai, inner and outer harbours (S. side of Chusan); Chinkeamun harbour (S.E. end of Chusan); Chin-Keang harbour (W. side of Chusan); Chang-pih or Fisher island (off the N. end of Chusan); and Ta-outse harbour (N.W. of Kintang.)

Severe gales are not unusual at particular seasons in the China Sea.

In September or October, a steady gale from the N.E.-ward has been known to last for several days near the south coast of China. During the same months, but off the west coast of Luzon, strong gales of short duration from N.W. veering to S.W. with heavy rain, may be expected; these raise a heavy cross sea.

During the S.W. Monsoon, strong N.E. gales, with very hard squalls, have been occasionally but not often experienced off the coast of China; at this season, however, but especially in May, June, July and August, when in the vicinity of the opening to the Gulf of Tong King, it is necessary to be on the look-out for the severe gales which, commencing at N.W. veer to S.W. in this vicinity, accompanied with dark gloomy weather and a perfect deluge of rain.

ON MAKING PASSAGES, TO AND FROM CHINA,

THROUGH THE CHINA SEA.

[N.B.—Mariners are cautioned that the remarks "on making passages" are merely notes on the best routes for the different seasons, and do not include a *description* of the rocks, shoals, and dangers.]

The China Sea may be entered from the Indian ocean by the straits of Sunda, Bali, Lombok, Allass, Sapie, Floris, Alloo, Pantar, or Ombay, each of which has its special advantage *according to the season and the port of destination.* Thence there are two principal routes separated from each other by the island of Borneo; that to the westward of Borneo is known as the Western Route, and is the shortest, but it can only be taken *during the S.W. Monsoon*, in which case a vessel having entered the China sea by Sunda strait, subsequently proceeds northward, either by Banka, or Gaspar strait; the other is the Eastern Route, and lies through some of the many straits and passages eastward of Borneo—the vessel having previously taken one of the straits eastward of Java; the *eastern route* is adopted during that part of the year *when the N.E. Monsoon prevails* in the China Sea.

Sunda strait leads into the Java sea, and whether bound through Banka, Gaspar, or Karimata strait to China, the dangers of the Thousand islands, and

those in the vicinity of the North Watcher,* can be easily avoided, if the navigator exercises ordinary prudence and has a good chart. It is never wise to make too free with the S.E. coast of Sumatra, and in order to avoid the banks off the coast do not stand into less than 9 fathoms water. The Lucipara passage will not be used so long as the advantages of Stanton channel are known.

Directions for **Stanton Channel** have been published by the Admiralty; and that part relating to the passage through is here reprinted:—

General Observations.—The advantages which a navigable channel along the coast of Banka island would offer to vessels passing through Banka strait having been long felt by seamen, H.M.S. *Saracen* was ordered in the early part of 1859, to survey the southern portion of the strait, from the Dapur islands to Parmassang point. During the survey, an excellent passage, now named Stanton channel, nearly 3 miles wide in its narrowest part, and with a depth varying from 7 to 20 fathoms, was found between Lucipara and Banka.

Stanton channel will be found to possess many advantages over that of Lucipara, for—it is a mile wider, the approaches to it are marked by well defined hills on Banka island, and a vessel of the largest draught may pass through it at any time of tide: whereas, vessels frequently get on shore in using the Lucipara channel—for the coast of Sumatra, consisting of low muddy mangrove shores about 50 or 60 feet in height, is unmarked by a single conspicuous object to assist the seaman to clear the mud flat bordering its entire length, and which a few miles southward of Lucipara point extends 11 miles from the land. The island of Lucipara also is small, about half a mile in length and 164 feet high, and no marks can be given to avoid the rocks extending a considerable distance to the southward and eastward of it.

The water also in the Stanton channel being much deeper than in the Lucipara, causes the banks, which are mostly of sand, to be more easily recognised by the light colour of the water on them. The tide also ebbs and flows more regularly in this channel, and sets directly through it, which enables vessels, even in calms, to drop through; whereas they are often, in light winds and calms, set over amongst the dangerous banks whilst rounding First point in endeavouring to get through the Lucipara.†

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* Commander Bullock, of Her Majesty's steam-vessel *Serpent*, has recently (1866) examined the positions of various dangers, which were supposed to lie in the track of vessels from Sunda strait and Batavia to Singapore; he reports that the Dolphin, Antelope, Jason, Banterer and Anna Paulowna shoals, were searched for, but not found; their names are therefore expunged from the Chart of the Western part of the Java Sea.

The position of Lynn bank, which uncovers at low water; as well as that of the Coventry reef, which also dries at low water, and on which the sea always breaks, has been accurately determined. The positions of several other dangers in this locality have also been rectified.

A shoal has recently (May 1866) been reported by Captain R. L. Sands of the *Glencoe*, who, when coming down the Java Sea, passed close to the wreck of a barque lying in the fairway; its position was, N. Watcher N. 62° E. 4¾ miles, North island S. 20° E. 12¼ miles, S. island of the Two Brothers N. 74° W. 18¾ miles: this has since been corroborated by two other shipmasters, who have reported the wreck near the N. Watcher without giving the position.

† Lucipara, said to be corrupted from Pulo Sippah, Betel-quid Isle.

The wind in the N.W. Monsoon blows off the Banka coast, and throughout the year land breezes generally occur during the night. A strong land wind from the N.E. has been experienced in the Stanton channel during the S.E. Monsoon, when the wind was blowing directly through the Lucipara from the S.W.

There is also but little variation in the depth of water between the Sumatra coast and the Lucipara shoals: and it is stated that during the months of January, February, and March, when the N.W. Monsoon is at its full strength, the southern current continues from 14 to 18 hours successively with a velocity of 2 to 2½ knots, which would make it almost impossible for an indifferent sailer to make any progress against it. It is also said that, during the latter part of the S.E. Monsoon, it frequently blows hard from the S.W., accompanied with much rain; this would considerably retard vessels going to the southward through the Lucipara and offer a fair wind to the Stanton channel.

Stanton Channel.—This channel lying along the south-western coast of Banka, is 19 miles long, and nearly 3 miles wide at its narrowest part with a depth, in mid-channel, increasing gradually from 7 fathoms at its south-eastern entrance to 20 fathoms near the other extreme. The approaches to it from the southward are marked by the well defined mountain of St. Paul, and the conical hills of Gadong and Toboe Ali Lama,†—and in fine clear weather by the more distant range of Padang, 2217 feet high; these cannot fail to point out the entrance, and the water being deep within half a mile of the Dapur islands, will give strangers confidence in steering for the land. Prominent points and hills will also be seen along the Banka coast, bearings of which will enable a vessel at any time to ascertain her position.

The channel is bounded by narrow banks extending in a N.W. by W. and S.E. by E. direction, and all partaking of the same formation, (sand) in their shoalest parts, with a mixture of mud and sand between; the two marking the western boundary of the channel are named Smits and Melville banks.

Directions for Stanton Channel from the Southward.—Vessels bound through the Stanton channel into Banka strait from the southward, should, after recognising Mount St. Paul, and Toboe Ali Lama peak, approach the latter on a northerly bearing, and when about 3 miles to the southward of the Dapur islands, steer N.W. by W., which will lead nearly mid-channel to abreast Banka point; a course may then be shaped along the Banka shore, passing Lalarie point at a distance not within 1⅓ miles, and from thence to Second point. When Pulo Dahun bears North, extreme care must be taken to avoid the spit, which extends in a south-easterly direction from the shore mud flat, between the above island and Banka point. Mamelon or Hummock, N.W. ¾ N., well open to the westward of Pulo Besar, clears this spit and the whole mud bank along the Banka shore; from the latter spit to the Tambaga rocks the bank may be avoided by not approaching it under a depth of 10 fathoms.

Working through.—Vessels in beating through Stanton channel may stand towards the south extreme of the Dapur islands to a distance of half a mile, as

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* Lama, old, former.

these islands have deep water at four cables from them. Between this and Toboe Ali the shore mud flat may be approached until Pulo Dapur bears S.E. by E. ½ E., and Lucipara to a distance of 5 miles from it; but when Gadong peak bears N.E. ½ N., or comes in line with Toboe Ali fort, Pulo Dapur must not be brought southward of S.E. by E. ¾ E. to clear the south-western part of the Eastern bank.

By not bringing Parmassang peak more open to the westward of Banka hill than to bear N W. ¾ N., will clear the Melville bank, and when Laboh point bears N.E. ½ N., by keeping over a depth of 10 fathoms, all the banks on both sides will be cleared. Lalarie point N.W. by W. will also clear the north-east part of Smits bank.

The shoal patches on the Nemesis bank should not be approached under a depth of 10 fathoms until Casuarina point comes open of Lalarie point; and in rounding the latter point, great care must be taken not to come into a less depth than 10 fathoms, as the bank is here steep-to. The Tambaga rocks may also be avoided by following the same precaution, and from thence it is recommended, until a more complete examination of the Banka shore is made, to work up from Second point along the Sumatra coast.

The land is low on the Sumatra coast of Banka strait, and, with the exception of the points, no objects which a stranger can recognise are visible. The points must be passed very carefully, as the bank extending from them is, by the action of the current, worn steep-to; the lead therefore is no guide, and vessels should be cautious in approaching them nearer than a distance of 1½ miles, and not within the depth of 10 fathoms.

Between the points, with the exception of a horn projecting from the main bank, 6½ miles to the northward of Second point, and also between Fourth and Batu-karang points, the soundings decrease gradually to 5 fathoms, which is generally close to the dry mud bank from the shore.

The spit or horn, to the northward of Second point, extends 1½ miles from the shore mud flat, and then in a south-easterly direction for 2 miles, with a depth from 2½ to 3 fathoms, mud on it,—and from 4 to 5 fathoms between it and the flat; from its northern extreme, Second point bears S.S.E. 8 miles, and Parmassang peak E. by S. 12½ miles; therefore in passing this spit, Second point should not be brought to the eastward of S. by E. ½ E. until Parmassang peak bears E.S.E.

After passing Fourth point, vessels should be very careful and not bring it to the eastward of S.E. ½ S., as the bank here is steep-to, 9 and 10 fathoms close to the mud, but when Monopin bears N. by E. ½ E., a more southerly course may be taken.

Directions for Stanton Channel from the Westward.—In sailing through Stanton channel from the westward, when abreast of Lalarie point, and 1½ miles distant, an E.S.E. course will lead nearly mid-channel between the Nemesis bank and the bank extending from the Banka shore, but when Panjang hill bears N.E. a more southerly course must be shaped to pass mid-channel. When Dahun point bears North, Mamelon or Hummock, N.W. ¾ N., open of Pulo Besar (the clearing mark for the spit off Pulo Dahun) also leads directly through the channel.

Working through.—In working through Stanton channel from the westward in

the S.E. monsoon, the same precaution must be taken as already mentioned to avoid the shoalest part of the Nemesis bank, which will be passed when the Mamelon bears N. by E. $\frac{1}{4}$ E.; and should a strong flood tide be then running, it would be advisable to anchor in 8 or 9 fathoms, sand, on the Nemesis bank, as the water on both sides of it is deep, and wait for a change of tide, or the chance of the land breeze, which blows generally either during the night or early in the morning from the Banka shore. When Panjang hill bears N.E., Lalarie point must not be brought to the northward of N.W. by W. to avoid Smits bank, and the same directions as already given in not approaching the banks under 10 fathoms until Laboh point bears N.E. $\frac{1}{2}$ N., will be quite sufficient to enable any vessel to work through.

Anchorage may be found anywhere in the Stanton channel; but ships bringing up with their kedge or stream anchor, must always be prepared to let go the bower anchor, as there will be experienced, particularly during the change of the monsoons, very dangerous squalls, with heavy rain, thunder, and lightning, which generally last for about an hour.

To China during the S.W. Monsoon.

Proceeding up the China sea during the S.W. Monsoon, *two routes*, are open to the navigator; one, the *inner*, lies along the coast of Cochin China, and thus to the westward of Pulo Sapata and the Paracels; the other, or *outer route*, lies eastward of those islands. The choice of the two routes depends upon how far the Monsoon is advanced; but during February, March, and the beginning of April both are equally tedious, and a beating passage may be expected.

Leaving Singapore or Banka in March, April, or the beginning of May, the *inner route* will probably be found the most expeditious; but by the end of May the season is too far advanced, for by the time the S.E. coast of Hainan island is reached, the easterly winds which prevail there are adverse for making Hong-Kong.

Speaking, however, in general terms, it will be found that during the S.W. Monsoon owing to the variable winds and weather that may be expected between Cape Padaran and the Gulf of Tong King, and the uncertain, gloomy weather, with occasional sudden squalls from the N.W. and West in and near that gulf, driving vessels over to the Paracels, the *inner route* is not preferable to the *outer* one for a good ship; but in the case of a weak and leaky vessel, the water near the coast is generally smoother, and shelter and anchorage may be had if necessary.

The **Inner Route.**—On leaving Banka strait, pass between Pulo Taya and the Toejo (or Seven) islands, and make for the Equator so as to cross it in Long. 105 30 E.; or, leaving Gaspar strait, cross in the same position. Thence steer for Pulo Aor, keeping a good look-out for Frederick bank, passing 10 miles to the eastward of it, in 25 fathoms: and further to the north avoid the banks on the

east side of Bintang island. From Pulo Aor, steer along the coast of the Malay peninsula to the Redang islands, and thence across the gulf of Siam, in which locality squalls from the westward may, perhaps, be experienced; from Pulo Obi, keep along the coasts of Cambodia and Cochin China, as far as Cape Touron; then make for the S.W. part of Hainan, coasting along the island, and passing between it and the Taya islands; thence cross towards the south coast of China, making it about Tien Pak, or near Hailing island, and proceed along the islands to Hong-Kong. The channels among these islands afford good shelter on an emergency.

The **Outer Route.**—Having passed 5 or 6 miles eastward of Pulo Aor, make for Pulo Sapata, allowing for the easterly current from the gulf of Siam that may be expected, in the run between these islands, to set the vessel several miles eastward of her reckoning. A little northing may be made on leaving Pulo Aor, to avoid the Charlotte bank (Lat. 7° 8′ N., Long. 107° 36′ E.), and so as not to make easting until the latitude of this bank is passed; then steer so as to sight Pulo Sapata.

If the weather has been such as to preclude the possibility of making observations, it will be necessary, when approaching Pulo Condore and Pulo Sapata, to attend to the lead,—as also when nearing the Catwicks.

Having passed about 20 miles eastward of Pulo Sapata, a course should be steered to strike soundings on the eastern part of the Macclesfield bank, allowance being made for the easterly currents generally prevalent during the S.W. Monsoon. The position having been ascertained by the soundings, shape a course for the Grand Ladrone, so as to make it bearing N., especially at the height of the Monsoon, when the wind is fresh from S.E. to S.W.; then pass between it and the Kypong islands, and between Singting and the Lema islands, for the West Lamma channel. After the middle of August, when easterly winds may be expected, make the N.E. head of the Lema isles, and enter the West Lamma channel by the Lema channel. The East Lamma channel is considered safe in both Monsoons, for though deep there is still anchorage if the wind fails,—with but little tide.

There can be little question that for a good well found ship, the *outer route* is always preferable, because the winds are stronger and more regular out at sea than near the coast.

Leaving Pulo Sapata towards the middle of September, keep well to the eastward as soon as the parallel of 12° or 13° is reached, and you are clear of the banks in the southern part of the China sea; for on going to the northward it is possible the wind may be from N.E. or E.N.E.: in which case you will be in a better position to make your port than if you were nearer the coast.

The *outer route* must always be uncertain for a sailing vessel if Pulo Sapata is not reached before the beginning of October, and there will be great difficulty in making direct for Hong-Kong, on account of the strong southerly currents and the prevailing light northerly winds alternating with calms. In this case the best route is to stand to the eastward, and make the west coast of Luzon, and not steer for the coast of China until well north of Cape Bolinao, keeping a good look-out when approaching the parallels of the Pratas.

The passage to the northward may be made at any time of the year along the

west coast of Mindoro and Luzon, and thence there will be no difficulty in making Hong-Kong; but keep as near the coast as may be prudent, so as to make the most of the land and sea breezes, as well as to take advantage of the light southerly airs then prevalent in the southern part of the China sea.

By the **Palawan Route,** which may be taken with advantage at the close of the S.W., or the beginning of the N.E. Monsoon, steer for the South Anambas, leaving those islands, as well as Low island and the Great Natunas to the northward; then proceed to the N.E.-ward, and if not certain of the longitude,* endeavour to make the Royal Charlotte or Louisa shoal, whichever is the weathermost, by running it down in latitude; and as the currents appear to be influenced by the prevailing winds, they should be prepared to anticipate a set in the direction in which it is blowing, the velocity of the current being proportionate to the force of the wind.

Having made either the Royal Charlotte or Louisa shoals, or passing mid-channel between them, an E.N.E. course should be steered for about Lat. 8° N. Long. 116° 10′ E., and having run 160 miles on it, a good look-out should be kept for Balabac peak, in Lat. 7° 55′ 23″ N., Long. 117° 1′ 52″ E., which will then probably be seen bearing about East southerly; and making like a rather flat-topped island, with a small peak rising in the centre.

This course may be continued until the island is clearly recognised, and when about 13 leagues distant from it, the low hills will be seen on either side of the peak, having at first the appearance of detached islands.

Having brought Balabac peak to bear about E.S.E. at the above distance, a N.N.E. ¾ E. course should be steered, when the high land of Boolanhow will soon be discernible, bearing about N.E. by E. ¾ E. This course will take you mid-way between the Royal Captain shoal and the edge of the bank (the most dangerous part of the channel), and 10 miles clear of the Elbow, which lies W. 15° N., 21¼ miles from the south point of Palawan, and bears *from* Balabac peak N. 22° W. and from Boolanhow mountain S. 47½° W. When Boolanhow mountain bears S.E. by E. ¼ E., you are in a line with it and the Royal Captain shoal, and in the narrowest part of the channel, which is 27¾ miles wide, and the high land of Mantaleengahan will then bear E. ¼ S.

If the wind be well to the *southward*, and the weather thick, Balabac island may be approached nearer, in order to get "well hold" of the land, but extreme caution should be taken not to go within 12 miles of the shore, as soundings of 26 and 20 fathoms extend that distance westerly from the peak, having shoal patches immediately inside them.

If the wind be to the westward, with thick cloudy weather, Balabac island should not be approached nearer than 12 leagues, for these winds usually force a strong current through the straits to the eastward, and when off the S.W. end of Palawan, it is not unusual for them, particularly in squalls, to veer to W.N.W.,

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* "Directions for Sailing through the Palawan Passage." By Commander W. T. Bate, R.N.

and sometimes N.W., blowing with great violence, and placing the ship on a lee shore with respect to the shoals inside the edge of the bank. It generally so happens, that about the time, September and October, when vessels adopt the Palawan route, this weather prevails off the S.W. end of Palawan, rendering it uncertain and difficult to hit the narrowest part of the channel, owing to the land being obscured, especially if neither the Royal Charlotte nor the Louisa shoal has been made, and the longitude corrected.

Under these circumstances, it is advisable to advance with caution, regulating the speed of the vessel so as to be in the fairway (viz., Lat. 8°N., Long. 116°15′E.) for making the channel at daylight. Horsburgh recommends Lat. 8° 30′ N., and Long. 116° 30′ E., but this may be running too close at night, unless confident of the accuracy of your reckoning.

If not certain of your position, endeavour to get soundings on the edge of the bank to the N.W. of Balabac island, and the safest part to approach for this purpose is that about the Elbow, or immediately to the southward of it, for we believe the portion of the bank which is embraced by the bearings N. 22° W., and N. 62° W. *from* Balabac peak, comprising a distance of 25 miles, to be free from danger. If the peak be obscured, the same bearings *from the body* of the island will, if taken with care, answer. Or should the north extreme of the island be discernible (showing like a hillock, with a low double hill to the southward), the part of no danger will be included within the lines of bearing N. 30° W. and West *from* it.

In the thickest weather, our experience leads us to believe the land is seldom totally obscured for any length of time, but generally shows a well defined outline between the squalls.

Having obtained soundings, which will be about 90 fathoms, if close to the edge of the bank, and from 45 to 55 fathoms, sand, if inside, haul off to the N.W., to give the edge a berth of about 10 miles, then steer the channel course N. 30 E. When Boolanhow mountain bears to the eastward of N. 74° E., you are past the Elbow, from which the bank then trends N. 35° E., and it is between this point and the parallel of 9° 15′ N. (a distance of 60 miles) *on the east*, and the Half Moon, Royal Captain, and Bombay shoals *on the west*, that the most dangerous part of the Palawan passage lies.

The Half Moon shoal is distant from the S.W. point of Palawan 57 miles, and from the Elbow of the bank 39 miles, in a N. 42° W. direction.

When Mantaleengahan mountain bears S. 50° E., or the Pagoda cliff (which is generally seen when the more elevated land is obscured) S. 38° E., you are on a line with the Bombay shoal, where the channel is 28 miles broad.

Having passed the Bombay shoal, abreast which the bank trends N. 40° E., a course parallel with its edge may be steered, preserving a distance of 8 or 12 miles from it, and 9 or 10 leagues from the land, or nearer if convenient, and the peaks on Palawan are sufficiently distinct to get good cross bearings. It is, however, not desirable to get too close, as the edge of the bank in about the parallel of 9° 30′ and 10° N., is not uniform in its outline, and several rocky patches lie within a mile, and in some places only 3 cables from the 100-fathom line.

This course, viz., N. 40° E., edging a little more to the northward when abreast Ooloogan bay, where the bank extends 28 miles from the shore, will take a vessel through the passage clear of every known danger.

Ships *working* through the Palawan passage, having conformed to the directions given for making the S.W. end of Palawan, should, in fine weather, endeavour to make their "*inshore boards*" in the afternoon, for the sun being then astern of the vessel, the patches lying near the edge of the bank will generally be distinguished by the man at the masthead in ample time to tack off.

In squally weather also, during heavy rains, these patches have been observed imparting a yellowish hue to the surface of the water very distinctly.

It is almost needless to remind seamen (when the land is obscured) of the desirableness of getting hold of the edge of the bank before dark, in order to have a good departure for the night, and on making the "*inshore board*," it must also be borne in mind, that the probability of coming *suddenly into soundings* is great, as the approach of this "tack" will generally be at right angles to the edge of the bank; therefore be prepared to "go round" immediately on getting the first indications of soundings.

Routes to China during the N.E. Monsoon.

During October and November, the winds are sufficiently favourable for making a good passage by the Strait of Macassar; this is the *First Eastern Route*. Later in the season, but especially from the middle of December until February, it is better to adopt the route by Pitts passage, which is the *Second Eastern Route*.

The First Eastern Route from the Indian Ocean.—On reaching the *Eastern Straits* from the Indian Ocean in the latter part of January, or during February, vessels generally take Lombok Strait, passing east of Pandita island, since the channel west of this island is very narrow; keep in mid-channel between Lombok and Pandita, and afterwards take the eastern side of the strait; thence steer for the strait of Macassar, passing east of Pulo Sakalla or Hastings island, and the Little Pulo Laut, and make the coast of Celebes on entering the strait.

If **Bali Strait** is adopted, with the view of entering the strait of Macassar, pass through Sapoedie strait between Sapoedie and Galiang islands, then well to the westward of the islands and banks off Kangeang, giving them a good berth; and subsequently passing Little Pulo Laut on either side, according to circumstances.

Taking **Allass Strait,** steer for the east side of Pulo Sakalla or Hastings island, as on coming from Lombok strait.

Taking **Sapie Strait,** in September and October, a vessel may, according to the prevailing winds, pass east or west of the Postillion islands, then proceed north between Tannakeke island and the Tonyn isles; she would thus be able to give a good berth to the islands and banks of Spermonde, N.W. of the bay of Macassar, and would enter Macassar strait towards the coast of Celebes.

On clearing Macassar strait, from off Cape Dondo, cross the Celebes sea and steer for the eastern end of Basilan. On shaping your course for the channel between Basilan and the west point of Mindanao island, be careful to keep well to the eastward if the wind will permit, to avoid, if possible, being drifted by

westerly currents among the Sulu islands. Should you, however, find yourself to leeward, there are good channels between the islands of the Sulus; you would then cross the Mindoro sea, keeping as near as possible to the coast of the Philippines—Mindanao, Negros, Panay, Mindoro, and Luzon. At the entrance of the channel between Mindanao and Negros, as also between Panay and Mindoro, strong N.E. winds with westerly currents are generally prevalent; shape your course, therefore, when running from one island to another, so as to be set to leeward as little as possible.

If, on leaving Basilan strait, the wind is steady from S.W. to South, steer direct for Nogas island (S.W. point of Panay),—or a little east of its meridian; if the wind is variable and uncertain, keep along Mindanao until Point Garda is reached, and then cross to Nogas island, endeavouring to coast along Negros island in making from one point to the other.

From Nogas island steer to the northward along the west coast of Panay, guarding against the outlying dangers; when past the islands off the south point of Mindoro, take the channel either east or west of the Appo shoal; by the eastern channel, if the wind is easterly, keep about 6 miles from the coast of Mindoro—avoiding a shoal patch in mid-channel; but with a westerly wind, about 12 miles, until north of the Appo reefs; thus being clear of Mindoro strait, and after doubling Point Calavite, as well as Luban and Cabra islands, follow the coast of Luzon as far as Cape Bolinao; thence you may be pretty certain of passing east of the Pratas, and reaching Hong-Kong; but perhaps it would be prudent to steer north as far as Cape Bojeador before crossing for the coast of China.

At this season, also, when the sea of Celebes is reached, a vessel may, if it appears preferable, enter the Pacific Ocean by passing south of Mindanao; for which purpose, if the wind permit, steer direct for the Serangani islands, afterwards pass between them and Mindanao, if compelled to do so, but otherwise to the southward of the Serangani; thence you would have to pass between the Meangis islands and Karekelang, one of the Tulur isles, so as to double the north of Morty island, with the wind at N.E.; or should there be any difficulty in taking this route, the channel formed by the islands of Tulur and Sanguir may be adopted.

Bound from a northern part of the Bay of Bengal for China, when the season obliges you to take the *Eastern route*, you may either go through the strait of Malacca and the Karimata channel, or pass west of Sumatra, as circumstances require; but at the beginning of the N.E. Monsoon, the strait of Malacca and the *Palawan route* will be better than the long circuit by the *Eastern route*. From the coast of Malabar or of Ceylon, or from any port on the south part of the Coromandel coast, a vessel can easily pass south of Java, and take one of the straits east of that island; Sunda strait might also be adopted, and then she must make her easting in the Java sea towards the strait of Macassar.

The Second Eastern Route is by the way of Pitts passage. This route, which leads into the Pacific Ocean by either the Gillolo passage, or Dampier strait, and is to be preferred to Macassar strait during December, January, and February.

A vessel intending to use Pitts passage, may take any of the eastern straits, as that of Bali, Lombok, Allass, or Sapie, and having passed through, make the strait of Salayer, crossing the eastern part of the Java sea. But for a vessel from the Cape of Good Hope, the Ombay channel is preferable not only as being the most direct but from being larger than those further to the westward, and the wind there being generally less variable.

To make for Ombay channel, pass either north or south of Sumba (or Sandal-wood) island,—better south of it—and then between Ombay and Timor; having rounded the east end of Ombay, steer north, keeping to-windward, so as to pass west of Boeroe island. If this cannot be done, pass east of Boeroe, between it and Manipa, and thus enter Pitts passage. The west entrance to Pitts passage is between Xulla Bessey and Boeroe islands. When near the meridian of the east point of Obie Major, and intending to take Dampier strait, a vessel should continue to run eastward: this strait seems favourable for good sailing vessels especially in January and February, when the N.E. Monsoon is getting more easterly. In March, when the N.E. winds become weak, the strait of Gillolo appears the best for entering the Pacific Ocean; this strait is also wider, and a ship may work both night and day in it, besides which the currents there are seldom strong. On leaving Pitt or Dampier strait, great caution should be used so as not to be set on the north coast of New Guinea; a vessel should therefore manage so as to round Point Pigot close to, keeping a good look-out for Buccleuch bank to the east of Waygieo island.

Pitt Strait should not be adopted from choice, but only when it is compulsory to do so. A vessel should keep in mid-channel to avoid being set on either shore by the tides, and should therefore make short boards, not approaching the coast on either hand. On reaching Jackson island, pass about five miles north of it and having doubled the reef eastward of the island of Battanta, steer North for Point Pigot.

Dampier Strait.—To enter Dampier strait, on passing the meridian of the east point of Obie Major, steer to the N.E.-ward, and go between Pulo Popa and the Canary isles. Vessels sometimes pass between the Boe islands and Pulo Popa, which is an advantageous route with N.W. winds; in this case run on for Fisher island or Cape Mabo, and thence pass between Pigeon (the eastern Duiven island), and Foul islands, keeping a good look-out; on leaving the strait, keep closer to Pigeon than to Foul island and steer so as to sight Pigot point, in order not to be set down to the coast of New Guinea by the northerly swell which prevails out at sea. The *tides* in Dampier strait are very strong and the currents very irregular, varying from 1 to 5 miles an hour. In the height of the N.W. Monsoon, in the narrow part of the strait, between Pigeon and Foul islands, the ebb, at full and change of the moon, runs between 4 and 5 miles to the E.N.E. for six or eight hours—and between 1 and 3 miles at neaps; the flood sets S.W. for three or four hours, but is weak. During the height of the S.E. Monsoon the flood sets West for eight or ten consecutive hours, turning successively W.S.W., S.W. and S.W. by S.; it then attains its greatest velocity, which at springs sometimes exceeds 2 miles an hour, and at neaps 4 miles. The ebb at this season runs E.N.E. or N.E., and is neither strong nor of long duration.

On entering the Pacific Ocean, from Dampier strait, make easting as quickly as possible between the parallels of 1° 30′ and 3° N.; this can be done even in December and January, since on this track an easterly current is found. A vessel having thus made good her easting may pass either east or west of the Pelew islands, according to her sailing qualities and the strength of the N.E. Monsoon. In any case, however she would not go so far east as the Caroline islands, near which in November and December, heavy squalls from the westward may be expected. From the Pelew islands steer for the Bashees, allowing for a westerly current, setting about 12 or 15 miles a day. From December to the middle of

February it is generally better to pass east of the Pelew islands, so as to be well to windward.

Leaving Dampier strait towards the end of the N.W. Monsoon, there is no necessity to go so far east into the Pacific. At the end of February and March pass west of the Pelew islands, as the winds in these months are often variable and veer to E.N.E.

Having reached the north part of Luzon, enter the China Sea by either of the main channels, between Formosa and Luzon. However, with the wind at N.E. at the beginning of the Monsoon, it will be necessary to pass *north* of the Bashee islands, and either north or south of the Cambrian rock. Approaching the south point of Formosa, if during daylight and with fine weather, you may pass between this point and the Vele Rete rock; but, during the night, or with bad weather, your route will lie nearer the Bashees: whichever may be the channel by which the China sea is entered, a course should subsequently be adopted to sight Pedro Blanco, and then enter the Canton river by the Lema Channel.

Gillolo Strait.—Geby island divides the strait of Gillolo into two parts; the channel between that island and Gillolo takes the name of the Gillolo passage; that between Geby and Waygieo islands is known as the strait of Bougainville.

The channels leading from Pitts passage to the strait of Gillolo are tolerably free from danger. In the N.W. Monsoon, however, that between Pulo Gass and Kelkik island is preferred, as being the largest; while the channel between Pulo Pisang and the Boe isles is at this season, too much to leeward. A vessel entering the Gillolo passage by passing between Pulo Gass and Kelkik, should round the southern point of the former island closely, to avoid missing the channel, as a strong easterly current often prevails there. However, whether going east or west of Pulo Gass, continue on so as to pass between Cape Tabo and Geby island; but if by night give the Fairway bank and Weeda islands a good berth. Should the wind be light keep as close as possible to the islands on the West coast of the strait, on account of the N.E. and easterly current.

If the wind be foul, no time should be lost in trying to get to the North of Geby island, in which case pass between it and Gagy island, and enter the Pacific by one of the channels near Syang island. But, whenever it can be done, one of the more westerly channels is preferable, because, then, with a northerly wind a ship can pass to the windward of the Aiou and Asia islands. Should there be any difficulty in passing west of the Asia isles, the channel between them and the Aiou, or even that between the latter and the north coast of Waygieo must, of necessity, be adopted.

Having gained the Pacific, endeavour, as soon as possible, to attain and keep between the parallels of 1° 30′ and 3° N., and make easting there as before directed.

If a ship **from the Gulf of Bengal** takes the Strait of Sunda instead of passing along the south coast of Java, on entering the Java sea she should pass north of the Thousand islands, and then make to the eastward (leaving the Watcher islands to the North), on her way to the strait of Salayer. If she has touched at Batavia, when clear of Edam island, steer so as to pass to the northward of the Bompjes, and then make to the eastward for Salayer strait. The best course through this strait with a N.W. wind is to pass south of Mansfield shoal: but at night, or when the wind is not steady, it is better to keep to the

northward of it, and along the coast of Celebes. From the strait of Sallayer, make for Bouton strait,—or what would be still better, if the wind is West, pass south of Bouton island; then, having passed along the S.E. coast of this island and having reached the N.E. end of it, if the wind is fresh from N.W., make to the northward for the island of Weywangy, and thence for the island of Xulla Bessey,—which is especially necessary for dull sailing vessels, in December and the beginning of January, because the winds are variable about this period, and haul to N.N.W., producing a strong southerly current. But although the winds and currents are generally variable in Pitts passage, so that it may be made almost anywhere, it is, nevertheless, prudent to keep the weather shore when northerly winds prevail. Should a vessel fall to leeward of the N.W. point of the island of Boeroe she should endeavour to pass it as quickly as possible, not by working to windward, but by running to the southward of the island and then pass to the eastward of it into Pitts passage. Vessels leaving Amboyna in the N.W. Monsoon invariably make to the northward along the coast of Boeroe where the wind is variable and off the land; while in the channel between Manipa and Ceram, southerly currents prevail at that season.

The following remarks by Commander P. J. Blake, H.M.S. *Larne*, on the **Passage up and down the China Sea,** though written many years ago, deserve careful consideration.

"Although the passage up and down the China Sea, against either Monsoon is now constantly performed, it may be useful to state a few remarks derived from my own observation, as well as from the experience of several captains of 'opium clippers,' whose constant practice has given them a tolerably perfect knowledge as to the best method of effecting the passage up and down the China Sea, between Singapore and Macao in either Monsoon.

"In beating *against*, or running *with* the strength of the Monsoon *up or down* the China Sea, ships should always pass to leeward of the Paracels, as well as of the Pratas, should they be near them, on account of the invariable set of the current to leeward. An exception may be made in beating up against the N.E. Monsoon, after reaching near Lat. 14° N., as there is an extent of sea room, and a ship must get well eastward towards the coast of Luzon before she can fetch Macao.

"In running down the China Sea with the N.E. Monsoon, the direct line mostly adopted is nearly mid-channel between Hainan and the Paracels, holding rather to the latter where a southerly current of 30, 40, and 50 miles a day is usual, and between 14° and 11° N., I have known it reach to 60 miles in twenty-four hours. Thence making the coast of Cochin China, about Varela, and shaping a course southward, so as to pass 30 or 40 miles outside of Pulo Sapata, whence the course to Singapore is clear, giving the Anambas a berth of about 40 miles, and always, if possible, sighting Pulo Aor to ensure the reckoning,—more especially should the weather be thick, when the lead should be constantly attended to.

"In running up the China Sea *with* the S.W. Monsoon, there can be no doubt but the *outer* passage by the Macclesfield bank is the best, thus passing to leeward of the Paracels with a clear sea. This Monsoon generally hangs very southerly during June and July, viz., from S.S.E. to S.S.W., the current always

setting in the opposite direction with a velocity proportioned to the strength of the wind. Although the *inner* passage by the coast of Cochin China is recommended by Horsburgh, for weak or leaky ships, I think, on his own showing, it is to be avoided, he having adopted that passage, and very narrowly escaped being wrecked on the North shoal of the Paracels in July.—on which, in the same gale a Portuguese ship was lost. This was during a gale blowing severely at N.W., out of the gulf of Tong-King, which is not unusual at this period of the year, while a steady S.W. wind is blowing in the middle of the China Sea. Owing to the strength of the southerly current, both his own and the Portuguese ship were set down towards the north-west part of the Paracels, when trying to weather them; and this same circumstance has since happened to other ships. In running with the S.W. Monsoon by this *inner* passage in thick weather, the current varying as it does in velocity and direction, must render it precarious as to shaping a course with precision or safety.

"On leaving Macao to proceed down the China Sea *against* the S.W. Monsoon, it is advisable to make the best of your way southward for the Macclesfield bank, keeping in from 113° 30′ to 116° 30′ E., and taking every advantage of the least veering of the wind.

"The *Larne* sailed on the 36th May, 1839, from Macao roads for Singapore, Penang, and Madras. Had moderate breezes at E. and S.E. for forty-eight hours; when having made nearly a due south course from the Ladrones about 250 miles, the wind drew to southward, and blew very hard with heavy squalls. This obliged us to stand eastward under close reefed topsails, and reefed courses. It moderated P.M. 2nd June, having found by our observed latitude and chronometer at noon, that the current had set us N. 28° E. 51 miles in twenty-four hours! With the wind at S.S.E., S.E. by S., we had recovered our lost ground on the 4th, from which day until the 11th we made a course, to south-eastward, the wind invariably being S.S.W. and S. by E. On this day at noon, in Latitude observed 14° 13′ N., Longtitude by chronometer 116° 25′ E.,—tacked to westward. By standing a few hours to S.E. each day, in order to make up for the northerly current, we made nearly a due west course for the coast of Cochin China until the 16th, when we made the land about cape Varely, which is very high with a curious conical hill inland. We here felt the additional strength of the current northward, which we found at noon the 17th had set us N. 46° W., 43 miles. We at once stood away again to S.E., the wind still sticking S. and S.S.W., and on the 20th at noon, we were within 10 miles, by the reckoning, of the Investigator shoal, but perceived nothing, the wind being light and a perfectly smooth sea. Tacked to N.W. for twenty-four hours, and on the 23rd had grappled slowly to S.W., about 60 miles.

"We were now nearly in what I termed the turnpike-gate of the China Sea, viz., the narrowest part between Pulo Sapata and the West London shoals. Here a fine easterly breeze sprang up, not more to our surprise than our gratification, with which we made way to S.W., and on the 25th had reached 7° 34′ N., and 108° 14′ E. Here the wind again became southerly and light for a day, but opening as we now did, the Gulf of Siam, we had light breezes W., W.N.W., and N W., until the 1st of July, which left us nearly 150 miles to the southward. Here, having again shut in the Gulf of Siam, the winds became southerly, light and variable, as before. On the 2nd of July saw Pulo Timoan S.S.W., 17 or 18 leagues. From this day to the 8th we were beating to the southward, in sight of

these islands, harrassed by very light southerly winds, and a daily current to the northward, of from 20 to 25 miles, retarding our progress. I thought we were doomed to a perpetual view of Pulo Tioman, Pulo Aor, and Pulo Pisang, nor was it until daylight of the 9th, that they had disappeared to northward, though we could distinguish the peak of Pulo Tingy to N.W. that day at noon. After noon we made out Bintang hill, Barbukit, and False Barbukit, a joyous sign of approaching Singapore. Working to southward, wind still light and southerly, and holding on by the stream anchor when calm,—current 2½ knots N. by E. On the evening of the 10th anchored in 24 fathoms, Barbukit hill W.S.W.; and at 3 A.M. the 11th, started with a fresh breeze off the land at north-west, and stood for Singapore straits. At noon passed Pedro Branca, and at 5 P.M. anchored in Singapore roads in 10 fathoms, 42 days from Macao.

"I conceive we had thrown away at least eight or nine days in our passage from Macao, for want of experience in making it. We should not have approached the coast of Cochin China as we did, nor have stood over so far eastward as the Investigator shoal. Had we made shorter tacks hereabouts, keeping the middle passage between the coast of Cochin China and the eastern shoals, we should undoubtedly have gained several days by it. The increased strength of the current in with the coast, we found spoke for itself, and after tacking to north-west from the Investigator shoal, we *could only* stand on the port tack, on account of the shoals to the northward, with the wind sticking dead at south-west. We ought also to have made the North Natunas, and then got to south-westward, as the winds out there are much fresher and steadier than towards the Malay coast, where we experienced them so directly southward, light and variable.

"I gathered the foregoing information by comparing the abstract of reckonings with an opium vessel, whose captain had had much experience, and which arrived at Singapore from Macao the same day as ourselves, although she left *ten days after us;* and the advantage gained by the track she pursued as above described, in contradistinction to our own, was obviously manifest.

"The passage down the China Sea, against the S.W. Monsoon, I conceive to be more tedious than difficult. With the exception of the *blow* we had 48 hours after leaving Macao, we had nothing to call a breeze.

"The direct course from Macao to Singapore is, nearly as possible, S.S.W., (*true*), distance 1350 miles.

"Of the *forty-two* days' passage from Macao to Singapore, we had the wind dead on end for about *thirty-eight* days, and the aggregate amount of the currents was 580 miles against us during the passage."

From China, bound for India or for Europe.

During the N.E. Monsoon and a part of the S.W. Monsoon, the course through the China sea to the straits of Singapore, Banka, or Gaspar is direct, either by the Inner or Outer Route, already described; but in May, June, July, and August, when the S.W. Monsoon is at its height, one of the Eastern Routes must be adopted; in every case, when bound to Europe, it is desirable to enter the region of the S.E. trade-wind as speedily as possible, and then stretch away to pass

well to the southward of Madagascar. Having taken the Inner or Outer Route, the Indian Ocean must of course be entered by Sunda strait; but by the Eastern Routes that ocean will be entered by the strait of Ombay, Sapie, or Allass, according to circumstances.

During the N.E. Monsoon.—Bound southwards, the Inner Route is generally the better of the two, and the coast of Cochin China should be made off cape Varela; thence the course will be towards Pulo Aor; and, if bound through Banka strait, cross the equator in about Long. 105½° E.; or if through Gaspar strait, from Pulo Aor steer to pass Toty island, about 15 or 18 miles to the eastward, and thence make for the strait.

But in March and April the Outer Route is preferable, since the weather is finer and the winds more favourable than by the former route; in this case from Macclesfield bank steer towards Pulo Sapata, being well to the eastward of it on the parallel of 10° N., after which approach it cautiously if uncertain as to your position; intending to take Gaspar strait during these two months, you will pass between the Natunas and Anambas islands.

During the S.W. Monsoon.—Bound for the Bay of Bengal, a good sailer would probably beat down the China Sea by the Inner or Outer Route, and arrive at her port quicker than by taking one of the Eastern Routes; but the latter are preferable when bound for Europe, or the west coast of India.

The First Eastern Route is by the way of Mindoro strait, passing E. or W. of Appo shoal according to the wind, thence through Basilan strait,—and by the Molucca passage or by the strait of Gillolo, according to circumstances; but sailers must generally take the latter, and probably during the height of the Monsoon it is the best for any ship; thence by Pitts passage make for the Ombay passage, and so into the Indian Ocean.

The Second Eastern Route is adopted from the middle of May to the end of July; it lies to the eastward of the Philippines; thence make for Pitts passage by either Dampier strait or the Gillolo passage; then by passing between Boeroe and Ceram, the Ombay passage leads directly into the Indian Ocean; but if Salayer strait is taken, then pass through either Sapie or Allass strait, and so across the Indian Ocean,—or for the west coast of India.

The *Great Eastern Route* to China, round the south of Tasmania or through Bass strait, is very rarely if ever adopted at the present day.

The Passage between Hong-Kong and Shanghai.

Vessels from Hong-Kong bound for Shanghai, in the N.E. Monsoon, should be in good condition for contending with rough weather, and for carrying sail. Either the Lyemun pass, or the Lamma channel can be taken, the latter being preferable for a large vessel; when clear of the islands the wind will generally be found to

be about E.N.E., or as the line of the coast trends, and when the Monsoon is not heavy, periodical changes of wind occur; at such times vessels should be close in with the land early in the morning, and tack off shore at about 8 A.M. standing off till about 2 P.M., and on the in-shore tack standing boldly into the coast, making such arrangements during the night as will bring the vessel in a position in-shore again in the morning. When the Monsoon is moderate, vessels should not stand far into the bays, as they will, by so doing, experience light winds and oftentimes calms; and, on the contrary, when the Monsoon is strong, they should stand in as far as possible into the bays, and then not stand farther off than is actually necessary, especially as the changes of wind above alluded to seldom occur at such times it must also be borne in mind that vessels almost always go faster in-shore than they do off, as there is a ground-swell heaving after them when in with the land.

During the severe Monsoon gales, which last about three days, vessels should seek shelter in one of the numerous good anchorages to the westward of Breaker point, when, upon the breaking up of the gale, they can make a fresh start, and perhaps get round Formosa before encountering another, especially after the month of November. Having reached Breaker point, stretch over for the south end of Formosa, and upon getting to the eastward, the wind will be found to veer northerly, or more as the coast of Formosa trends, and a good sailing vessel will be almost sure to fetch the South cape, or Lambay island to windward. Upon getting in with the land, light variable winds or calms are often met with; but the strong S.W. currents will very soon drift a vessel down, when she will find the breeze coming on fresh again. In passing the South cape in the day-time, keep close in to the land, and the nearer the shore the stronger the favorable current—there being no hidden dangers. In going round in the night, however, and when there is no moon, it will be advisable to pass to the southward of the Vele Rete rocks, and tacking to the N.W. when nearly in the longitude of Gadd's reef, or sooner if it is daylight, as the South cape of Formosa is very low and rather unsafe to approach in a dark night; and again when a gale comes on and a vessel is obliged to heave-to, being to the westward of the cape, and near it, a strict look-out should be kept during the night, as several vessels under these circumstances have found themselves to the eastward of the cape in the morning, having been drifted to windward during the night and passed probably within a dangerous proximity of the Vele Rete rocks. The current sometimes sets with incredible velocity round the cape, and then up northward along the coast, and the stronger the gale the stronger the weather current, gradually diminishing in strength towards the north end of Formosa. After rounding the cape vessels should work short tacks along the east coast of Formosa, keeping close in-shore to get the benefit of the current.

Having weathered the north-east end of Formosa (the wind not having veered to the eastward, as may be sometimes the case) keep between the meridians of the Barren islands and the islands off the north-east of Formosa, not stretching in for the coast of China until able to make a lead in for Video or Leuconna island.

Regarding the passage to or from Shanghai in a fair Monsoon, little can be said, excepting that coasting vessels, when without observations, are in the habit of sighting the land to verify their reckoning. In the N.E. Monsoon there is a constant current down the coast, running with more or less velocity according to

the strength of the wind, and the wind generally blows along the line of coast *i.e.*, E.N.E. from Hong-Kong to Breaker point; N.E. in the Formosa channel; and N.N.E. from Formosa northwards, The first part of the Monsoon is very strong, and frequently in the month of October it is almost an incessant gale; at a later stage, from January to May, S.E. winds are not uncommon, and they become more frequent as the season advances; there is also much thick weather in the latter part of the Monsoon; and a S.E. wind to the northward of Formosa almost invariably brings a dense fog with it.

The passage from Shanghai to Hong-Kong in the S.W. Monsoon is very tedious from the frequent alternate calms and squalls, with a constant strong current up; coasting vessels generally use their kedge when there is not sufficient wind to make any progress. In working down it is well to keep in with the coast, stretching into bays and by headlands, to get out of the current, if there is sufficient wind to preclude the possibility of getting becalmed.

Captain James Turnbull, of the *Glen Clune*, a frequent contributor to the *Mercantile Marine Magazine*, beat up the China Sea in September 1864, against the N.E. Monsoon, and then worked from the S.W. cape of Formosa to Shanghai in 10 days, by following the great Japan current; this, he states, may be a sufficient reason for giving a detailed account of the latter portion of his passage.

"The object of nearing Formosa, is to get into an easterly set, in-shore, working round and joining the permanent great stream from the Pacific on the east side near Botel Tobago. This set is found as soon as the N.E. Monsoon has set down the Formosa channel, impelling the water and thus making it perform the entire circuit of the island, down the west and up the east coast. While working off the south coast, wind northing, stood right for the Bashees, there tacked and fetched Botel Tobago, when we were fairly in the Japan current; temperature of water 83°, average daily set 30 to 36 miles N.N.E., and made 70 to 80 miles per diem. From the East cape, too many vessels still commit the mistake of working to the northward, direct for Shanghai, whereas the current sets N.E.-ly over towards the Hoa-pin-su group. Follow it, drawing for its western edge a curve line from the East cape to 30 miles west of Hoa-pin-su, and on the east side of the Linschoten or Cecille group; its eastern edge cannot be so well defined, but draw a line from Kumi to the east of Raleigh rock, and then past Sulphur island and west of Lu-chu group. The reason the western edge is better defined, is that it follows a sudden rise of the bottom, from ocean depth to about 50 fathoms. If you have an atlas on board, you will find the Japan stream placed 2° and 3° further S.E.-ly, that is just where a vessel would get the back eddies southwards,—any representation that I have seen of it being merely from the guesswork of generalisation, not from actual observation. When the winter has set in, the temperature is a good guide on its N.W. side; but in summer and fall, the heat of the water right up to the inshore set of the China coast is nearly the same, 81° to 82°. From Botel Tobago to off Sulphur island I beat up in six days, then tacked, heading N.W. by W., and in two days fetched the lightship.

"On making the Barren islands, as nearly the whole flood tide sets S.W., keep

to windward and do not be tempted to seek shelter under the Saddle islands. Either work in the open sea under a press of sail; or if possible, stand on until near the Amherst rocks, when, if dark, anchor. You will have rough riding, but the pilot boats and coasters do so at all times in preference to seeking shelter to leeward, as in spite of the sailing directions it is difficult to get back."

On Making Passages between China and Japan.—Captain D. Scott says:—As regards the passage to and fro, our usual plan, after leaving the lightvessel at the mouth of the Yang-tze Kiang, with the wind favourable, was to pass close on either side of the Amherst rocks, thence shaping a course for Tsu-sima in the strait of Korea; and having passed that island on the port hand, to steer so as to go midway between the Hornet and Oki islands, as by so doing we kept in the strength of the current; but, sometimes—owing to the wind keeping well to the eastward—we were forced to the northward of this track, and had to go between the island of Quelpart and the Korea coast,—which passage we found quite safe, with a rattling current in our favour. After getting beyond the Hornet rocks, steer for the coast of Nipon about cape Gamaley, behind which is a very high peaked mountain, visible in clear weather fully 60 miles off; and in order to make your course good, it is necessary to allow half a point to the eastward. for the set of the current, until you get as high as 39° 30′, north of which a whole point will not be too much; for the current then begins to set N.N.W., which, with strong southerly winds, will, in the course of 24 hours, set a vessel from 40 to 50 miles off her position, by dead reckoning.

It is very necessary to guard against the current in cloudy or hazy weather, when good observations cannot be taken, before making the land; for, notwithstanding the allowances we always made for this set, we invariably found our vessel to the northward, generally coming in towards the islands of U-Sima and Ku-Sima, although steering a course for the western shore of Japan.

The above-named islands are an excellent mark for the entrance of the strait of Tsugar, and can be seen from 25 to 30 miles off, in clear weather; a vessel can pass on either side, or go between them, as they are clear all round; but it is best always to leave them on the port hand, or to the northward, as they are nearly due east from Matsumae point, which forms the north-western boundary of the strait.

We think a stranger ought not to enter this strait at night, if bound to Hakodadi because, should the wind fail (as it often does), or were he to mistake the different points of the land, his vessel is almost certain, in either case, to be driven through, into the Pacific, and a week may be lost in endeavouring to get back again.

On making the land in the day time, the best way is to stand close up to cape Tsiuka, about 18 miles from Hakodadi, on the northern side of the strait, from thence keeping the northern shore aboard, till, getting up towards Mussel point, you will have an eddy current in your favour, and will be able to bring up, should the wind fail, so as to hold on till a breeze springs up again.

There were two *buoys* placed off the end of the reef when we left (in January 1862), both painted *red*, and bearing from each other S. ½ E. and N. ½ W. nearly, distant about three-quarters of a mile; but in 1871 a light-vessel was moored in

the port of Hakodadi. The vessel exhibits a *fixed white* light, at an elevation of 36 feet above the sea, visible in clear weather from a distance of 10 miles.

The vessel has two masts, carries a red ball during the day, and is moored in 7½ fathoms water, at the extremity of the bank extending in a northerly direction from the peninsula of Hakodadi.

The approximate position is given in Lat. 41° 47′ 30″ N., Long. 140° 44′ 39″ E. of Greenwich.

A vessel leaving Hakodadi for Shanghai, will have some difficulty at times in getting through the strait, owing to the prevailing westerly winds; we are inclined to think it advisable, nevertheless, to go that way always, in preference to taking the passage outside of the Japan islands; for besides a difference of 300 miles in the distance,—by Van Dieman strait, more stormy weather may be looked for, and the currents are much stronger against you; certain it is, that all the ships which have taken the latter route, either way, have made long passages.

Our plan on leaving Hakodadi, with the wind between West and S.W., was to stand over towards Mussel point, on the opposite side of the bay, and after rounding it as close as we could with safety, work close in along the bay, making as short tacks as we could, so as to keep in the eddy current; by so doing, we generally managed to reach close up under cape Tsiuka before nightfall, where there is very good anchorage, in from 6 to 12 fathoms water, abreast a little village,—the cape being to the southward, rather less than a mile distant. We found this the only safe anchorage in the bay, because a vessel can easily get under way from there, should the wind happen to chop round to the eastward suddenly, and you lie with very little strain on the cable, on account of the eddy which sets out to the S.E. round the cape; but, where the anchorage is marked on the Admiralty chart of the strait, should a vessel be caught with an easterly breeze, she would have some difficulty in working out and would stand a fair chance of driving ashore, as the bottom is hard sand, while at the other place it is a kind of mud, being the debris of the adjoining mountains. Should the wind continue westerly till the following day, by starting at daybreak, and working along the northern shore as far as Matsumae point, you will from there be able to clear cape Greig, on the south side, by standing out on the starboard tack:—the wind is likely to favour you a point or two on opening out the mouth of the strait, so as to give you a chance to make a clear offing. The northern shore of the strait, between cape Tsiuka and Matsumae point is rather foul, but a vessel has no need to stand too close in there, as the current slacks considerably after getting round cape Tsiuka. Having cleared the strait—and your vessel is as far south as 37°—should the wind still be on the southern cant, it is advisable to keep in towards the Japan shore, so as to pass inside of the Oki islands, as by so doing, a vessel is out of the prevailing current, and is likely to have a slight set in her favour, all along shore, as far as the Hirado channel; we worked along that shore several times, passing inside of Mino-sima, Colnet and Obree islands, and found the coast clear of dangers, until close to the last-named island (Obree)—between which, and the land there is a small rock, with a considerable reef round it; the rock itself stands from 8 to 10 feet above the water, and bears from Obree E.S.E.; during the night it might be taken for a small vessel or a junk. It is not laid down on the old charts; but is noticed in the China Pilot, in the narrative of Her Majesty's ship *Saracen*, from Hakodadi to Nagasaki in 1855.

After passing this place, a vessel will have to stand into the strait of Korea; but as there is a survey of this coast going on at present, we may hope that when the new chart comes out, there will be a good channel laid down for vessels inside of the Goto islands, so as to avoid the strong current in the Korea strait, when the wind is westerly.

Once clear of this strait, the passage across to the coast of China is seldom tedious, as the Monsoons, in general, blow northerly and southerly,—from 3 to 5 days is about the average passage; but it is often made in 36 hours, when bound northwards.

The best landfall in either Monsoon, is Shaweishan island, or the Amherst rocks, near which you can anchor in from 6 to 7 fathoms, should the wind fail,—and thus you may sometimes save a tide or two. A vessel coming in towards the Saddles, during the northerly Monsoon, will find a much stronger tide and current setting to the southward, than another which gets close up to the Amherst rocks.

We found the passage from Shanghai to Hakodadi shorter and easier to make, than the return one,—as might be expected from the current in our favour. Our quickest run to the northward, was 9 days in May; the longest, 16 in October; the best downwards was 11 days in November,—whilst our worst was 29 days in June; but a passage has been made in 6 or 7 days. (See *Mer. Mar. Mag.* Vol. X, 1863).

Routes from Singapore to New Caledonia and the N.E. Coast of Australia.

*November to March inclusive.**

Southern Route:—Vessels bound to the south-eastern Colonies of Australia almost invariably adopt the Southern Route at all seasons of the year, entering the Indian Ocean by the strait of Sunda. The passage to Sydney, under very favourable circumstances, has been made in seven weeks, and that to Melbourne in a few days less; but the average is between nine and ten weeks. The passage to Port Curtis or New Caledonia will occupy ten days or a fortnight more, if no intermediate port is touched at. None but staunch and well-found vessels should attempt the passage.

Vessels leaving Singapore during the season from November to March will carry northerly or N.W. winds to the southward of Banka and Billiton; after which West and W.S.W. winds may be expected, and if these should prove strong and steady, it would be advisable to bear up at once for Bali strait, as much loss of time is experienced by attempting to beat out through the strait of Sunda during the spurts of westerly wind, which sometimes hang at S.W. for days together. Indeed, commanders who have had opportunities of testing both

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* These remarks by a practical seaman originally appeared in the Singapore *Free Press*, and subsequently in the *Nautical Magazine* for 1859.

straits at this season will be disposed to run at once for that of Bali on leaving this port.

Bali strait has latterly come to be much used by the homeward bound Dutch ships from Java,—even vessels that have loaded at Batavia running down nearly the whole length of the island to avoid a dead beat out of the strait of Sunda. Pilot cutters are always cruising during the season under the lee of the land to the northward of Bali strait, as the commanders of the Dutch Indiamen are under instructions not to pass through without a pilot; but his assistance is scarcely necessary, as there are no hidden dangers in the narrow part of the strait. All Dutch ships anchor at Banjoewangie for live stock and fresh water; the latter is particularly good, and easy of access, as it is led down from the spring in the mountain by an aqueduct, which is carried out into the sea beyond low water mark. As good water is scarcely attainable by shipping on the north coast of Java, this convenience may have something to do with the popularity of the strait. There is never any difficulty in getting out of the strait to the southward at this season, even with a S.W. wind, as the strait opens to the S.E.

The S.E. Trade will be met with in from 10° to 16° S. Sometimes there is only an interval of a few hours between the cessation of the Monsoon and the setting in of the Trade wind. But there is more generally a week or ten days of calms, light airs, and occasional squalls from the southward before getting the regular Trade. It extends at this season as far as 32° S., and S.E. winds are often experienced as far as 40° S., when it will be advisable to stand on into the westerly variables, which prevail about that parallel.

Vessels bound to Port Curtis or New Caledonia should pass to the southward of Tasmania, as easterly winds prevail in Bass strait during the summer season. In those high latitudes the winds are sharp and bracing, but a native crew will not suffer much if well clad. After passing Tasmania, a vessel bound to Port Curtis should not approach the east coast of Australia nearer than 300 miles until near the parallel of Sandy Cape (24° 40′ S.), as N.E. winds prevail along shore. A direct course may be made to New Caledonia after rounding Tasmania. Should supplies be required before the passage is completed, Hobart Town is the most convenient port to touch at.

Eastern Routes:—The Eastern or more direct Routes to Port Curtis and New Caledonia can only be adopted between the middle of November and the middle of February—when there is a tolerable certainty of meeting with favourable winds throughout the passage. The route to the north of New Guinea, which, from the first half being identical with that followed by ships bound to China by the Eastern Passage, may be called the "Eastern Passage Route, is best suited for vessels over 150 tons burthen. Smaller vessels, more especially if the number of people on board is so great as to render supplies of wood and water necessary during the voyage, should take the Torres Strait Route, which, indeed, is the only one that can be adopted with ordinary safety by vessels under 80 tons burthen.

Eastern Passage Route between Singapore and N.E. Australia:—The first half of this route is so well known, from its being frequented by vessels bound to China during the westerly Monsoon, that it will only be necessary to notice the ports on this portion of the route that are most convenient for obtaining

supplies, should they be required. These are Bonthain, at the south extreme of Celebes; and Geby, an island in the Gillolo passage. The former has a secure and convenient anchorage during the westerly Monsoon: and fresh water, wood, fruits, vegetables, and live stock can be obtained on very moderate terms. The water is particularly good as it is supplied by springs from the mountain range, at the foot of which Bonthain is situated. Geby also has an excellent anchorage, and the water is of the best quality; but in other respects it is not so good a refreshment port as Bonthain, besides which, it is a little out of the way if the most direct route (through either Dampier or Pitt strait) is taken. But it is the last port on the route at which it will be advisable for small vessels to touch, as Port Dory is not convenient, and the natives of the islands further to the eastward, although extremely anxious to trade, are a formidable race, and intercourse with them had better be avoided.

The passage to the eastward along the North coast of New Guinea is well known to the whalers of the Pacific, who, when they have been drifted off their fishing ground by easterly winds, recover their position by taking advantage of the westerly winds that prevail at this season near the Line, and which extend far into the Pacific. But these experienced navigators rarely publish their notes, being satisfied with making their passages in the quickest possible time, —not caring whether others adopt their routes. It will therefore be necessary to look up other sources of information for those details which will naturably be expected under the circumstances.

The first navigator that passed along New Guinea from West to East was the celebrated Dampier, who became aware of the existence of a westerly Monsoon in these seas while cruising with the buccaneers: on their return to Europe from the West coast of America, in the year 1687, they touched on the coast of Celebes, and, departing in the month of November, met with westerly winds, which obliged them to stand to the south, past Timor, until they reached the N.W. coast of Australia. Twelve years afterwards, Dampier returned in a king's ship, the *Roebuck*, for purposes of discovery, and leaving Timor on the 12th of December, sailed for the coast of New Guinea with westerly winds, and passing through the strait that bears his name, reached the north coast, along which he ran as far as New Britain. The westerly Monsoon was very strong in that year (1699) often amounting to a "fresh gale," and they were unable to commence the return voyage until near the end of March. The westerly winds, however, did not cease until a month afterwards, but they found a current setting in the opposite direction at the rate of 1 mile an hour.

The next authority for the winds during this season is Captain Thomas Forrest, who sailed from Balambangan for the north coast of New Guinea in November 1775, in the *Tartar*, galley, belonging to the East India Company; he was on the coast or in its neighbourhood during the five following months. As Captain Forrest seems to have published his journal as it was written, the details respecting the winds are very full and satisfactory. The following is an abstract:—

Day.	Winds.	Strength and Weather.	Remarks.
Nov. 9	S.W.	Fresh.	Left Balambangan
10	N.W.	Calm, lt. br.	
11	S.W.	Fresh.	
13	N.N.W.	„	Left Cagayan Sulu
14	North.	Moderate fine.	
17			Arr. at Sulu
18	S.W.	Squally.	
19	N.W.	Fresh.	Left Sulu
20	N.N.W.	„	
21	E.N.E.		
22	N.E.		
23	West.	Moderate.	
25	„	„	
28			Passed Ternate
30	West.	Moderate.	
Dec. 2	N.W.	Fresh.	
4	„	Squally, rain.	
6	W.N.W.	Squally.	
7	West.	Fresh.	
8	S.W.	„	
9—10	N.W.		
14	N.E.		Arr. on coast of New Guinea
16—18	N.W.	Fresh.	Arr. at Salwatty
19	„	Hard Gale.	
20	Var.	Rn., cm., fine	
22	N.W.	Squally.	
23	West.	„	
24	N.W.	Rain.	
25—26	West.	„	
27	Var.		
28	E. & N.		
29	N.W.,E.		
30	N.N.W.	Fresh gales.	
Jan. 1	North.	Gales.	
2	Var.		
4	„	Light rain.	
5		Fair.	
8	West.		Left Salwatty, Current E.
12	N.N.W.	Fresh gales.	Night fine
17	W.N.,E.	Rain.	
18		Fine.	
20	N.W.	Moderate.	
21	„	Squally.	
22	„	Mod., squally.	Heavy sea
23	„	Gale.	
Jan24		Gale ended.	
25—26	N.W.	Fresh.	
28	„	Squally.	
29	„	Rain.	
30	„	Fine.	
Feb. 2	„	Moderate.	
5	„		
6	„	Fine.	
7—10	Sy.	„	
10—17	E.&S.E.	„	
19	Wy.	Squall., rain.	
20	Land & sea breezes.		
23	N.E.		
24	N.W.	Fine.	
Mar. 1	Var.	Fine since	24th.
3	N.E.		
4	N.N.E.		
5	W.S.W.		
6	North.		
7	S.W.		
9	Calm.		
10	S.W.		
11	N.W.		
12	„		
16	From W.N.W.	12th Wy.	Squalls. Heavy sea at entr. of harb. Efbe on Mysol.
17	West.	Squall., rain.	
19—23		Fine, light.	
25	S.E.	Squally.	
28—29	South.	„	
30	East.		
Apr. 1	Calm.	Rain.	
3—5	West.		
6—8	Calm.	Rain.	
9—10	S.W.		
11	N.N.W.	Fine.	
13	N.W.		
14	S.E.	Rain.	
15	East.	Squally.	
16	E.N.E.	Hard gales.	
17—27	Var.		
27	West.		
28	N.W.		
29	„	Fresh.	
30	„		
May 1	South.	Fine.	

The variable winds here recorded are partly accounted for by Captain Forrest being in harbour a great part of the time he was on the coast; but from notices that appear in his journal, it is evident that he supposed a strong Monsoon to be blowing in the offing.

The next authority is Captain (now Admiral) Keppel, of H.M.S. *Meander*, who left Port Essington on the 1st December 1849—with the garrison and remains of the establishment—with the express object of proceeding to Sidney round the north side of New Guinea, and of putting the practicability of the route to a test. He touched at Banda, and afterwards had to beat to the westward between Ceram and the S.W. coast of New Guinea against a strong breeze with a proportionate sea, in order to get sufficiently to windward to enter Pitt strait, formerly much used by ships making the "Eastern Passage" to China, but latterly the Gillolo passage seems to be preferred.

The *Meander* entered Pitt strait on the 21st of December, and passed through during a single tide. "On emerging from the straits, we found the wind still blowing fresh from the westward, with a following swell, and a strong easterly

set; but as our course now lay in that direction, before the following morning we were many miles on our voyage, and thereby missed seeing a large portion of the northern coast of New Guinea."*

December 24th.—"We passed Point D'Urville. It had been our intention to visit Humboldt bay, as laid down in the chart, that we might see something more of that country and its people: but to our disappointment, the strong current carried us past in the night."† The *Meander* reached the Admiralty islands on the 29th of December, and remained at this and the neighbouring group, New Ireland, until the 12th of January, wooding and watering, and carrying on a great barter for curiosities with the natives. This impairs the utility of the voyage as a test of the route, or rather of the rapidity with which the voyage can be made. And unfortunately no details are given of the passage from New Ireland to Sydney; but from the track chart it appears that she must have met with easterly winds in about 10° S., as she could not weather the east end of the Louisiade group without tacking, and her course after getting round is laid down as S.S.E. for the few miles that remain before the margin of the chart is crossed. She arrived at Sydney on the 7th of February 1850, so that the run from Pitt strait may be estimated at 34 days. Of this 27 days were occupied by the portion of the voyage from the Louisiade to Sydney; and as Port Curtis is only half way, and so far to leeward that a ship leaving cape Deliverance with the wind at S.E. by E., can fetch the port without tacking, 14 days will be a liberal estimate of the time that would have been occupied in making the passage to Port Curtis.

The deficiency in the *Meander's* journal is partly supplied by that of H.M.S. *Rattlesnake*, which left the Louisiade group for Sydney on January 8th 1850, while the *Meander* was at New Ireland. For the first few days the wind varied from N.E. round by the northward to S.W., and they did not get the Trade wind until they reached 20° S., when it blew a steady breeze between E.S.E. and S.S.E. enabling them to fetch Sandy Cape, about 120 miles to the southward of the parallel of Port Curtis. The *Rattlesnake* made the passage from the Louisiade group to Sydney in 28 days; but the date at which she made Sandy Cape is not given. It is evident that the sea which lies between the Barrier Reefs and New Caledonia must be considered a region of variable winds during the period in which the S.E. Trade wind is held in abeyance by the westerly Monsoon.

The following paragraph on the winds in this neighbourhood is extracted from a paper "on the Steam Route through Torres Strait," in the *Indian Archipelago Journal* for 1851, p. 493. Several additional passages from West to East by sailing vessels have been made since that time, but the additional experience has not rendered any correction necessary.

"Hitherto Torres Strait has only been navigated generally by ships passing from East to West; but on three or four occasions vessels have sailed through in the opposite direction. This passage, however, has always been attended with great delay, as it was found that the westerly Monsoon, which prevails from November to March (inclusive) in the seas of the Indian Archipelago, does not blow steadily within Torres Strait, where it only appears in spurts of eight or

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* Keppel's Voyage of the *Meander*, Vol. II, p. 190.

† Ibid, p. 201.

ten days duration about the change of the moon. Occasionally these westerly winds blow with considerable strength; but they are usually unsteady, in fact mere interruptions of the S.E. Trade wind. These spurts may be expected in November and in the following months until March. Sometimes, but rarely, they are encountered as late as April. In this month of 1844, the writer, while *en route* from Sydney to Port Essington by the 'Middle Passage,' met with a spurt of N.W. wind when in Lat. 19° S., which lasted from the 24th to the 29th of the month. It blew a steady six-knot breeze throughout this period, and the writer was subsequently able to trace it to Port Essington, the Arrou islands, and Macassar, where it blew with some strength, and was remarked as an unusual occurrence so late in the season. This period appears to be the fine season in Torres Strait, (as is the case in the Moluccas), at least to the south of Cape York, as this is the time chosen by the Murray and Darnley islanders for making their annual excursions to the islets which lie off the N.E. coast of Australia. The question of winds is, however, of little importance when steam routes are under consideration, especially on the present occasion, as parties interested will be satisfied on learning that no winds have ever yet been experienced in Torres Strait which are calculated in the slightest degree to interfere with the progress of steamers in either direction."

We have another authority for the winds and currents on the north coast of New Guinea in Lieutenant De Bruijn-Kops, of the Dutch Navy, who visited the coast in the Government schooner *Circe* during the same season as the *Meander's* visit, but much later, and the details are not without interest. The object of the voyage was to examine Humboldt bay with a view to settlement. The *Circe* ran down from Java to Amboyna with the West Monsoon, and left the latter place on the 16th December 1849, for Ternate, where they were to receive their instructions; but, meeting with strong N.W. winds (the same spurt that the *Meander* experienced in that neighbourhood) and a strong current setting to the eastward, they were forced to put into Wahaai, a port on the north side of Ceram, where they heard of the *Meander* having passed. This was on the 24th of December, and they lay wind-bound until the 13th February, when they put to sea, and reached Ternate on the 25th. It was not until the 15th of March that they finally sailed for New Guinea, and arrived at Geby, an island in the Gillolo passage, on the 19th. Here they were joined by a fleet of Molucca prahus, belonging to the Sultan of Tidore, which accompanied them for the remainder of the voyage. Leaving Geby on the 26th March, they passed through Dampier strait, were abreast of Cape Good Hope on the 22th, and entered the Great bay on the 31st, where they anchored at Port Dory. The direction of the wind from leaving Ternate is not given, but it must have been favourable throughout.

The *Circe* remained at anchor at Port Dory until the 25th April waiting for the flotilla of prahus, which did not join until the 20th. The winds during their stay are stated as follows:—"From the 1st to the 22nd of April the wind for the most part was S.E. and N.E., which towards evening was often alternated with N.W., seldom with S.W. winds." Weather fair, but occasional showers. On the 25th, left Port Dory with light westerly winds, and stood into the Great bay, where several trading stations were visited, and on the 11th of May they anchored at the N.E. point of the bay. During this period, regular land and sea breezes were experienced, the first at S.E. and the latter at N.W., but an adverse current was found in the offing, setting W.N.W. On the 24th of May a strong breeze

set in from S.S.W., which in four days carried them up to Humboldt bay; but as they were about to enter, the wind shifted to S.E. and E.S.E., with a chopping sea, and the *Circe*, being a slow and far from weatherly vessel, was forced to bear up and return to Amboyna.

The details of the latter portion of the voyage given above will not be of much use to navigators, who are supposed to adopt this route during December, January, February, and part of March, the only period in which westerly winds can reasonably be expected to remain steady; but they are interesting as showing the possibility of fast and weatherly vessels being able to make the passage even late in the season.

The *Meander* lost the strong westerly wind and favourable current when she approached the Admiralty islands. It is therefore a question whether she would not have made a more rapid passage by running down her easting along the Line as far as Pleasant island, or even farther, if the wind held, when, by getting into the S.E. Trade, she would have had a free wind for the remainder of the passage. That the westerly winds blow thus far the writer of these notes is aware from his own experience, having crossed the Line at the latter end of December, 1847, with a westerly gale that had brought the ship under close reefed fore and main top-sails, and the squalls were so heavy that the fore top-sail had to be taken in twice during the night. We had left Sydney, bound for Hong-Kong, December 8th, and met with N.E. winds, which obliged us to stand off the land for about 200 miles, when we got S.E. winds, which carried us to 14° S., when the wind came to the westward, light at first, but gradually increasing as we approached the Line. We made Pleasant island on the 31st December, passed to leeward of it, crossed the Line the same night, and lost the westerly wind between 6° and 7° N., getting the N.E. Trade almost immediately after.

New Caledonia.—As regards vessels bound to the French settlements in New Caledonia by the Eastern Passage Route, there can be no doubt that it would be advisable to run down their easting along the Line, even as far as the meridian of 150° if the wind holds, as the Trade will be met with at this season, when well to the eastward, in about 10° S., blowing steadily between East and E.S.E. as far as 20° S.; this will enable them to lay to windward of the New Hebrides group, which, with New Caledonia, seems to be the barrier between the trade wind of the South Pacific and the variables of the Papuan Sea.

Torres Strait Route.—The Torres Strait Route to Port Curtis is the most direct, the distance being 3,400 nautical miles. This route is better suited for small than for large vessels, for although the depth of water is sufficient for the largest ships, and the navigation is no where more difficult than that of the straits of Malacca between Pedra Branca and the North Sands, still commanders who have been chiefly accustomed to open sea navigation often feel uncomfortable. But, on the other hand, it is the only route that can be adopted with safety by vessels under 80 tons barthen, unless they carry a much larger supply of water than is usually the case, for there is no place near the Eastern Passage Route, after passing Port Dory, where a small vessel can with safety obtain water,—owing to the formidable numbers and character of the natives, who, although friendly enough towards large vessels, might be tempted to lay violent hands on small craft.

The track as far as Bonthain will be the same as that of the Eastern Passage Route, but after passing through Salayer strait a south-easterly course has to be

followed towards the north side of Timor, along which the track passes. If supplies are required, Manatuti, a Portuguese settlement about 80 miles east of Dilli, is the best place to touch at, as the road is sheltered from the westward by a point of land; but if the breeze is fresh from any point to the northward of West, it will not be safe to approach the coast very close. In that case, the bay on the west side of Kissa, or the south coast of Moa, will be the best place to visit, as small vessels can lie close to the shore, and the anchorage is perfectly safe at this season. Fresh water, poultry, fruits, and vegetables, including excellent yams and sweet potatoes, can be obtained here in any quantities that may be required on very easy terms, as cash is almost unknown and the natives gladly exchange their produce for small cutlery, calico, pieces of bar iron of the size required for a parang, empty bottles, old cloths, buttons, and other trifles. At Kissa there will be a slight delay, as the chief villages are on the east side of the island, and two guns should be fired as a signal for trade. At Moa, the best place to touch is a bay on the south coast, about four miles beyond the S.W. point, where there are four villages close to the shore—of which Patti is the most important—and an old Dutch fort. The chiefs and principal inhabitants of Kissa and Moa are Protestant Christians; Dutch missionaries resided at both places during the existence of the establishment at port Essington,—when intercourse was frequent,—the natives proving particularly friendly towards Europeans.

The Macassar prahus employed in the trepang fishery in the Gulf of Carpentaria (high-sterned vessels, with the tripod mast) always adopt this route. They leave Macassar about Christmas, and generally touch at Dilli or Manatuti to fill up water and dispose of some native cloths, and also occasionally at Kissi, Letti, and Moa; but those that leave later in the season make one run of it, and sometimes complete the passage from Macassar to the Gulf in ten days.

Endeavour Strait seems to be the best entrance to Torres Strait from the westward, now that the survey has been completed. The following directions, which are extracted from the fifth volume of the *Journal of the Indian Archipelago*, will carry a vessel in,—by that channel where the least depth is 4½ fathoms at low water:—

"The western entrance of Endeavour strait is easy to make. At a distance of 120 miles to the westward the soundings begin to decrease from 36 fathoms, the usual depth across the mouth of the Gulf of Carpentaria, to 30, 20, and 9 fathoms as the strait is approached. The only precaution necessary to be taken when running for the strait is to avoid going to the north of the parallel of Booby island, as there are some shoals to the W.N.W. which have not been well examined, from being out of the usual track. South of this parallel the sea is believed to be clear of danger as it has been well explored. In clear weather Prince of Wales island, which may be seen from a distance of 30 miles, will probably be made before Booby or Wallis islands, which, although moderately elevated, are not visible from a ship's deck much more than 15 miles. There are several channels into the strait through the sand-banks which project from Prince of Wales and Wallis islands, and from the mainland, but the widest and most available is that which lies immediately to the north of Red Wallis island. By bringing Booby island to bear N. by E. mag., distant 11 miles, when Red Wallis will bear E. by S. ½ S., a direct course steered for the latter will lead clear into the strait between the spits which project from cape Cornwall and the Wallis

island, and will also clear two patches of 3 fathoms which lie in the channel. The depth is from 4½ to 8 fathoms. The strait is perfectly clear within, with the exception of the Heroine and Eagle rocks, which may easily be avoided; and, as it has been repeatedly examined and sounded in the course of the last eight years by Captains Blackwood, Stanley, and Yule, Endeavour strait may be considered as one of the best surveyed spots in the Eastern seas."

Nearly a dozen passages have been made from India to Sydney by way of Torres Strait, mostly at long intervals, with the exception of three voyages of the brig *Heroine*, Mackenzie, in 1844–5–6, but although no accident took place, the results were not sufficiently favourable to lead to a more general adoption of the route. All these vessels passed through the Barrier into the open sea as soon as possible, and were delayed by the variable winds, which are now known to prevail at a distance from the land. It was not until 1847 and 1848 that the inner passage along the land came to be tested by the vessel employed in attending Mr. Kennedy's overland expedition from Rockingham bay to cape York, when it was found that the Easterly winds often experienced outside the Barrier very rarely blow home on the land, and that N.W.-ly winds occasionally blow along the coast for days in succession. The Monsoon, however, more generally appeared in the form of a land wind, rising about midnight and blowing through the greater part of the following day, when it would fall calm until midnight. This *inner route*, too, has the advantage of having been accurately surveyed by the late Captain King, and of being perfectly free from coral, which is attributed to the fresh water from the rivers being carried along the coast by the tides. The navigation of the *inner route* is comparatively easy, owing to the landmarks being always in sight during the day, and often during the night also, for the weather is remarkably clear, this being the fine season. Showers are often experienced, particularly during the night, when the land breeze comes off, and much rain falls on the high land of the interior, as is shown by the volumes of fresh water poured out by the rivers.

Nevertheless, the passage along the coast from cape York to port Curtis will occupy more time than might be expected from the distance—a little more than 900 miles—for it will be necessary to remain at anchor during dark nights for the first 500 miles after leaving cape York, and if the passage is made in twelve days it will be a favourable run.

New Caledonia.—Vessels bound to New Caledonia by the Torres Strait route should enter by Prince of Wales or Bligh channels, and take the wide northern passage discovered and surveyed by Captain Blackwood, of H.M.S. *Fly*, the entrance of which from the Pacific is 40 miles wide, with regular soundings. Hence, along the south coast of New Guinea and the Louisiade, West and N.W. winds may be expected without interruption during December, January, and February, and probably much later, for the mass of high land produces a temperature which causes a rush of air towards the region of variables to the S.E.

The following memoranda are from the journal of H.M.S. *Rattlesnake* in December, 1849, and January, 1850, while completing the survey previous to sailing for Sydney:—

December 11th, 1849.—A light air from the N.W. (Darnley Island).

16th.—Since the 11th, light winds. This day "a strong N.W. breeze, which came on last night, and caused us to drag the stream anchor.

19th.—Left Bramble Cay with a fine breeze from the N.W.

20th.—Wind N.W. At daylight abreast of cape Possession.

21st.—Light north-westerly breeze.

28th.—Since the 21st, at anchor in Redscar bay. During the week "the wind was usually from the westward, varying between N.W. and S.W., and on one occasion had a sudden and very violent squall from the westward." This is the identical week during which the *Meander* made her longest runs on the north coast of New Guinea, with N.W. winds and a strong current in her favour.

January 6th, 1850.—"Our passage to the Duchateau islands (Louisiade group) a distance less than 400 miles, has been protracted [the *Rattlesnake* sailed from Redscar bay on the 31st December] by the prevalence of light winds, although these were generally favourable, or from the westward. Occasional calms, squalls, and rain occurred, but the weather generally was finer than during the S.E. Monsoon."—(Vol. ii. p. 60.)

The *Rattlesnake* left the Louisiade for Sydney on the 8th of January. This part of her voyage has already been spoken of in the notes on the Eastern Passage Route, but the following remarks by the historian of the voyage may be added:—"Our daily average progress during the passage to Sydney (which occupied a period of 28 days) was less than 50 miles.* The winds for the first few days, or until beyond the influence of the land, were light and variable, shifting between S.W. and N.E. by the northward, and accompanied by occasional squalls and rain. It became a matter of difficulty to determine when we got into the S.E. Trade; it was not until we reached Lat. 20° S. that the wind, light on the preceding day, but on this strong, with squalls, and rain, appeared steady between E.S.E. and S.S.E., and this carried us down to Sandy cape in Lat. 24° 41½ S."

Routes from Singapore to New Caledonia and the N.E. Coast of Australia.

May to September inclusive.

Direct Southern Route.—During this season the quickest passages have been made to the Australian colonies by the southern route; for although some delay is experienced in getting to the strait of Sunda against the S.E. winds there is no difficulty in passing through the strait into the Indian Ocean, where the trade wind is usually strong and steady as far as 28° S.; after which the westerly winds which blow with great strength to the South of that parallel soon carry a ship to her destined port. And as these winds curve round Cape Howe, and blow from the southward and S.W. along the East coast of Australia as far as the tropic, no difficulty will be experienced in reaching Port Curtis and New Caledonia at this season.

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* It should be mentioned that the *Rattlesnake* was a remarkable dull sailer. She was a frigate-built ship of 450 tons, and carried twenty-four carronades when a war vessel. She was rigged as a barque, and had a large poop built on her when she was fitted for the surveying service.

The only disadvantages connected with the route are the foul winds that will be experienced at first starting, and the inclemency of the winter season in high southern latitudes; where the cross seas which get up when the wind chops suddenly from N.W. to S.W., which often happens, are of a peculiarly dangerous character. This route, however, is so well known, at least as far as Bass strait, that it is only noticed here for purposes of comparison.

Northern Route.—The passage from Singapore to the Australian colonies by way of the North Pacific has never yet been tried, nor would it be advisable for any vessel bound to a settlement South of Moreton Bay to make the attempt, as great difficulty would be experienced in getting to the southward against the southerly and S.W. winds which prevail between the East coast of Australia and New Zealand, and which have much the character of the Monsoon that occurs at the same season in the Mozambique Channel.

Ships from China to the southern colonies by the Pacific route are often greatly retarded by these winds towards the conclusion of the voyage, which has made the route very unpopular of late, and it is not much used now except by vessels carrying native passengers, when it is an object to avoid the inclement weather of the winter season to the south of Australia. Ships carrying freight from China and Manila generally stand to the southward when they get the N.E. Trade and enter the Indian Ocean by the Gillolo passage and Timor strait, after which the southern route is pursued.

During this season the N.E. and S.E. Trade winds of the Pacific blow with steadiness and regularity, and ships pass from one into the other, on crossing the Line, without an interval of calms or variable winds. And as the S.W. Monsoon blows steadily between this port and the N.E. coast of China, the only point on which details are necessary is with respect to the facilities for running down sufficient easting in the northern variables to enable a ship to lay up across the Trades so as to fetch to windward of the destined port.

Log books, however, show that the winds are at least as favourable for making easting as those experienced to the south of Australia during the summer season. Commodore Perry, with the U.S. squadron left Shanghai for the Loo Choo and the Bonin group on the 23rd of May, 1853, and carried the S.W. Monsoon throughout the passage. He says—"as during the return voyage moderate breezes from S.S.W. to S.W. prevailed with warm weather, and as, in fact, the wind ever since the first departure from Napha (Loo Choo) had continued from the southward and westward, it may be inferred that the S.W. Monsoon extends as far north as the parallels of latitude in which the course of the ships laid."

The Kuro-Siwo or Japanese Gulf stream which is found in these latitudes will also materially aid a ship in making her easting. The entire report of Lieutenant Bent, the officer employed to observe the phenomena, is given on pp. 26–29. This singular current, with the water at a temperature of 86°, affords a clue to the mystery of the Bonin islands having an exclusively tropical vegetation, which has long been a puzzle to naturalists. It also accounts for the productiveness of the southern islands of the Japan group in sugar and other produce which is usually confined to intertropical regions. It will be well for a navigator making his easting to keep in this stream, which he may easily do with the aid of a thermometer, as it is supposed to curve to the southward after passing the Bonin group, and at the same time is likely to have an influence in producing favourable winds.

It is doubtful whether it would not be best to enter the Pacific by the Bashee

channel to the south of Formosa, so as to get at once into the stream of current; it is also doubtful how far a ship ought to get to the eastward before entering the limits of the Trade winds. Horsburgh, in a short paragraph which treats on the route of "ships from Macao to the N.W. coast of America, or to Australia," recommends getting into longitude 165° to 170° before standing to the southward of the parallel of 30° S., and in the case of heavy sailing ships this would probably be advisable; but fast and weatherly vessels may safely enter the Trades 10° to the westward of this point. It seems, too, that while the S.W. Monsoon prevails in the China Sea ships will make more easting by keeping between the parallels of 25° and 30°. This was the course adopted by the Spanish galleons, which made annual voyages from Manila to Acapulco, in South America, for upwards of century, and they had the benefit of a long experience.

Should water and refreshments be required during the passage, they may be obtained at Peel island, in the Bonin group, where there is a secure port on the west side of the island, which is much frequented by whale ships. There is a population numbering about 100, consisting of a few Europeans and Americans, and the remainder Sandwich Islanders, who grow vegetables and rear stock to supply the ships that call for refreshments. Turtle are also abundant. Further on, near the Line are the Kingsmill island and Pleasant island (the latter is in Lat. 0° 35′ S., Long. 167° 10′ E.,) both of which abound in refreshments and are much resorted to by whale ships.

The details given above will enable a reader to compare the routes and draw his own conclusions, as the distances to be traversed on both routes are exactly the same. Commanders of European vessels, when the crews are well provided with warm clothing, will probably still prefer the southern route, where there is more sea room: but commanders of country ships, or vessels carrying native passengers, are likely to incline to the northern route, where no cold weather will be experienced throughout the passage. Perhaps at some future day, when a Trade comes to be established with Port Curtis and New Caledonia, two ships may leave this port on the same day, the one taking the northern and the other the southern route,—and this, after all, will be the only safe test of the comparative merits of the two routes with regard to the time occupied in making the passage.

The following paper contributed by Captain Hunter to the *Nautical Magazine* in 1843, will form a fitting appendix to those just given. (p.p. 54-65); it describes the Wind, Weather, and Currents that may generally be expected in the Western Pacific, and shows that the Passage from Singapore to Sydney *may be made at all times of the year* by taking the North Coast of New Guinea, by keeping northward of the Equatorial current and making easting between the two Trade Winds.

Mr. Horsburgh briefly states that the West Monsoon, which blows regularly in the Indian Ocean, extends to New Guinea. This Monsoon blows as steadily, strongly, and regularly along the north side of New Guinea, at New Britain, New Ireland, and all contiguous islands south of the Equator, so far eastward as Malanta and the northern part of the New Hebrides, as in any part of the Indian Ocean whatever; and extending in a wind of gradually decreasing constancy and continuation from hence far eastward to the Society Islands and Marquesas. The limits in latitude appear similar to the Indian Ocean, from 1° to 15° S.,

occasionally to 19° S., and the period from the beginning of January until the end of March.

Having said thus much, as this is written principally with the idea of endeavouring to show the practicability of making passages to the eastward in the Pacific (instead of the circuitous route round New Holland), which I believe, has never been attempted by trading vessels, although performed by whalers continually, I proceed to state a few facts of such passages; and will first attempt to prove the practicability of making a passage to the eastward during the Easterly Monsoon in South latitude, or from April until December or January, by keeping to the northward of the equatorial current, and between the Trades or Monsoons.

In October, 1835, being off the Asia Islands, and wishing to make a passage to the eastward, winds light and variable and current running strongly to the westward, against which we could make no progress, stood to the northward, and on the 19th of October were in Lat. 2° 6′ N., Long. 134° 11′ E. Having lost the westerly current, pushed to the eastward between the parallels of 2° 15′ and 2° 34′ N. On the 27th were in Long. 147° E. From hence stood to the southeastward and made Matthias Island,—it being my object to cruise in this neighbourhood. On the 30th passed through St. George channel quickly, current favourable, and to the Treasury islands. Cruised here until 19th of December. Started with a westerly wind, which carried us to 169° 36′ E. on the 26th, having passed on the south side of Banks islands. Becalmed two or three days; then with variable winds, chiefly from E.S.E., proceeded to the southward and anchored in the Bay of Islands 15th January.

These passages were made at a season deemed impracticable, before the West Monsoon had set in steadily, by a southseaman of moderate sailing qualities, without using studding sails. The passage to the eastward may, I am convinced, be made at all seasons by pursuing the same plan; which is, as before stated, to keep to the northward of the equatorial current, and between the Trades or Monsoons. Here you will have a variable wind, chiefly from the westward, with a drain of favourable current at times.

Further to corroborate this opinion,—June 23rd, in 1° S. and 149° E., having been drifted from Matthias island and New Hanover by a westerly current of 2½ or 3 knots an hour, stood to the northward, got westerly winds on the Equator. With these made easting, and on the 27th reached 155° E. and 0° 45′ S. Made Bouka point soon afterwards; then found a current equal in stength to that at Matthias island. At this time the westerly current did not extend quite to the Equator.

Again, in September, 1840, being unable to hold on near the Admiralty islands, in consequence of strong westerly currents, stood to the northward, and when in 0° 24′ N. and in 146° E., proceeded to 2° N. before losing the current; then worked to the eastward, and stood to the southward on the east side of the Green islands, which are in about 156° E. The passage from Morty to Bouka has also been made in August by adopting the same plan. Although all these passages terminated in the longitude of the Salomon islands, it was not through inability to proceed farther to the eastward, but merely in consequence of this being the destination. More might be quoted tending to show that these line currents seldom extend northward of 2° N.

During the West Monsoon in South latitude it has been a common practice,

the last fifteen years, for ships to make passages from Timor to the Salomon islands; some returning at the commencement of the Easterly Monsoon, and others spreading over the Pacific. Last year, 5 ships, which had been cruising in the Indian Ocean, proceeded eastward between January and April: one along the Line to the eastward of the Kingsmill group, another to the Salomon islands and New Zealand, and the remainder to New Ireland and elsewhere. From all which I wish it to be inferred that any ship leaving Manila between the beginning of December and the beginning of March, or any port from which she can reach the North end of the Molucca or Gillolo passages, or Dampier strait, between the middle of December and the middle of March, will make a speedy passage to any part of the Pacific Ocean in East longitude; and that during all other seasons the passage is practicable by keeping northward of the equatorial current and between the Monsoon winds.

In the period of the West Monsoon northerly and N.W. winds prevail to the Cape of Good Hope of New Guinea. Passing eastward of this point the westerly wind will generally be experienced fresh and steady, with a current of 2 or 2½ knots running to the eastward, and extending from New Guinea shore to about 1° N. A ship may pass near the St. David islands without risk of losing this wind or current, and northward of Providence islands. From hence any of the passages may be chosen, according to discretion. That by the eastern Dampier strait, although, perhaps, the most direct if bound to Sydney, I should not recommend until the islands northward of New Guinea are more correctly inserted. If St. George channel be adopted it may be preferable to steer along the Line until in the longitude of the Admiralty islands; then pass to the south-eastward between these and Matthias island, thus avoiding the low islands and reefs to the southward. Sail could be carried during the night without fear. Keeping along the Equator there cannot be many undiscovered dangers, this track having been a good deal frequented of late years. The other route to the northward of the Salomon islands, when bound to New Zealand, the Feejee islands or anywhere to the eastward, appears to be the best. In the case of New Zealand, the tenth degree of South latitude should not be crossed until reaching Long. 171° or 172° E.; then steer to the southward on the west side of the Feejee islands, passing pretty near, as the easterly winds prevail far to the southward in January, February, and March; but by weathering the reefs near the south end of New Caledonia a passage may always be effected.

The westerly Monsoon in the Pacific, as in the Indian Ocean, is attended with cloudy overcast weather, squalls, and heavy rains. Some of these squalls are very severe, requiring all sail to be taken in when crossing the wind; even when running close reefs will be found enough. I have experienced several near New Ireland and New Guinea, which generally gave warning and commenced at W.S.W., blowing furiously the first hour, and continuing in a strong gale, veer-to the N.W. for 5 or 6 hours.

From Lat. 10° S. to the southern tropic hurricanes are likely to be experienced from November until April, agreeing also in this respect with the Indian Ocean; and I have no doubt that one of these occasioned the loss of La Perouse and his fellow voyagers. These scourges of the sea are more prevalent near the New Hebrides and New Caledonia than the Feejee group and Friendly islands. In fact, the liability to hurricanes appears in exact ratio to that of the S.W. Monsoon,

or rather to the meridians in which the westerly Monsoon blows, differing in latitude; the Monsoon seldom extending beyond 17° or 18° S.,—indeed, at times 13° S. is the limit,—whereas hurricanes are experienced as far as the tropic.

From all that I can gather of these hurricanes of the South Pacific, having conversed with several masters who have encountered them, some of whom have had their ships dismasted, I scarcely think they are of that terrific description occasionally experienced elsewhere: and am almost inclined to believe them more often and more severely felt near the islands than well clear of the land, although aware of this disagreeing with the new theory; but future facts will be necessary to elucidate this subject,

They are still of unfrequent occurrence in the Pacific, several years intervening without any ship encountering one. I possess no facts which would be serviceable in pointing out their track or direction of rotation. They will, without doubt, be considered to agree with other places in the same latitude, yet a few more well authenticated descriptions as these southern hurricanes would not appear to encumber the evidence of their uniformity in these particulars.

Near the Friendly islands (and perhaps elsewhere) storms occasionally happen of extreme violence, blowing from one point and producing similar effects to hurricanes. In November 1835, 8 or 10 ships, English and American, encountered one of these near Tongataboo and Eooa from S.S.E., the heavy part of which lasted about 8 hours, causing more or less damage to all,—one or two were dismasted. It was described by the masters whom I saw, which included most of them, as being more severe than anything they had ever seen. Ashore at Eooa, it was most violent,—houses and trees blown down and all the crops destroyed. It likewise did great damage at Tongataboo, and was also felt very severely at the Hapai islands and Vavaoo. Here Mr. Thomas the missionary, was obliged to shore his house up, although it was considered by the natives that a gradual decrease in strength had been experienced in proceeding northward. Still further North, the *Nassau* encountered it in 16° N., in the shape of a heavy gale. At all these places the wind was from the southward,—S.S.E. by the ships; ashore they had no compasses, but it certainly was from the southward, and without shifting. I have thus endeavoured to be explicit, through an impression that more is required to be known of hurricanes and gales in localities, and having a strong belief that many of the hurricanes, even those producing the most disastrous effects, will be found very local.

Reverting again to the N.W. Monsoon:—At the Salomon Archipelago it commences in December or January. In some years these months are tolerably fine. During February and March strong winds, with severe squalls and heavy rains, may be expected. April generally is a fine month, with variable winds; also in May there is a good deal of fine weather. The S.E. Monsoon sets in strongly in June, with heavy rains and squalls, and continues so until the end of August; in all these months, nevertheless, there are considerable intervals of fine weather. In September the strength of the Monsoon is spent, and the weather is more moderate from this time until the return of the north-wester.

Farther to the eastward, about the meridian of Rotumah, the westerly Monsoon is less constant, beginning generally in January, and blowing strongly about 17 or 18 days consecutively, then declining; and, the easterly wind returning in a fresh breeze for nearly the same period, the westerly wind again intervenes, usually commencing with a gale, and always continuing in a strong breeze, with

squalls and rain;—the easterly and westerly winds thus alternating until the end of March, when the S.E. trade sets in steadily. Proceeding still further to the eastward the westerly Monsoon gradually becomes less constant and finally disappears, I think, somewhere about the meridian of the Marquesas islands.

Of currents I can only speak in very general terms, these being subject to great changes in many localities. From 1° or 2° N. to about 3° S., a current of 2 or 3 knots an hour prevails, taking its course from the wind, which is easterly during the greater part of the year; current, therefore, westerly. I have, however, experienced an exception to this. In July 1833, on the equator, in Long. 175° E., a current of about the strength already mentioned ran to the eastward for 14 or 15 days, although the wind was then fresh from the eastward; and I believe such changes have generally occurred once a year, probably indueed by a strong S.W. or westerly Monsoon in North latitude reaching at this time near the line. They are fitful changes and not to be depended on, nor can I state their extent eastward.

In other parts of this ocean, well clear of the land, there appears to be very little current. Mr. Horsburgh speaks of a drain to leeward, and this seems to express all there is. Indeed, I think the swell may almost account for it; therefore it is obviously not such a serious matter to fall to leeward in the Trades as may be imagined; almost any ship with perseverance may work to windward, the wind varying considerably, and veering at times far to the southward. For instance, in April I have worked up in a dull sailing and leewardly ship from the reefs off New Caledonia to the west side of the Feejee group. From thence, in June, to the islands called by the natives Fotuna and Alloaffy, (marked in one as Alluffalli in the chart.) and from thence to Wallis island. Moderate westerly winds of two or three days duration happen in every month.

Off the islands, so far as my observation extends, the currents decrease in strength in proportion to the increase in latitude, that is, the nearer to the equator the stronger the current, and generally with the wind. There are no doubt many exceptions, but without an account of each island, which I am unable to give, no statement can embrace all the particulars, yet one or two instances of such deviation may be mentioned. Cruising to the southward of New Georgia and Bougainville islands throughout the S.E. Monsoon from May until October, in the years 1836 and 1840, the current ran strongly to the S.E. against a strong wind and heavy swell, although at the same time on the north side of these islands it was running as strongly to the westward. Off the north side of New Ireland, where a westerly current prevails, changes to the eastward occur for 10 or 12 days at all seasons.

In concluding these remarks, I may be permitted to hope that some of your readers will follow them up. The winds of the western part of the North Pacific seem very imperfectly known. No statement has appeared of the eastern limit of the S.W. Monsoon; it certainly enters this ocean. In June I have run to the northward, keeping about 3° eastward of the Philippines, with a fresh and steady breeze from S.W. The same wind prevailed until reaching 27° North, and 138° East.

Guajan and the other islands of the Ladrone group are also understood to be subject to hurricanes, for which the inhabitants prepare by lashing down and securing their houses; yet the seasons at which these are most likely to be experienced are not generally known. Having only crossed this locality once or twice

in making passages, I can merely give hearsay evidence. The present Governor of Lamboangan, who has resided in Guajan two years in the same capacity, informs me that in June, July, and August. also in December and January, they are expected. December 1832, the *Japan*, a new ship, encountered a severe hurricane in 13° North, and about 160° West, the meridian of some of the Sandwich islands, in which she was totally dismasted, and fears were entertained of her weathering it; this is the farthest to the eastward in the North Pacific of which I have heard.

In corroboration of Captain Hunter's remarks we could introduce the experience of many masters, but it will be sufficient to notice the observations of Captain P. A. Palack, of the Hamburg barque *Esmeralda*, who leaving Fu-Chau-Fu on the 24th September 1861, went North of Formosa to 30° N. and 150° E.; there he turned South, crossed the Line in 162° E., passed without trouble east of the Salomon group and west of Caledonia, and arrived at Sydney on the 21st November, 58 days out; and he continues,—"while at Sydney there arrived an English barque 127 days, and another 107 days from Fu-Chau-Fu; and a Dutch barque which left 14 days before me had not arrived on the 16th of December. These vessels all went through the China Sea.

"Leaving the east coast of China from the end of October to the end of January, bound for Sydney, I would advise a ship to go north of Formosa, if enabled to do so, without loss of time; otherwise, go between the Pescadores and Formosa, and outside the Bashees, and stand down south or S.E. as high as the N.E. Trade or Monsoon will admit without pinching, keeping topmast studding sails set, and try to reach the Line in 140° to 145° E. From there steer along the Line and pass between New Ireland and Bougainville; or steer along the north coast of New Guinea, between that island and New Britain, along to the S.E. When in about 10° S. and 157° E., steer south or S.E., and pass either between Caledonia, and Fairway reef, or altogether west of these shoals, west of Caledonia, and so down to the N.E. coast of Australia, where you will find the northerly wind prevail.

"I give the preference to the New Guinea route because I do not believe that the West Monsoon blows so far to the east as Captain Hunter says it does. It may blow to 160° E. as an exception, but not like a Monsoon. I met a captain at Sydney who had cruised there for three years, and he agrees with me in this respect,—he never found a West wind worth mentioning; and on the voyage up I was boarded by the officer of a whaler, who said that in their three year's cruise, they had never experienced a West wind. From 10° S. to the Line, between 160° and 165° E., I had nothing but calms and light northerly winds. I did not notice even a sign of westerly wind; but I strongly believe that at New Guinea a constant West wind is blowing from November to February, and am confident that I could make the aforesaid passage to Sydney in 35 to 45 days, especially when under the Line in January.

"This route is 600 miles shorter than going out to 30° N. and 155° E., and about 2300 miles shorter than through the China Sea and south of Australia."

CHINA SEA;—ROCKS, SHOALS, &c.

The following remarks on many of the islands in the S.W. part of the China Sea, between Singapore strait and the coast of Borneo; and on the rocks, islands, and shoals in the *main route* between Singapore and China, and in the route from Singapore to China by the Palawan passage, are the result of the surveys made during 1863–5, by the officers of H.M. surveying vessel *Rifleman*.

Islands between Singapore Strait and Borneo.

St. Barbe Island is high, and appears like two islands when first seen, being low in the centre. The highest hill on its N.E. end is 762 feet high, and in Lat. 0° 8′ 6″ N., Long. 107° 13′ 32″ E. The hill on the south end is 684 feet high.

Direction Island is smaller than St. Barbe island; between the two islands there are 20 to 30 fathoms of water. The summit of the island is 639 feet high, and in Lat. 0° 14′ 39″ N., Long. 108° 1′ 53″ E.

Welstead Shoal, nearly in mid-channel between Direction and Tambelan islands, is in Lat. 0° 32′ 27″ N. The Longitude, 107° 53′ E., was obtained by true bearings to Direction island and Tambelan peak.

The rocks extend half a mile in an E.N.E. and W.S.W. direction, their breadth being about a cable. They consist of a number of pinnacles, with varying depths of 7 to 3 fathoms.

When at anchor on the shoal, Direction island bore S.S.E. ½ E. (the small islet off the west side of that island being just visible from the bridge), and Tambelan peak bore N.W. ¾ N.

Pulo Dattoo is high and of an oblong form. The peak is in Lat. 0° 7′ 38″ N., Long. 108° 35′ 50″ E., and its height 1042 feet.

St. Esprit Islands.—This group extends 4 leagues, W. by N. and E. by S., and it is only necessary to remark here that vessels should be cautious when passing through them, as a coral patch of 3 fathoms water was found between the Brace islands and the island next west of them. The highest part, 825 feet high, of the largest island of the group, is in Lat. 0° 37′ 31″ N., Long. 107° 0′ 50″ E.

Howqua Shoal is marked on some charts as a doubtful danger, S. by W. 4 miles from the south-west island of the St. Esprit group. The *Rifleman* steamed over and about its reported position for a day, but could not discover it.

Green Island is small and covered with trees. Its centre is in Lat. 0° 44′ 43″ N., Long. 107° 18′ 52″ E.

The Tambelan Islands, about 35 miles N.E.-ward of the St. Esprit group, extend in a N.W. and S.E. direction. The highest peak of the Great Tambelan (1300 feet high) is in Lat. 1° 1′ 5″ N., Long. 107° 32′ 22″ E. On the W. side of this island there is good anchorage, with shelter with most winds; the channel between its S. point and the adjacent islets is a mile wide.

Rodger or Ellen Rock is of very small extent, and about 100 yards square; but at low water springs there are but 3 feet water on it. Its position is Lat. 0° 41′ 15″ N., Long. 107° 31′ 12″ E., and from it Tambelan peak is seen over the right summit of Pulo Jarrang, and bears N. $\frac{1}{8}$ E.: Green island W. by N. $\frac{1}{4}$ N., $12\frac{3}{4}$ miles; the right extreme of the Tambelan group N. by E.; and the left extreme N.N.W. $\frac{1}{2}$ W.

This is an exceedingly dangerous rock, for there are regular soundings of 19 to 22 fathoms close-to and for miles around it. The *Rifleman* was steaming about this danger for 4 days before it was discovered. It was ultimately found by the tide making against the wind and causing a slight ripple.

There is little doubt, but this is the rock seen by Mr. Robert Loney, R.N., when in command of the *Rose Ellis*. The rock is so far from the islands, that the least error in bearing would cause the discrepancy in its position as given by Captains Rodger and Loney.

Europe Shoal extends about a mile in a N. by E. and S. by W. direction, the shoalest patch of 3 fathoms being on about the middle of the line. Horsburgh gives 2 fathoms, but not less than 3 fathoms were found at low water springs, and the boats were sounding over it for several hours. Southward of the 3-fathom patch, the shoal extends, westward, nearly $\frac{3}{4}$ of a mile, with 6 to 10 fathoms water. All around the shoal there are 18 to 25 fathoms.

The 3-fathom patch is in Lat. 1° 11′ 19″ N., Long. 107° 25′ 27″ E., and the Rocky islets bear from it W. $\frac{1}{4}$ S. $12\frac{1}{4}$ miles; Gap rock E. by N. 9 miles; summit of Pulo Way S. by W. $\frac{1}{2}$ W. $5\frac{1}{2}$ miles; right extreme of the Tambelan group S.S.W. $\frac{1}{4}$ W. $6\frac{1}{4}$ miles; and left extreme S.W. $15\frac{1}{4}$ miles.

White Rock, about 80 feet high, lies E.S.E. from Pulo Jarrang, the south-east island of the Tambelan group. On its S.W. side are two small pinnacle rocks about 12 feet above high water. Vessels should not make too free with this rock, as shoal water extends from it between the N.W. and S.W. bearings to a distance of 2 cables.

Constance Shoal.—A danger has been reported and marked on the charts under this name, about $1\frac{3}{4}$ miles south of Pulo Jarrang. The *Rifleman* was steaming a whole day about this position without discovering any danger. Beyond being in the chart we are not furnished with any particulars, and, moreover, the shoal being marked as doubtful both in itself and in position, we are induced not to believe in its existence.

A Coral Shoal, however, was found lying off the S.W. end of Little Jarrang (the next island westward of Pulo Jarrang) the shoalest part of which, with 3 fathoms water, bears W.N.W. $\frac{9}{10}$ of a mile from the south-west end of that island. From this patch (which is on the western extreme of the shoal,) it extends about S.E. by E. $\frac{3}{4}$ of a mile, with depths over it varying from 4 to 9 fathoms. This, probably, is the Constance shoal.

Tambelan highest peak on with the right extreme of Harbour island leads $\frac{1}{2}$ a mile westward of the shoal; and White rock on with the right extreme of Pulo Jarrang leads in 9 fathoms over its south-east end. White rock kept well open of the right extreme of Pulo Jarrang leads to the southward.

There are 17 to 20 fathoms water between this shoal and Little Jarrang.

Several other shoal patches and dangers were found near the Tambelan

islands, but they lie out of the ordinary track of vessels, and a glance at the chart will give a better idea of them than a long account here.

Rocky Islands, lying N.W. $\frac{3}{4}$ W. 12 miles from the channel between Pulo Way and the outer island of the Tambelan group, are merely two barren rocks, the resort of sea birds. They are bold close-to, and occupy a space of about 2 cables in extent. The northern and larger rock, 134 feet high, is in Lat. 1° 11′ 9″ N., Long. 107° 13′ E.

Gap Rock lies North 11 miles from the eastern extreme of the Tambelan group, in Lat. 1° 12′ 30″ N., Long. 107° 34′ 39″ E. This rock, which consists of two large boulders lying upon a flat rock, is very remarkable; the larger of these boulders is 124 feet above the water. There is no small rock to the eastward of it, as mentioned by Horsburgh, but a shoal extends about 2 cables from its south side.

St. Julian, in Lat. 0° 55′ 40″ N., Long. 106° 43′ 30″ E., is a remarkable island, being nearly a mile long, and only 200 yards broad. The island is low in the centre, rising to a hill 537 feet high on the north end, and to another 318 feet high on the south end. The hill on the north end forms an exceedingly bold cliff to seaward. There is deep water close to on all sides.

Camel's Hump, in Lat. 1° 11′ 46″ N., Long. 106° 53′ E., is about $\frac{1}{2}$ a mile long, east and west, and about $\frac{1}{3}$ of a mile broad. It is well named, the highest part of the island forming a sort of hump, the height of which is 574 feet. No danger was discovered in its vicinity.

Saddle Island, in Lat. 1° 19′ 20″ N., Long. 107° 2′ 17″ E., is only $\frac{1}{2}$ a mile long, and a $\frac{1}{4}$ of a mile broad. This island is also well named; the hills forming the saddle are in line on a S. $\frac{3}{4}$ W. and opposite bearing, the higher one on the north side being 387 feet high.

Victory Island, in Lat. 1° 34′ 46″ N., Long. 106° 18′ 40″ E., rises to a hill in the centre, 285 feet in height. A patch of 5 fathoms, with deep water all round, was found about $\frac{1}{3}$ of a mile off its S.W. end.

Acasta Rock, lying N. by W. 4 miles from Victory island, is just under the surface of the water, and in calm weather the central part appears of a very brown colour, declining to a pale green around. The least swell breaks on it.

Barren Rock, in Lat. 1° 31′ 50″ N., Long. 106° 25′ 35″ E., is a whitish rock 80 feet high, about a cable in extent, with deep water all around it.

General Remarks.—As the *Rifleman* was constantly shifting her position during the operations of the survey, no good opportunity offered for obtaining a series of tidal observations; but it was observed, that during the S.W. Monsoon (from the middle of July to the middle of September,) and also during the N.E. Monsoon (in the month of December,) the tides set to windward every day against the prevailing current, although they were uncertain as to commencement and time of duration.

The weather was very fine and the winds generally light. *Ships would frequently shorten their passages through this part of the China sea if they kept a kedge ready to let go during light airs and calms, and when both current and tide would otherwise be setting them back over the ground they had with difficulty gained.*

All the islands, like most others in the tropics, are covered with a dense vegetation, and have, generally, white sandy beaches upon which turtle and the iguana may frequently be found.

The islands of the St. Esprit group, and others, are occasionally visited by small parties of Malays for the purpose of catching turtle.

The only islands permanently inhabited are those of the Tambelan group, all of which have a few Malays upon them. The village in the bay of the Great Tambelan contains about 500 inhabitants, but vessels cannot get supplied there. A few fowls were procured, but with great difficulty.

Rocks, Islands, and Shoals in the Main Route between Singapore and China.

Hughes Shoal.—On leaving Singapore, the *Rifleman* proceeded first to Victory island, to thoroughly examine the 5-fathom shoal off the S.W. end of that island, over which one of her boats had passed during the recent survey, and also to search for the doubtful reef of Horsburgh, said "to have been seen by Captain Hughes, of the *Bombay Merchant*, in January 1825, and was nearly in one with Victoria island, bearing N.E. 5 or 6 miles."

The *Rifleman* anchored on the shoal, the island bearing N.E. ¾ E., distant ½ a mile, in 3½ fathoms, reduced to low water springs, which was the least water found. The shoal is of coral, ⅓ of a mile long, N.E. and S.W., and a ¼ of a mile broad. Its outer edge in 8 fathoms lies S.W. ¼ W. ¾ of a mile from the island.

It is possible that Captain Hughes meant that his ship was distant from the island 5 or 6 miles when the breakers were seen in one with the island. However that may be, after a careful search under favourable circumstances (the water being so clear that the formation of the coral could be seen distinctly all over the shoal), the least indication could not be found of any other danger in that direction. Believing, therefore, that the shoal explored was, in all probability the same that was seen by Captain Hughes, it was named Hughes' shoal.

Pyramidal Rocks.—From Victory island a line of soundings was carried to the position of a "doubtful rock" placed 11 miles S.W. of the Pyramidal rocks off the west coast of the Great Natuna. The *Rifleman* passed close to the spot without discovering any danger, and had soundings in 33 fathoms.

The Pyramidal rocks were passed within 4 miles, but it was getting too dark to examine them closely. They appeared to be just as they are described in Horsburgh, and their position is within a mile of the chart.*

French Rocks.—From the Pyramidal rocks a line of soundings was carried to

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* A Dutch Notice, printed at Batavia in 1857, states that a rock, 25 feet above water, was discovered lying N.E. by E. ¼ E. of the Pyramidal rocks. Its appearance was similar to those in the neighbourhood of Pulo Semione, and it is said to be in Long. 107° 26′ E.

Also that the Dutch vessel *Lamina Elizabeth* struck on a reef lying off the south-east coast of Great Natuna island, with Pulo Kamodi and Pulo Jantay nearly in one, bearing N. by E. ½ E.; Mount Ranay N. by W. ⅞ W.; the nearest high land on Natuna W.N.W. ¾ W.; the south point of the same W. ½ N.; and the point of Lagong island about W. by S.

the position of the French rocks, represented as three rocks above water lying N.N.W. ½ W. of Pulo Laut, or the North Natuna. Their position was approached on a W. by N. ½ N. bearing, and at noon the *Rifleman* was 2 miles north of it; she then steered south 7¾ miles, N.W. 9 miles, and N.E. 6¾ miles, without discovering any signs of the rocks. The soundings about the spot were from 35 to 40 fathoms.

Holland Bank is an extensive coral bank with various depths of water upon it. Its greatest length (under a depth of 10 fathoms) is 6½ miles E.N.E. and W.N.W., and its breadth 4 miles. The shoalest patches are towards its N.E. end. The soundings on these patches are very irregular; the least water found was 2½ fathoms, reduced to low water springs. From the centre patch, in Lat. 10° 39′ 17″ N., Long. 108° 43′ E., the south-west summit of Pulo Ceicer de Mer bore about E.S.E. distant 15 miles; and High rock about E. by S. 10½ miles.

The south-west summit of Ceicer de Mer bearing S.E. by E. ½ E. leads just outside the depths of 10 fathoms, on its north-east end; and bearing E. by S. ¼ S., leads outside the same depth on its south end. Therefore, vessels passing northward of the Holland bank, should not bring the south-west or high and sloping summit of Ceicer de Mer to the eastward of S.E.; and those passing south of the bank should not bring the same summit to the southward of East.

The soundings round the bank are very irregular, and afford no certain guide, but the bank is much steeper on its eastern edge than elsewhere. The lead, however, is not at all to be relied on in approaching that edge, for 20 fathoms may be obtained one cast, and 4 fathoms the next. Excepting the eastern part, if the lead be attended to and hove quickly, it will point out the edge of the bank before a ship gets into danger.

The following valuable remarks, from Horsburgh, cannot be improved upon:—"To avoid this bank on its western side, do not raise Pulo Ceicer de Mer more than to have the summits of the two hills visible from the poop of a large ship when the island is bearing between E. ½ S. and S.E.; for if the low part of the island between the hills be *in sight from the poop*, bearing from E. by S. to E.S.E., the vessel will be near the edge of the bank.

Pulo Ceicer de Mer.—The two small hills which were formerly supposed to lie near its north and south extremities, are, in fact, both towards the north end of the island, and bear E.N.E. and W.S.W. distant a mile from each other. The south-west and higher hill of the two is in Lat. 10° 32′ 36″ N., Long. 108° 56′ 30″ E., is 360 feet high, has a round top, slopes gradually until it joins the low land, and is visible 24 or 25 miles. The north-east hill, 306 feet high and of a conical form, rises abruptly from the low land, and has several irregular masses of rock near its summit, which give it a somewhat remarkable appearance.

The island is 3½ miles long N.E. and S.W., and 1½ miles broad. Nearly ½ a mile off its north-east end are several masses of rocks with foul ground round them; the most conspicuous is a large black rock 60 feet high. This part of the island should not be approached by vessels of large draught nearer than 1½ or 2 miles, nor by small vessels nearer than a mile. In a case of emergency it is possible, perhaps, to gain shelter from the S.W. Monsoon by anchoring off the north-east end in 14 or 15 fathoms; but the bottom is rocky and bad holding ground, and by no means to be recommended as an anchorage.

On the east side of the island is a sandy bay which has the appearance of

affording convenient anchorage; but a coral reef not only fills it completely up, but projects in such a manner that the 5-fathom line of soundings forms an arc of a circle convex to seaward more than a mile distant from the depth of the bay, and approaching within a cable or two of the north-east and south-east points of the island. Vessels should be extremely cautious in approaching this treacherous bay, as the soundings decrease so suddenly from no bottom with 40 or 50 fathoms to 4 or 5 fathoms, that the lead cannot be relied upon to give warning of the danger in sufficient time to avoid it.

A sandy beach extends along the whole west and south-west coasts of the island, the south-west point being formed by a number of black rocks. There is fair anchorage in 13 to 16 fathoms, with a bottom of sand and shells, all along these shores; but the best is just to the southward of the south-west point, where vessels may conveniently anchor in 10 to 14 fathoms. It is necessary, however, to be careful in coming to, as shoal water and rocks extend about $\frac{1}{3}$ of a mile from the island, and the depths rapidly decrease from 11 to 4 fathoms.

At $\frac{1}{2}$ a mile off the south-east end of Ceicer de Mer is a smaller island lying in a north and south direction, the highest point of which is 133 feet above the sea. The south-east part of Ceicer de Mer is nearly the same height, and both present steep rugged cliffs to the eastward. In the middle of the channel between these islands is a mass of rocks just above water, between which and the small island is a channel for boats. At $\frac{1}{4}$ of a mile S.E. of the small island is a conspicuous black rock about 30 feet high, with small rocks round it; 2 cables S.E. of which, again, are two rocks awash. The small island, therefore, should not be approached within a mile when bearing to the westward of North.

Pulo Ceicer de Mer is inhabited by poor fishermen and others, and is well cultivated, but no supplies could be obtained. The natives brought off a few fowls upon one occasion, and seemed pleased to receive some empty bottles, biscuit, &c., in return; but they refused all offers of money, and would not be prevailed upon to sell anything. They were much disturbed at the vessel remaining so long in their neighbourhood, and kept up an almost incessant noise with drums and gongs all the time she was at anchor. They always lined the beach, armed with spears and other Chinese weapons, when any boat landed, but did not attempt to molest the crew.

High Rock, of a white colour, 60 feet high, and the resort of sea birds, lies N.W. $\frac{1}{2}$ N., nearly five miles from the north-west point of Pulo Ceicer de Mer. Nearly half a cable north of it is a small rock a few feet above water; close to the northward of which is a rock awash.

In the channel between Ceicer de Mer and High rock the depths vary from 8 to 12 fathoms, and the bottom is coral. Near the rock some patches of 5 and 6 fathoms were found, but no danger discovered. The channel between Ceicer de Mer and Holland bank is about 12 miles wide. The depths in it are very irregular, varying from 26 to 10 fathoms, the bottom generally sand, or sand and shells at the deep soundings, and rocky at the shoal ones.

Caution.—Vessels should keep a good look-out when passing between Ceicer de Mer and High rock, or High rock and Holland bank; for although many hundreds of soundings were obtained in the neighbourhood, and the result of the survey affords reasonable assurance that these channels are quite safe, yet with depths so irregular and the bottom mostly of coral, the possibility of some small

patch having escaped the lead, even in the most careful survey, should always be borne in mind and guarded against as far as possible.

Pulo Sapata, or Shoe island.—Its summit, 346 feet high, is in Lat. 9° 58′ 23″ N., Long. 109° 6′ E., and bears S. by E. ½ E. 35½ miles from the S.W. summit of Ceicer de Mer. Under very favourable circumstances it is possible to effect a landing upon the rocks at its base; but otherwise it is an inaccessible barren rock, ⅓ of a mile long, north and south, about half as broad, and visible in clear weather at 22 or 23 miles.

With the exception of a rock awash lying a ¼ of a cable eastward of its south end, the island is bold close to; 16 and 17 fathoms were obtained about 2 cables eastward of it, and ½ a mile off in that direction 25 to 30 fathoms. On the west side the soundings are a few fathoms deeper.

The Pyramid or Little Catwick, is a small peaked rock 56 feet high, lying N.W. by W. ½ W. 2¼ miles from Pulo Sapata. It is steep close to, with no danger near it, and can be seen about 9 or 10 miles.

The channel between this rock and Pulo Sapata is free from danger, and the soundings in it are deep,—50 to 65 fathoms. The following observations from Horsburgh are very valuable:—"Although this passage seems to be safe with a commanding wind, it ought not to be adopted excepting in a case of emergency, for it is contracted and the currents are strong and irregular about these islands. Ships passing here in the night, during the N.E. Monsoon, ought to make proper allowance for a south-west current, which is liable to deceive, and to carry them down upon the islands, particularly if the wind is strong at the time."

Round Island, or Great Catwick, is a barren rock, 196 feet high, and about 1½ cables in diameter, bearing W.N.W., distant 11¾ miles from Sapata, and nearly South, about 30 miles from Ceicer de Mer. It is bold close to, having 30 to 50 fathoms at a short distance from it in all directions.

Yusun Shoal, in Lat. 10° 16′ N., Long. 109° 2′ 15″ E., is a very small coral patch of 4 fathoms, lying in the fairway of the channel between Ceicer de Mer and the Catwicks. From it the south-west summit of the former bears N. by W. ¾ W. 17⅔ miles, the Great Catwick S.S.W. ¼ W. 14¾ miles, and Sapata S. by E. ¼ E. 18 miles, which is very nearly the position assigned to it by its discoverer; close round it are 45 and 50 fathoms, which is the general depth of the middle of the channel; but about a mile W.N.W. of the shoal is a patch of 24 fathoms.

In fine weather the shoal is not easily seen, but when blowing hard in the strength of the Monsoons, the sea has been frequently observed to break heavily upon it.

There is good reason to believe that the Yusun is the only danger in the channel between Ceicer de Mer and the Catwicks, which is otherwise spacious and safe. The soundings in the channel are irregular, and will be better understood by a reference to the chart, which these observations are intended to accompany than by a description here.

La Paix Rock is a small spot with a pinnacle awash lying nearly in the fairway of the channel between the Great and Little Catwicks, and which may, with this exception, be considered safe to navigate. From the pinnacle the Great Catwick bears West a little northerly, distant 4¼ miles, and the

Little Catwick is seen to open to the south of Pulo Sapata, S.E. by E. a little easterly, 5½ miles.

Except in exceedingly fine weather the sea always breaks upon this rock, but vessels should not attempt the channel at night, unless their position is exactly known, and circumstances otherwise favourable.

Julia Shoal is a small coral patch about a quarter of a mile in extent, with only 2½ fathoms on it at low tides, lying S.E. by E. distant 3½ miles from Pulo Sapata.

The Little Catwick in line with the north extreme of Sapata, N.W. by W. ⅔ W. leads nearly half a mile north-eastward of the Julia; the Little Catwick exactly in line with the south extreme of Sapata, leads over 10 fathoms water on the south-west edge of the shoal; and the Little Catwick well open of the south extreme, N.W. ⅔ W. leads half a mile south-westward.

When the Little Catwick is just lost behind the south extreme of Sapata, and the angle of elevation of that island is 1°22′, or more (the height of the eye being 15 feet), ships will be 1 mile or more inside the Julia. When the angle of elevation is 0° 45′ or less, (the height of the eye being 15 feet), they will be 1 mile or more outside the shoal.

In 1836, Captain Thomas, of the ship, *Good Success*, observing a rippling, sent a boat to examine it, and found a sharp pinnacle rock to which the boat was held by a boat hook. In 1847 it was examined in the ship, *Julia*, but no less water than 3 fathoms could be found, which is no doubt the usual depth upon the shoal although it is not safe to depend upon finding more than 2½ fathoms.*

From the examination made in the *Julia*, the danger obtained a position on the chart, which position was very nearly the same as that ascribed to it by Captain Thomas. We also agree with both in bearing, but make the distance from Pulo Sapata (which with them must have been a matter of judgment only) a mile less than they.

There is no doubt that the existence of this shoal has been the cause of more anxiety, perhaps, than any other in the China sea. In all probability many of the reported positions of dangers in that locality (for instance, the Hopkins bank), have proceeded from this shoal, having been seen and its position wrongly estimated.

The *Christopher Rawson* (the only vessel heard of striking on a shoal near Pulo Sapata), was probably lost upon the Julia shoal; and from the impossibility of correctly calculating the ship's position at the time of the accident, the navigation of the China Sea has for 20 years been encumbered with the **Rawson Shoal,** which appears on the charts as a doubtful danger about 20 miles E.S.E. of Pulo Sapata: it was hereabouts the *Christopher Rawson* was supposed to have struck; but this position must have been a matter of mere conjecture.

A day was also spent in searching for the **Hopkins Bank,** but no sign of danger was met with in this case either.

The Raglan is another doubtful danger† which could not be found, there being upon the spot no bottom with 300 fathoms.

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* It is possible that the *Christopher Rawson* knocked off the pinnacle mentioned by Captain Thomas. She struck with great force, dragging the stern-post clean out of her.

† The ship *Lady Raglan*, in September, 1858, is said to have passed over a rocky shoal lying about S.E. ¾ S. 39 miles from Pulo Sapata, in Lat. 9° 28′ N., Long. 109° 25′ E. No soundings were tried for, but the rocks were plainly visible under the vessel's bottom. Shoal water was seen a short distance off; the direction, however, is not stated.

Forth, Columbia, and Alexander Shoals.—A day was spent in carefully searching for each of these doubtful dangers, but nothing of the sort could be met with. Upon the positions of the Forth and Alexander the *Rifleman* had no bottom with 500 fathoms; and no bottom with 350 fathoms upon that of the Columbia.

Captains White and Crokett, experienced navigators in the China sea, state that they have passed over the positions of all these supposed shoals, and have never seen any sign of danger. Many similar statements have been received from other captains not so well known as those referred to, but in every way worthy of credit.

From these, and from the result of the *Rifleman* examination, it may, therefore, be inferred that the main route to China is not fraught with so much difficulty and danger as has been imagined: and that, with the exception of the Julia shoal, there is no good reason for believing in the existence of any danger between Pulo Sapata and the western edges of the reefs known to extend from the North danger far to the south-westward.

Minerva Bank.—Soundings were tried for on the spot where this bank is said to be, but no bottom was obtained with 200 fathoms. Mr. Reed, has, however, no doubt that it exists somewhere near its assigned position on the chart; but as 28 fathoms is the least water reported upon it, he did not deem it sufficiently important to occupy his time in making a closer search.

Corsair Rock.—The existence of this rock has frequently been denied. The *Riflenan* passed so close to its reported position, Lat. 9° 54′ N., Long. 108° 35′ E., that she must have seen it had it been there.

Royal Bishop Bank.—From near the Great Catwick, the *Rifleman* carried a line of soundings for this bank until she came to a coral patch having 10 fathoms least water upon it, in Lat. 9° 40′ N., Long. 108° 14′ E. Its extent is 3¼ miles long, E.N.E. and W.S.W., and about 1½ miles broad. There are 28 to 30 fathoms all round it.

Circumstances did not permit of a farther search for the shoal patches said to be found on the Royal Bishop, and which will probably be discovered to the northward of the bank examined.

Helen Shoal is a small patch 1¾ miles in length, E.N.E. and W.S.W., and a mile wide; its centre is in Lat. 19° 12′ N., Long. 113° 53′ 39″ E. The least water upon it is 6½ fathoms, the general depths being 8 and 9 fathoms; around it no bottom could be obtained with 100 fathoms of line.

St. Esprit Shoal is a coral bank 2¼ miles in length, east and west, and 1¼ miles in breadth; the centre of the shoal is in Lat. 19° 33′ N., Long. 113° 2′ E. The general depths upon it are 9 fathoms, the least water obtained being 7 fathoms, with 60 to 80 fathoms close to. The *Dove* remained at anchor upon the shoal for two days, on both of which good observations were obtained for determining its position.

Captain Ross, of the *Discovery*, who passed over the shoal in 1813, placed it about 5 miles to the south-eastward, and Monsieur D'Apres 19 miles to the westward, of the above position. D'Apres' position was well sounded over, and regular depths of 95 to 105 fathoms obtained. The *Asseviedo's* account placed the shoal in Lat. 19° 6′ N., Long. 113° 4′ E., and this position was also sounded over, but no bottom could be obtained with 200 fathoms of line.

The *Dove* also sounded over the position of the discoloured water seen from the *Althea* in 1806, Lat. 19° 36′ N., Long. 112° 17′ E., but regular depths from 65 to 70 fathoms were found in that locality.

The St. Esprit shoal is described in Horsburgh's Directory (Vol. 2, p. 244) as being "6 leagues in diameter, with 9 to 15 fathoms on its southern part, and on the northern part there are rocks even with the water's edge;" but no such dangerous shoal exists near any of the above localities, all of which were sounded over under circumstances extremely favourable for observing the sea topping or breaking over dangerous patches, had any such existed.

Currents.—The strong ripplings on the St. Esprit shoal, mentioned by Ross, were not observed by the officers of the *Dove* during the two days she was anchored on the shoal. Strong ripplings were, however, seen during the search over the various positions ascribed to the shoal, but on examination they appeared to be mere current ripplings, the water being as deep there as elsewhere. The current was found to set generally to leeward.

Shoals and Dangers in the Route from Singapore to China by the Palawan Passage.

The Breakers off St. Pierre Islands, which were supposed to lie about 3 miles S.S.W. from the smaller island of St. Pierre, do not exist.

Logan Reef.—Captain Logan, of the *Rob Roy*, bound from Labuan to Singapore, reported having seen off Api point, on the N.W. coast of Borneo, the wreck of a vessel ashore on a reef, lying with Marundum island bearing N.E. ½ N., Haycock island N. by W. ½ W., and St. Pierre island W. ¼ S.

Several of H.M. gunboats have passed over the position assigned to this reef without discovering the least trace of danger; nor was the *Rifleman* more successful in finding it. There is, in fact, good reason to conclude that Captain Logan was mistaken in supposing the wreck to be on a reef. The wreck was fallen in with afterwards by other vessels, drifting about, and ultimately went on shore a short distance southward of Api point.

Niger Bank, discovered in 1858 by H.M.S. *Niger*, is composed of hard clay. 4½ miles long, east and west, and 1½ miles broad. The outer edge of the centre part of the bank is about North, distant 5 miles from Tanjong Datu. The bank has 5 to 9 fathoms on it; the 5-fathom spots are towards the east and south-east ends.

The Acis Patches were reported to be "two coral shoals off the N.W. coast of Borneo; the position of the eastern shoal was given as Lat. 3° 45′ N., Long. 112° 42′ E.; the other shoal on the same parallel, and a short distance to the westward." The *Rifleman* anchored near to these patches, and searched for them without success. It is possible, however, they may exist somewhere in that locality.

Scout and Victoria Patches are two coral shoals to the south-westward of the Bruni patches, the channel between which and the coast of Borneo, heretofore considered quite safe, being thereby rendered very dangerous. Each shoal

extends nearly a mile in a north and south, and about half a mile in an east and west direction.

H.M.S. *Scout* passed over the edge of the former patch, in 4 fathoms. The least water found by the *Rifleman* was 2 fathoms, which lies S.W. by S, $4\frac{3}{4}$ miles, from the west Bruni patch, and W. by S., 12 miles, from Keti islet.

The Victoria patch was discovered by H.M. I.N. steam-vessel *Victoria*, 16th August 1860, and the least water obtained upon it was 17 feet. It bears S.S.W. $\frac{1}{2}$ W. 7 miles from the west Bruni patch, S. by W. $\frac{1}{2}$ W. 2 miles from the Scout patch, and W.S.W. $12\frac{3}{4}$ miles from Keti islet.

The only mark to clear these dangers is a bearing of Keti islet, which is just visible at a distance of 12 miles. For vessels passing inside the Bruni patches, the safest course will be to keep along the edge of the shore bank in 5 fathoms. But the more prudent plan to adopt, particularly in ships of large draught, is to pass outside the Bruni patches where there is nothing in the way. The islands Great Rusukan and Kuraman, with the high land of Labuan island, can be seen in plenty of time and run boldly for, except in thick bad weather, which seldom occurs on this coast.

Luconia Shoals.—Several dangers from 90 to 120 miles to the north-westward of Barram point and between the parallels of 4° 55′, and 6° 2′ N., and the meridians of 112° 16′ and 112° 42′ N., known as the Luconia bank, dry,—Luconia shoal,—Luconia breakers,—George and Abercrombie shoal,—and the Friendship shoal.

These were found to comprise a mass of coral reefs and shoals, amongst which no vessels should venture. Whilst preserving the names of the original discoverers for particular or more conspicuous portions of these dangers, we have adopted the general name of the "Luconia shoals" as referring to the entire group.

The position ascribed to the "dry bank" was sounded over without discovering it; but 5 miles north of its reputed position a reef was found upon which the sea was breaking in fine weather, and which is no doubt the "dry bank" of the charts. This danger, in Lat. 5° 3′ 24″ N., Long. 112° 38′ 36″ E., was named the Luconia breakers. From this position dangerous shoals, with rocks nearly awash on them, extend 12 miles west, 5 miles south, 2 miles east, and 3 miles north. This may not be the entire extent of the shoals in this vicinity, but bad weather prevented the *Rifleman* from making a further search.

The most conspicuous danger of the Luconia shoals is in Lat. 5° 31′ N., Long. 112° 33′ 17″ E., about a mile long, N. by E. and S. by W. and one-third of a mile broad. From these breakers, shoals extend as far as the *Rifleman* was able to sound, viz., 18 miles north, 5 miles south, 5 miles east, and 13 miles west.

It is probable that these soundings have nearly reached the limits of these shoals, excepting to the northward, in which direction they are only as far as the latitude of the southern part of the Friendship. Captain Bate in H.M.S. *Royalist* passed over the position ascribed to the George and Abercrombie without finding it. He supposed that it and the Friendship were the small shoal; but the error was in the longitude of the George and Abercrombie, which placed it too far to the westward. It exists, and forms part of the mass of shoals which extends continuously from the Seahorse breakers to the Friendship.

Caution.—No directions can be given that will enable vessels to pass safely

through these reefs and shoals. Although not less than 3 fathoms was found upon those to the northward of the Seahorse breakers, yet they should be avoided as it is quite possible there may be knolls with less water upon them which have escaped the lead.

Kirton Shoal and Euphrates Reef, two doubtful dangers reported to be in the fairway of vessels proceeding to the Palawan between the Luconia shoals and Barram point; the *Rifleman* passed over their reported positions and sounded about the locality without finding anything like danger, but it will be necessary to make a much closer search before removing them from the chart.

Islands and Dangers off Bruni Cliffs.—The five Commades and Three islands, &c., have no existence. This has now been proved by the *Rifleman* carrying lines of regular soundings right across the whole of their positions.

Ottawa Shoal.—Reported position Lat. 7° 16′ N., Long. 116° 5′ E. The *Rifleman* search for this danger for 3 days, but could find no indication of it; nor could bottom be got with 1000 fathoms of line. The area sounded over is comprised within the following limits;—8 miles east, 15 miles west, 5 miles north, and 5 miles south of the position given above. It is much to be regretted that the broken water seen from the *Ottawa* was not examined from a boat, and the fact of the existence of a shoal or otherwise placed beyond a doubt.

Roger Breakers were reported to be in Lat. 8° 21′ N., Long. 116° 25′ E. Mr. Reed remarks—"This is another instance in which it was most desirable that a boat should have been lowered to examine the breakers and to find out if there was really any rock there or not. It was of the greatest importance to avoid placing a doubtful danger at the very entrance and in the centre of the fairway of the Palawan channel. We searched over and about its position for a day without finding anything of the sort, and I think that the appearances must have been deceptive in this case. It is well known how frequently they are so to all accustomed to navigate the China sea. Captain Curling, of the P. & O. Co's steamer *China*, who has made many voyages by this route, assures me that the appearance of breakers where no real danger exists, is very common in the Palawan.

"I think, after much consideration, that this very doubtful danger should be removed from the charts. It is a great pity to encumber an important channel like the Palawan, where so many real dangers exist, with doubtful ones. Ships, not unfrequently, I believe, get too near real dangers whilst keeping clear of imaginary ones, and I am of opinion that in much frequented channels it is wiser not to insert doubtful dangers unless there be very strong reasons for believing them to exist.

"If we are ever to have a complete Chart of the China sea, Captains of vessels should assist in the work by endeavouring to ascertain when passing near what appear to be dangers—in such cases as the Ottawa and Roger breakers, for instance—whether they be such or not. An hour or so would have decided the point beyond all doubt in either of the above cases, whereas several valuable days of our time were occupied in searching about the spots without enabling us after all to decide the matter positively."

Furious Shoals were discovered in August 1859. by H.M.S. *Furious*. From the ship's position at anchor in 11 fathoms in Lat. 7° 3′ 19″ N., Long.

116° 17′ 15″ E., on the North Furious shoal, the middle Mantanani island* bore S. ⅔ E., and Banquey peak E. by N. ¾ N. The shoal is of coral, and extends N.W. by N. and S.E. by S., nearly 2 miles. The least water upon it is 7 fathoms.

The South Furious shoal is a small coral bank barely half a mile in extent, N.N.W. ¼ W. nearly 7 miles from the west extreme of the Mantanani islands. It is in Lat. 6° 48½′ N., Long. 116° 10¾′ E. The least water upon it is 7 fathoms.

Other Shoals off the Mantanani Islands.—N.N.W. about 5 miles from the west extreme of the Mantanani islands is a small patch of 7 fathoms; and N. by W. ½ W., 3½ miles, is another spot of 10 fathoms.

About 2 miles S.S.W. of the South Furious patch is a bank of coral of 7 fathoms, about a mile in extent; westward and south-westward of which again, are other and more extensive banks, the limits of which were not determined. Seven fathoms was the least water found upon any of them and the soundings were very irregular.

In bringing a line of soundings from these shoals towards Labuan, the *Rifleman* came on another bank at night, lying S.W. by W. 17 miles from the middle island of Mantanani group. Possibly this may be a dangerous bank, for passing over it slowly, very irregular soundings and as little as 4 fathoms water was obtained.

Barton Rock, reported as awash in Lat. 6° 52′ N., Long. 116° 16¾′ E. 9½ miles North of the Mantanani islands;—the *Rifleman* passed over the position of this danger without finding it; 28 fathoms was the least water obtained, but circumstances did not allow of a farther search.

Vernon Shoal was discovered by H.M.S. *Vernon* in 1858, and the least water obtained on it was 4¾ fathoms. The *Rifleman* found only 2¾ fathoms, and in some places the water appeared to be much shoaler. This might have been caused by the sun shining upon the water. There is but little doubt, however, that it stretches a long way to the westward, and probably is connected by a series of shoal patches with the shoals passed over by H.M.S. *Fury* in 1858.

Caution.—It is apparent from the above observations, that the whole of that part of the China sea extending from the Fury banks N.W. of Labuan, in a line, passing over the Saracen bank and Mangalum island to the Furious shoals should be navigated with the greatest possible caution. To render this navigation safe it will be necessary to make a close survey of the whole, similar to Captain Bate's survey of the Palawan, and to bring down the 100-fathom line from where he left off, along the whole coast of Borneo as far as the Luconia shoals.

Commanders of vessels proceeding to China by the Palawan channel are therefore cautioned not to venture amongst the shoals near Labuan and Mangalum island, but to keep to the northward of them, and closer to the track recommended by Horsburgh. It will be seen that that line passes very close to the Ottawa. This is why it was so necessary to determine whether that shoal existed or not, and occasions so much regret that Captain Gribble did not settle the

* A small, but high island, between the two large ones of the group.

question definitely, and thereby render a most important service to the Hydrography of these seas.

Fury Banks.—Two dangerous coral banks were passed by H.M.S. *Fury*, in 1858, on her passage to and from the island of Moaro, on the north-west coast of Borneo.

The first, in Lat. 5° 42′ N., Long. 114° 59′ E., and situated to the north-west of the 4-fathom sounding, marked Samarang, appeared to be 4 or 5 miles long, east and west, and 3 to 4 miles broad, with heavy breakers extending 1½ miles. There was a heavy sea at the time, and the deepest water obtained was 12 fathoms, the least 6 fathoms.

The second, in Lat. 5° 56′ N., Long. 114° 50′ E., was also about the same length, east and west, and, as far as could be judged from the discoloured water, 3 miles in breadth. No breakers were seen; the bank appears to be steep-to, and was first struck on one side with a depth of 11 fathoms, and on the other with 7 fathoms. The vessel was then steered West 1½ miles, when the soundings shoaled, then North, when they shoaled to 4¾ fathoms, and then suddenly deepened to no bottom with the hand lead. The soundings on this bank were very regular.

Caution.—Vessels proceeding by the Palawan passage should be careful not to stand too far to the southward, between the northern Fury patch and the North Furious shoal, until the locality has been more thoroughly examined, as many indications of danger have been found to exist there.

A dangerous rock, with only 3 feet water on it, lies in Lat. 5° 44′ N., Long. 114° 57′ E., between the southern of the Fury patches and the Vernon bank, about 26 miles north-westward of Labuan. At 1½ miles to the southward of this danger is another with 8 feet water on it.

Ruby Shoal.—The supposed position of this shoal was also ineffectually sounded over in 1864 and 1865; nothing was seen on either occasion which could lead to the supposition of there being any danger in the vicinity.

Caution.—Great attention should be paid to the lead and a good look-out kept for discoloured water when in this neighbourhood, for it is well known to be full of shoals, and the mariner is cautioned not to make too free with its navigation.

Gillies Shoal.—The position of this shoal, which was ineffectually searched for in 1864, was again sounded in 1865, but no trace of shoal water was observed; the depth when on its supposed position was 800 fathoms.

Bombay Castle, Orleana, Johnson, and Kingston Shoals were found to be patches on the edge of a large coral bank, which has been named the Rifleman bank.

Rifleman Bank lies between the parallels of 7° 31′ N., and 7° 57′ N., and extends from Long. 111° 32′ E. to 111° 45′ 30″ E. of Greenwich.

Around the edge of the bank several shoal patches were found, one of which, ½ a mile in extent, in Lat. 7° 55′ 20″ N., Long. 111° 42′ E., has only 11 feet water; with this exception, 4 fathoms was the least depth obtained on the bank.

It is deemed probable that the 11-foot patch is the shoal observed by Captain Cameron, of the *Orleana*, who obtained a cast of 8 feet, and placed the danger in

Lat. 7° 56′ N., Long. 111° 38′ E. The 8-foot knoll was not found by the *Rifleman's* boats, but it is quite possible to have escaped the lead, for large isolated rocks are known to exist on coral reefs, though extremely difficult to find.

Heavy breakers mark the position of this patch, in any but the finest weather.

In the centre of Rifleman bank the soundings are from 20 to 40 fathoms, sand and coral; and around its edge, outside, a few deep casts were obtained, varying from 300 to 600 fathoms.

The *Rifleman* sounded over the position assigned to the Bombay Castle reef, in Lat. 7° 56′ N.. Long. 111° 51′ E., but no bottom was obtained with upwards of 100 fathoms of line, nor could any sign of shoal water be seen from the mast-head under most favourable circumstances, when on, and cruizing around its supposed position; it is therefore deemed probable that the *Bombay Castle* must have sighted the 11-foot patch on the Rifleman bank, as the latitude is nearly the same, though the longitude differs 9 miles.

Prince Consort Bank, situated between the Vanguard and Prince of Wales' banks, was discovered whilst carrying a line of soundings between the North Danger and Singapore.

The bank extends from Lat. 7° 46′ N. to Lat. 7° 58′ N., and between the Longitudes of 109° 55′ E. and 110° 6′ E. No danger exists on it; the general soundings are from 30 to 50 fathoms, sand and coral, the least water found being on a small coral patch of 10 fathoms.

Lizzie Webber Reefs.—While proceeding from the wreck to Labuan in the boats, Captain Dallas reports that they saw breakers in Lat. 7° 38′ N., Long. 113° 55′ E., and in returning to the wreck in a small vessel, the *Lizzie Webber*, they struck upon a reef in Lat. 8° 4′ N., Long. 113° 12′ E. This latter reef is a narrow strip of land and coral lying very little under water, in a north-east and south-west direction.

East London Reef is 7 miles in length East and West, the breadth varying from 1 to 2 miles. Its east end is in Lat. 8° 49′ 38″ N., Long. 112° 37′ 26″ E.

The coral bordering the reef encloses a lagoon having from 4 to 8 fathoms water; no entrance into the lagoon was discovered, but there was an appearance of numerous coral patches inside.

The sea breaks heavily on this reef, and on its western extremity are one or two rocks which seldom cover. No soundings could be obtained with 100 fathoms of line at the distance of a mile from where the coral dries, and the attempt was equally unsuccessful with 500 fathoms of line, at the distance of 2 miles from the reef in a northerly direction.

Cuarteron Reef, named after the Spaniard who discovered it, is awash, and shaped like a crescent, whose chord is 3 miles in length E. by S. and W. by N., with the curve to the southward. Its eastern extremity is in Lat. 8° 50′ 54″ N., Long. 112° 49′ 34″ E.

This reef was found to be steeper-to than any yet visited, for although deep water is found close to all, there was generally some slope from the rocks awash, on which the vessel could anchor for a short period, to enable the position to be fixed; here, however, although the *Rifleman* anchored in 5 fathoms, with the jib-boom over the rocks awash, the reef was so steep as to cause the anchor to roll down the incline, and run the cable out to the clinch.

Central London Reef.—This important danger was discovered whilst sounding between the East and West London reefs. It is a coral patch awash, half a mile in extent, with a shallow lagoon inside the belt of coral. On the south-western extremity of the reef, is a sandy cay 60 or 70 yards in circumference, which is probably covered at high water springs.

The centre of this danger is in Lat. 8° 55′ 30″ N., Long. 112° 20′ E.; it is in every respect a most dangerous reef, and lies directly in the track of vessels working up or down the China sea.

Being small, it is not marked by great masses of breakers, like those which so readily point out the positions of the East and West London reefs, for one of which it has probably been mistaken, when sighted, as it has doubtless been.

Caution.—Like all other dangers in the China sea visited by the *Rifleman*, this reef is surrounded by deep water, thus rendering the lead useless; it is therefore essentially necessary to observe the greatest precaution when in their vicinity, and never to stand towards them with the sun shining ahead, as under these circumstances it becomes almost impossible to distinguish shoal water or breakers.

The Fiery Cross and Investigator N.W. Reef.—The ship *Fiery Cross* from London to Hong-Kong was wrecked, 4th March 1860, on a reef reported to lie about midway between the Dhaulle and N.W. Investigator shoals; but the Fiery Cross and Investigator N.W. reef, which are marked as two distinct dangers in the chart, prove to be one extensive coral reef having several dry patches on it, upon most of which the sea breaks even in light winds, or with a light swell. It is 14 miles in length N.E. by E. and S.W. by W., and 4 miles in breadth. The south-west end of this danger is in Lat. 9° 32′ N., Long. 112° 53′ E.; and its north-east end in Lat. 9° 41′ N., Long. 113° 4′ E. The largest dry patch is at the south-west end of the reef, and here were found the wrecks of two vessels, supposed to have been those of the *Fiery Cross* and *Meerschaum*, both of which ships are known to have been lost upon this reef.

Flora Temple Reef, on which the ship *Flora Temple* was wrecked, October 1859, on her passage from Macao to Havana with Chinese coolies, lies in Lat. 10° 19′ N., Long. 113° 34′ E. The soundings were 4 fathoms under the bows and stern of the wreck: no bottom with 27 fathoms of line within a short distance to the south-east, and close to the reef; and no bottom with 70 fathoms within a mile to the north-west. The breakers were not more than 150 yards wide, and extended about half a mile in a curved line from N.E. to S.W.

Caution.—The mariner is cautioned not to make too free with the dangerous archipelago of reefs and banks lying between Pulo Sapata and the coast of Palawan until their position and existence are more correctly ascertained. Vessels have passed through them with difficulty and risk; but others have either been wrecked or have lost their anchors on the extensive coral flats.

North Danger Reef, of Coral formation, is about 8½ miles long, in a north-easterly and south-westerly direction, and 4½ miles broad. On the north-west side of the reef are two sandy cays, the north-easternmost of which is half a mile in length, and a ¼ of a mile in breadth, with an elevation of 10 feet above the level of the sea at high water; the south-western cay is only 4 cables long, and 1½ cables broad, but its elevation is 15 feet above the high water level.

Between these cays is a passage 1 mile broad—with from 4 to 9 fathoms—leading into the lagoon of the reef, where the depth of water is from 20 to 25 fathoms.

Shoal water exists all round the edge of the North Danger reef, and there are heavy breakers over the coral, awash at its north-east and south-west extremities. No soundings could be obtained close to the edge of the reef with upwards of 100 fathoms of line, but one cast of 380 fathoms was procured 1½ miles north-east of the breakers on its north-eastern extremity. On the eastern side of the reef no bottom could be obtained with 480 fathoms of line.

Both cays are covered with coarse grass, and on the north-easternmost of the two is a stunted tree in Lat. 11° 28′ N., Long. 114° 20′ 45″ E., of Greenwich. The cays are frequented by Chinese fishermen from Hainan, who collect Beche-de-mer, turtle-shell, &c., and supply themselves with water from a well in the centre of the north-eastern cay.

Currents.—During the time the *Rifleman* was at anchor among the reefs, careful observations were taken of the set of the currents; the result agreed with that obtained in 1864, viz., that during 16 out of the 24 hours the current invariably sets to windward, generally with the greatest force when the Monsoon was strongest.

Scarborough Shoal.—The following notice appears in an *Annonce Hydrographique*—published by the French Hydrographic Office.

Scarborough shoal or Maroona has recently (March 1866) been examined by H.M. surveying-vessel *Swallow*. It is a coral reef, in the form of an irregular triangle, the sides of which face the South, West, and N.E.; and about 25 miles in circumference. The reef encloses a shallow lagoon, the opening to which is at the S.E. extremity, and about 2½ cables' wide.

From this opening the reef extends S. 49° W. 1½ miles, to a rock 10 feet high; then 5½ miles to the westward with a slight curve, and finally West to its S.W. extremity. This is the south side of the reef, and besides the rock just mentioned there are two others,—one, of 5 feet, about 4 cables to the eastward of the S.W. elbow,—and the other, of 7 feet, about 1½ miles still further east.

From the S.W. elbow, the reef extends N. 27° W. with a slight westerly curvature for 2 miles, and then N. 20° E. for the distance of 4 cables, where, in an inward bend of the reef, was a wreck. Thence, in a serpentine line, it extends northward $4\frac{7}{10}$ miles to the west extremity, and then E.N.E. for 1 mile. On the west side of the reef there are two rocks, 10 feet high, one in a bend N. 27° W. 1½ miles from the wreck,—the other N. 3° E. $2\frac{6}{10}$ miles from the former, and S. 8° E. $1\frac{1}{10}$ miles from the west extreme of the N.W. front of the reef.

From the east extremity of the N.W. front, the reef has a general direction towards S.E. by E. for $6\frac{4}{10}$ miles, with a N.E.-ly curvature for the first half of the distance, and with a S.W.-ly trend for the second half, thence to the eastward for 1½ miles, and lastly, S. by W. 9 cables to the east side of the opening mentioned above. On the N.E. side of the reef there are three rocks, 6 feet high;—the first, 9 cables N. by W. from the opening; the second, 1½ miles N.W. of the former; and a third rock, N.W. by W. 7 miles from the second, and S. 74° E. half a mile from the east end of the N.W. front.

Soundings.—In the middle of the opening there are soundings of from 5½ to 22 feet; outside of which at the distance of 2 cables are 100 fathoms water. At the

same distance off the south side of the reef there is no bottom at 150 to 160 fathoms. Off the west side of the reef, no bottom was reached at 150 to 190 fathoms, except at the distance of 1 mile W.N.W. of the north rock, where one sounding gave bottom at 134 fathoms, shells and coral,—and at 1½ miles south of the same rock, 135 fathoms, weed, sand, and coral. Off the N.E. side of the reef the depth is about 110 fathoms, sand and coral,—and the same, ½ a mile N.E. of the most easterly rock.

Position.—From good observations made close to the wreck, that part of the reef is in Lat. 15° 6′ 44″ N., Long. 117° 43′ 49″ E. of Greenwich.

Tide.—It is high water, full and change, at 8h. 15m. and the spring rise is 5 feet.

JAVA SEA:—WESTERN PART.

Commander Bullock, of Her Majesty's steam-vessel *Serpent*, has recently (1866) examined the positions of various dangers, which were supposed to lie in the track of vessels from Sunda strait and Batavia to Singapore: he reports that the Dolphin, Antelope, Jason, Banterer and Anna Paulowna shoals, were searched for, but not found; their names are therefore expunged from the chart of the Western part of the Java sea.

The position of Lynn bank, which uncovers at low water; as well as that of the Coventry reef, which also dries at low water, and on which the sea always breaks, has been accurately determined. The positions of several other dangers in this locality have also been rectified.

A shoal has recently (May 1866) been reported by Captain R. L. Sands of the *Glencoe*, who, when coming down the Java sea, passed close to the wreck of a barque lying in the fairway; its position was, North Watcher N. 62° E. 4¾ miles, North island S. 20° E. 12¼ miles, S. island of the Two Brothers N. 74° W. 18¾ miles: this has since been corroborated by two other ship masters, who have reported the wreck near the North Watcher, without however, giving the position.

STANTON CHANNEL—BANKA STRAIT.

Stanton Channel—Smits Bank consists of four smaller banks, nearly connected, and forming one long narrow ridge 15 miles in length, with its shoalest part of 3 feet, lying 6 miles, and the next shoalest of 9 feet, 3 miles from the north-western end, and two other patches of 3 fathoms and 2¾ fathoms to the south-eastward of them.

Panjang hill, bearing N.E., leads to the north-eastward of this bank, between it and the Nemesis bank, in 6 fathoms at low water. Gadong peak, in line with Toboe Ali point, N.E. ½ E., or Lucipara S.W., clears the south-eastern end in 4 fathoms; and Lalarie point N.W. by W., or not approaching the bank in a less depth than 10 fathoms, clears the north-eastern side.

Melville Bank, 5 miles long, and nearly ¼ a mile broad, lies a ¼ of a mile to the eastward of the south-eastern part of Smits bank, with a depth of 7 and 8 fathoms between. The shoalest part of this bank is near its north-western extremity, and is about 2 miles in length, with from 2 to 3 fathoms on it. At the north end, in 5 fathoms, Laboh point bears N.E. by E.; and the bank is cleared

to the south-east in 7 fathoms by the latter point bearing N. by E. ½ E.; and to the eastward in 8 fathoms, by not bringing Parmassang peak more open to the westward of Banka hill than N.W. ¾ N.

Between the above banks and Lucipara, there are many others, all tending in the same direction, with narrow deep water channels between; but as these channels are exceedingly narrow, and no marks can be given to clear the banks they are not available for vessels.

Eastern Bank.—The bank bounding the eastern side of Stanton channel is 13 miles long and nearly a mile wide at 3 miles S.W. by S. of Laboh point, which is the broadest and shoalest part. It is formed by three smaller banks nearly joined together, with from 2 to 3 fathoms on the north-western and south-eastern ones and only 4½ feet on the middle of the centre bank. The north-western extremity is separated from a projecting horn, extending from the shore mud flat, at 2 miles S.S.E. of Pulo Dahun, by a narrow channel of 6 fathoms.

Gadong peak, in line with Toboe Ali fort, bearing N.E. ½ N., clears the south-eastern part of the bank, in 4½ fathoms, to the southward; Dapur island, S.E. by E. ¾ E. to the westward; and the Mamelon or Hummock kept open to the westward of Pulo Besar, N.W. ¾ N., clears the west side of the north-west extremity of the above banks.

There is a small bank of sand lying one mile to the westward of the south-east extreme of the Eastern bank, but as a depth of not less than 4½ fathoms was found on it at low water, it is not dangerous to ships passing through.

Inner Channel.—To the eastward of the Eastern bank along the coast of Banka, there is an inner channel nearly a mile wide, with from 4 to 6 fathoms water in it, but as it is encumbered with shoals, it is only navigable for small vessels. Dapur island, bearing S.E. by E. leads nearly mid-channel.

There are also two outlets in the main channel over the Eastern bank, in 5 and 4 fathoms; the former with Pulo Dahun, bearing N.N.E.; the latter and southern outlet, when Pulo Puni and Gosong point are in line, E. ½ N.

Nemesis Bank, lying nearly mid-channel between Pudi and False First points, is a long ridge of sand extending 9 miles in a N.W. by W. and S.E. by E. direction, with irregular soundings of from 3 to 10 fathoms on it. The shoalest part consists of two patches of 3 fathoms, about 2 cables each in extent, on one of which the French frigate *Nemesis* grounded. They lie E.S.E. and W.N.W. from each other, distant half a mile, and from the western patch Lalarie point bears N.N.W. ¾ W., 4¾ miles,—and False First point S.S.W. ¾ W., 4¼ miles.

Casuarina point kept open of Lalarie point bearing N. by W. ¾ W. leads to the westward of these shoal patches, in 14 fathoms water; the Mamelon or Hummock N. by E. ¼ E., or False First point S.W. ½ S., leads to the eastward: whilst Lalarie point bearing N.W. ½ N. clears them to the northward. There is another patch of 5 fathoms lying 2 miles from the south-east extreme of the bank, with False First point W. ¼ S. and First point S. by W. ¼ W., distant 3¼ miles.

Making the Land.—Vessels from the southward intending to proceed into Banka strait by the Stanton channel cannot fail in approaching the coast of Banka to recognise the mountain of St. Paul by its flattish top, having several nipples of nearly the same elevation, and Gadong and Toboe Ali Lama peaks by their conical appearance.

Mount St. Paul rises with a gradual acclivity on its south-eastern shoulder to a peak 990 feet in height, with two others adjoining, of nearly the same elevation, the western peak terminating rather abruptly to a lower spur in the direction of Gadong hlll.

When to the westward of Puni island, owing to a projecting spur from the middle peak, the eastern peak of St. Paul is hidden, and the western one then appears the highest, and forms, with the north-west brow, a saddle hill.

Gadong is a pyramidal peaked hill, and its summit attains an elevation of 593 feet.

Toboe Ali Lama.—The peak of this hill is less elevated, but similar in shape to that of Gadong. It rises to 512 feet above the level of the sea, and, owing to the land contiguous to the above hills being low, they appear as islands at a distance over 15 miles.

Mount Pedang,—Should the weather be clear, the distant high range of Pedang will be visible. The highest peak of this range is quoin shaped, attaining from its western shoulder an elevation of 2217 feet, with several lower hills of a rounder and more conical appearance adjoining, the two westernmost being about 1200 and 1400 feet high.

Dapur Islands.*—On a nearer approach to Banka, the two small Dapur islands will be seen. At low water they are connected by rocks; and a coral sandy beach extends from the southern and highest, which very much resembles a shoe in appearance, and is 120 feet high. Between it and Baginda point, which has a small round hill over it, the land (with the exception of some hillocks nearly midway) is low, and, as it will be found throughout the whole of Banka strait, entirely covered with trees, with mud banks extending some distance from the shores.

There is a narrow channel, ¼ a mile wide, between the Dapur islands and Dapur point; from thence to Nangka† point, there are several white rocks lying inside the mud flat close to the shore.

Nangka Point may easily be distinguished by a round hillock, 264 feet high; and the receding land forming Toboe Ali bay, the shore of which is low, and fringed at high water with sandy beaches inside the mud flat, which here extends 2 miles off the land.

Toboe Ali Fort, with its red-roofed barracks, stands upon a low mound 40 feet in height, at the left point of the entrance of a small river, on the banks of which is the village of Sabang, situated close to the fort, and containing a mixed population of 600 Malays and Chinese. At low water the river dries to 3 cables from its mouth. No supplies of any description can be procured but water and wood; the former may be obtained at the above river, or at a small stream ½ a mile to the eastward of it, from half flood to half ebb. A Dutch Administrator and a Captain, with a small military force, garrison the fort.

Anchorage.—The anchorage off Toboe Ali Fort is in 4 fathoms (mud), with Toboe Ali Lama peak bearing S.E. by E. ¼ E., and Gadong peak in a line with

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* Dapur, Cooking place. Prahus in passing generally land to catch turtle, as it is the only place in Banka strait that they are seen.

† Nangka, the jack fruit (*artocarpus integrifolia*).

Toboe Ali Fort N.E. ½ N.; smaller vessels may approach on this bearing nearer the shore as the soundings decrease regularly. In southerly and south-westerly winds there is a heavy swell here which makes the landing difficult.

Toboe Ali Point has several white rocks near it, and a conspicuous tree on its summit, which is 213 feet in height, and visible 14 miles off.

Gosong Point.—From Toboe Ali point the land forms a deep bay with low mangrove trees to Gosong point, where a small stream disembogues into the sea.

From Gosong to Laboh* points the land is more elevated,—the highest part, 250 feet in height, with rocky points and sandy beaches, between which are numerous rocks close to the shore.

Puni Island, lying midway between these points, is 47 feet in height and conspicuous from the white granite rocks forming its base, and other rocks of a similar appearance near it.

Laboh Point from the south-east presents rather a shelving appearance, with large white rocks extending from it, which when seen from the westward, have the appearance of a village, from the contrast they offer to the green verdure of the point. Prahus frequently anchor here.

Parmassang Range.—A vessel having proceeded thus far, the high range of Parmassang will be visible, rising from a gradual slope on its western shoulder to a flat top peak, with two lower ones adjoining. The three hills of Banka, Panjang, and Wooded will also be seen; the two former may be known by their wedge shape, and the latter by its isolated position.

The shores of the coast from Laboh to Dahun points are low, and covered with mangroves; there is a range of hillocks parallel to the coast, the highest of which is 230 feet in height. There are also several small rivers; and close to the coast, at 2 miles N.W. ½ W. of Laboh point, a remarkable square tree, 167 feet high, which is very conspicuous, there being no others of the same elevation near it; in clear weather it may be seen 12 miles off, closely resembling a ship under sail.

Dahun Point.—At this point the land attains a greater elevation, faced with sandy beaches and rocky points; at 4½ miles to the N.N.E. ¼ E. of the point is a round hill, named Wooded, 315 feet in height, and very conspicuous from the high trees on it, and from there being no other hills near.

The cluster of rocks lying to the westward of Dahun point, are nearly all, with the exception of Pulo Dahun, covered at high water. The latter is 30 feet in height, and remarkable by its having a solitary tree on it,—whence its name Dahun, in Malay meaning leaf or bough.

Panjang Hill (or Long hill) rises close to the coast between Dahun and Banka points. When seen from the south-east it shows (as already stated,) as a wedge, with its greatest elevation, 316 feet, on its eastern end. From the north-west it appears as a long hill rising to a peak near its centre, with a conspicuous gap between the trees. A stream of fresh water runs close to the north side of this hill, and the coast between it and Pulo Besar is low, and covered with mangroves, off which there are several ledges of rocks.

Pulo Besar is nearly connected with Banka point by rocks. Although its

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* More probably Labûh-an, Anchorage.

name in Malay signifies large, it must be so in comparison with Pulo Dahun, it being only 3 cables long, and 63 feet high.

Banka Point and Hill.—The land to the westward of this point recedes into a bay; the point is about the same elevation as Pulo Besar, but at 1½ miles to the northward it rises to Banka hill, which from the south-east appears of similar shape to Panjang hill, but differs in having the highest part on its western extremity. From the north-west it shows with a flat top, having three clumps of trees on its summit, the whole height being 256 feet.

Lalarie or Lang-kong Point is 68 feet in height, and the perpendicular aspect of the trees on it, gives the point on all bearings a bold bluff appearance.

Casuarina Point, so called from a number of Casuarina trees on it, is nearly midway between Lalarie and Brame points. The coast between is low, with sandy beaches at high water; several hills, from 300 to 400 feet high, rise at 3 to 4 miles inland.

Brame Point is a termination of a spur from the Parmassang range, with a conical peak of 505 feet over it showing very prominently both from the northward and southward.

Tambaga Rocks (or Copper rocks,) so called from their reddish colour, are a group of three small rocks, lying east and west of each other, about a cable in extent. The highest and western rock is 4 feet above high water, and from it Second point bears W. ¼ N. 5¾ miles, and Brame point N. by E. 3 miles. Shoal water, about ½ a mile in breadth, extends nearly ½ a mile to the northward, and 2½ miles to the southward, and forms, with the shore and bank of Banka, a channel ¾ of a mile wide.

Water may be procured at a stream about ½ a mile to the northward of the Tambaga rocks, from half flood to half ebb, after which the mud prevents a boat approaching near.

Mintok Bank.—There is less water on this bank than the depth given on the Dutch chart, having near its south-east extreme a depth of only 2 fathoms at low water. A *temporary* triangular *beacon* of wood has recently been placed on the Hodji and on the Brom Brom rocks.

Frederik Hendrik Rock.—A *red buoy*, surmounted by a staff, and the letters F.H. on a vane, is moored in 13 fathoms water at 3½ cables to the S.E. of this shoal, and is visible about 3 miles off. From it Bata-karang point bears W. by S., Monopin hill E. by S., and Kalian point S.E. by E. ¼ E., but as the buoy from the strong tides frequently shifts its position, vessels are cautioned not to place too much dependence on it; do not approach the westward side of the shoal under a depth of 14 fathoms.

Tides.—In the S.E. Monsoon it is high water, full and change at Toboe Ali point, on the Banka shore, at 8.30 P.M. The ordinary rise at springs is 10¾ feet, but it sometimes reaches to 12 feet. The highest tide generally occurs two days after full and change. The rate at springs is 2½ knots. The flood stream sets to the N.W. and runs for about 12 hours, and the ebb the same period in the opposite direction, but they are both sometimes influenced by the strength of the Monsoon. When it is blowing strong from the S.E., the flood stream often runs for 14 hours.

At Laboh point it is high water, full and change, at 11 P.M., and the rise is 10 feet at ordinary springs.

After rounding Lalarie point in the S.E. monsoon, the flood sets N.N.W., and the ebb to the S.S.E. along the Banka shore.

The time of high water at Laboh point being 2½ hours later than at Toboe Ali point, in the southern part of the Stanton channel, for a few days after full and change the tides will be found (as there is generally 12 hours flow and ebb) to run in one direction all night, and the opposite direction during the day, with a velocity of from 2½ to 3 knots. The current also setting directly mid-channel, the flood N.W. by W. and the ebb S.E. by E., vessels may take advantage of it in light airs to drop through.

In the N.W. monsoon it is high water, full and change, at the Nangka islands at 7 A.M., and the rise is about 9¾ feet. At Kalian point, near Mintok, it is high water at 8.17 A.M., and the rise is 12½ feet. Many eddies and small races will be met with in the vicinity of the Nangka islands; they are caused by the tidal flood wave from the China Sea, meeting the flood from the southward.

Between Bata-karang and Fourth points, the ordinary current in Banka strait after heavy rains is considerably accelerated and diverted in the direction of Kalian point, until it nearly reaches mid-channel, by the freshes from the many rivers in this vicinity. Vessels sometimes take advantage of this to complete water, as it is frequently quite fresh on the surface. In the N.W. monsoon there will always be found a current setting to the south-eastward, following the trendings of the bank along the Sumatra coast, whilst, on the Banka shore more regular tides will be met with.

Sung-ei Soengsang or Palembang river.—Since the survey of the north-west part of Banka strait in 1860, a deeper and more direct entrance to the main channel of this river has been formed, carrying 9 feet at low, or 22 feet at high water springs.

This new entrance is marked with beacon poles, similar to those in the old passage, but as, on account of the many floating trees and strong freshes, they will probably not remain long in their position, a vessel of large draught may safely enter at high water by bringing the trees forming the west point of the river entrance S. by W. ¾ W., and running for them on that bearing until Pulo Payong (Umbrella island) bears South; then steer for the island, but take care in approaching it to keep close to the eastern bank of the river, to avoid the spit extending 2 miles off its north end. If a pilot is required one may be obtained at Kampong Soengsang, the small village on the left bank, but there is no channel available for ships on the west side of Payong.

This branch of the Soengsang at its entrance is upwards of a mile wide, but within the navigable channel is contracted in some places to a cable by the different islands and banks, until close up to the town of Palembang when the river widens to ¾ of a mile with 5 and 6 fathoms close to the shore.

Vessels can navigate the whole length of the river, up to the town, by keeping close to the right bank; but those of large draught are recommended, when passing Pulo Singris and the bank off Kampong Maya, to keep near the opposite

shore. Both sides of the river are wooded, and on nearly all the isolated banks there are small trees, and on others fishing stakes, consequently there will not be much difficulty in avoiding them.

Palembang, one of the largest Malay towns in the Archipelago, and the largest in Sumatra, derives its name from the many bridges across the numerous creeks that intersect it. A Dutch resident and other officials reside here, and to support their authority there is a military force consisting of one European and two native companies. The total number of Europeans in the town is 109, and by the last census the native population consisted of 45,000 Malays, 4,000 Chinese, and 1,000 Arabs. The climate in the vicinity is considered so salubrious that convalescent soldiers are sent here from Banka.

Near the extreme end of the town, commanding the mouth of the Ogan river, is a substantially built fort. It is a square enclosure of masonry, with walls 8 feet thick, about 50 feet high, loop-holed, and at each angle a circular bastion mounting 8 guns in casement embrasures. The fort could easily accommodate 1,500 men, and is surrounded outside with strong wooden palisades, a thick bamboo hedge, and a ditch 20 feet broad. The fort is in Lat. 2° 59½′ S. There are several smaller ports some distance up the river.

Covered prahus (called bedahs) daily arrive from the interior, laden with large supplies of cotton for exportation. This useful article grows quite wild some distance up the river, in some places close to the stream and covering many miles of land. The greater portion of it is sent to Batavia. The total quantity exported this season is estimated at 1,735,500 lbs.

All the necessaries of life are here found in abundance. The country abounds in large game, deer, wild pigs, &c. The river swarms with fish. Beef, fruit, vegetables, &c., are cheap and plentiful. Foreign vessels are not permitted to trade, and Dutch European vessels are not allowed to enter the river unless under special circumstances. The export trade, consisting principally of pepper, rattans, cotton, honey, dye woods, and gutta percha, is confined to 13 European built ships, and numerous country craft, all owned by wealthy natives.

From November to March rains prevail, and the wind varies from N.W. to N.E. At this period vessels belonging to Palembang either remain in port or trade to other places, as it is almost impossible for sailing vessels at this period to make any progress up the river, against the freshes. During a stay of five days off the town in January, the influence of the flood was not once felt. The ebb slackened during the day, but at night it often ran 5 knots. After much rain the freshes out of the river are felt in Mintok bay.

Lucipara Island.—All the trees on the peak of this island, with the exception of a solitary one in the centre, have been cut down. There will be no difference in the elevation of the island, as this tree is the highest, but instead of rising to a peak as it formerly did, the summit presents a ragged appearance, and in making the land there will be more difficulty in distinguishing it from the trees on the flat coast of Sumatra.

Pulo Taya rises to a double peak 630 feet above the sea. The northern peak is about 60 feet less in elevation, and both peaks being in line on a N. by E. and S. by W. bearing, they then show as a single triangular peak; there are two small islets off its north-east side. The whole shore of the island is steep, and may be approached to 3 cables.

The island is uninhabited, of granite formation, and covered with wood. Two sandy bays are formed in the bight between the hills. There is a spring of excellent water on the western side of the island, and a boat at high water can approach to 40 feet, but at low tide rocks extend nearly a cable from the sand. The knowledge of this is most important to the mariner, as no similar facility for water occurs between Banka and Rhio strait. In the fine season boats come here from Linga seeking turtle.

Castor Bank is a long ridge of coral and sand, nearly a mile wide, and 13 miles long in a N.N.E. direction. The general depths on it are 10 to 6 fathoms, but on one part, N.E. ½ N. 10 miles from Pulo Taya, there is a ridge about a mile in extent, and its eastern side steep-to, carrying only 5 fathoms. The bank is famous for a red species of fish, called from their colour Ikan Merah.

The Cowman bank, said to lie 6½ miles N.E. by N. of the Castor, was searched for in vain. The Dutch have also made several ineffectual attempts to find it, and the bank is erased from their chart. Neither do the fishermen of Linga believe in its existence.

The *Saracen* anchored on the supposed position of Smith bank, S. ¾ E. 20 miles from Pulo Taya, and sounded in every direction, 10 miles north, 4 miles south, and 5 miles east and west. The soundings were regular, from 7 to 9 fathoms, mud bottom, and gave no indications of the existence of a bank.

The blank space on the chart off the Sumatra coast, south of Tanjong Bon, was partly sounded. A bank of 4 fathoms was found with Tanjong Bon, bearing N.W. by W., distant 9 miles; a depth of 6 fathoms also nearer the shore. It is probably a projecting horn or spit extending from the mud flat, and as shoaler soundings may be found, vessels bound to Brahalla strait should keep 5 miles off shore until Tanjong Bon bears West.

Linga Island.—Numerous hillocks, from 200 to 300 feet high, form the east side of this island, and give the coast a uniform appearance. The peak of Pulo Rodong, resembling a haycock in appearance, 724 feet high; the mountain of Linga, with its high split peak, 3,921 feet high, called by Horsburgh, from the strong resemblance, Asses Ears; the Domino islands and sharp pyramidal peak over the east extreme of Linga, were good objects for fixing the soundings, which were confined to those above 10 fathoms, as vessels can gain no advantage by keeping close in shore.

The east extreme of Linga, called by the natives Tanjong Eung, from its prominent position and pyramidal peak, 750 feet high, is very conspicuous, and visible in clear weather 30 miles off. Tanjong Roe may be known by a saddle hill, 630 feet high, near it. The southern coast of Linga, between these points and between Tanjong Roe and Linga river, being low, both points make like islands when above 13 miles distant.

Linga Road.—The *Saracen* anchored in this road in 4 fathoms, mud, Pulo Badas bearing N.N.E. ½ a mile,—Sinkep peak, 1,440 feet high, S.S.W.,—and Ponoebo peak, 955 feet high, W. ½ S. Pulo Badas is connected by a reef to a larger island, with a grove of cocoa-nut trees on it, called by the natives Pulo Mapar. The village here contains about 300 Malays and Chinese, chiefly fishermen.

Good water was obtained, but with difficulty, from a well in the interior of the island. It was at first produced from a well near the village, but the natives,

from religious scruples, objected to its use. The shore is bordered by a reef, which makes watering difficult, except from half flood to half ebb.

The town of Linga, called by the natives Dyak, is prettily situated on the banks, and nearly a mile within the entrance of the fresh water river marked on the chart. The high, rugged, fantastic peak of Linga in the background, together with the rakish appearance of the country prahus, all moored to cocoa-nut trees and areca palms, their rich foliage almost obscuring the houses, give to the whole a picturesque appearance. The river is not more than 100 feet wide, and will only admit small vessels, as its bar dries at low water springs. Both sides near the entrance are densely wooded, and alligators are numerous.

The town is said to contain about 4000 Malays and 1500 Chinese. The former prefer their usual style of houses constructed on poles, but the Chinese have substantial buildings of stone. The produce is rattans, pepper, and gambier, which is carried to Singapore and Rhio by country vessels and prahus. Gold is found in small quantities after heavy rains. Tin has not yet been found, but the neighbouring island of Sinkep produces some. There are no Europeans on the island. The Sultan is nominally under Dutch protection, and the resident of Rhio pays him an annual visit.

Tides.—In Linga road it is high water, full and change, at 7 p.m., and the rise is 7 feet. The flood runs at the rate of 2 knots to the westward.

Tides.—During the shifting months of the Monsoons the tidal streams are regular, but during their strength the surface current will always be more or less governed by the wind.

The flood tidal wave comes from the northward, and runs nearly parallel to the east coast of Bintang, along its southern sides towards Abang strait, and to the northward in Rhio strait, meeting another tide from Singapore strait near the town of Rhio.

The flood sets to the southward along the east coast of Linga, and close to Tanjong Eung, its south-east extreme; from thence it runs west to Ponoebo strait, and obliquely across Linga bay to Brahalla strait. From Tanjong Eung to Pulo Taya, and onwards to Banka strait, its direction is nearly south; another stream from about 2 miles south of Taya sets towards Brahalla strait.

The ebb stream sets in the opposite direction, and the meeting of this stream from Banka and Brahalla strait was observed to take place near the supposed position of Smith bank.

Winds.—During the shifting months of the S.E. Monsoon, sailing-vessels are often 5 and 6 weeks in making the passage from Singapore to Banka strait. In the month of September, the *Saracen* had the S.E. Monsoon strong, with much rain; about the equinox there were several heavy squalls. This Monsoon is generally supposed to shift about the beginning of October, but during the whole of this month the wind was only 4 hours from the northward, there being a succession of calms, light southerly airs, a close muggy atmosphere surcharged with electricity, and frequent heavy Sumatra squalls or south-westers. On the 9th of November the Monsoon shifted with furious gusts.

These squalls at this season generally take place at night, accompanied with heavy rain, thunder, and lightning. They are of short duration, and it was noticed that when one occurs about the time of full and change, another may be expected an hour later every night till the next change of the moon.

Rhio Strait.—In this strait, owing to the similarity in the appearance of the coast, which is covered with trees, it is extremely difficult for a stranger, especially in thick weather, to recognize the different points and islands. The following brief observations, taken in the *Saracen's* passage through from Singapore, may therefore be found useful.

The ebb from Singapore meets the flood setting through Rhio strait about the Pan shoals; vessels therefore weighing at high water from Singapore will carry a fair tide through both straits.

The Governor's house at Singapore bearing West, leads 2 miles south of Johore shoals; and Johore hill, North, leads east. Entering Rhio strait, pass eastward of Pan shoals, and to do so, be careful not to bring Johore hill north of N.N.W. ½ W. until Barbukit hill bears N. ¼ W. The above hills bear a slight resemblance to each other, being of the same height, and of a pyramidal shape. Barbukit may be recognised by the low land adjoining it; Johore terminates abruptly to the point forming east entrance of Tambuk strait.

Pulo Skeree, on east side of entrance of Rhio strait, is of an oblong form, about 80 feet high, and will be recognised by the coast near it receding to the north-east, in the direction of Subong river.

Maling Jarong are a group of flat rocks, extending nearly a mile off shore, with a single clump of trees upon them. Datached rocks will be seen at low water nearly to West point, which presents a round, shelving appearance, and may be approached nearer than the land northward of it.

Pulo Bato, fronting the bay between West and Bato points, lies nearly north and south, and with the exception of a round lump, which rises in its centre, is lower than the adjacent land. There is deep water in the bay between it and the shore, but its south end is nearly connected with rocks to Bato point. Vessels occasionally anchor off its northern end. At Bato point the land recedes abruptly to the eastward.

Loban Islands, lying south of Bato point, may be recognised by the gradual rise the largest island takes from its north end to a round hummock in the centre, which with the islet off its west end, Loban Kitjel or Little Loban, present, to vessels approaching them from the westward, the appearance of three distinct hills.

Between these islands and Bato point are numerous rocks, one of which, named Dessa, is conspicuous from having a solitary tree upon it.

It was too dark to see the *beacon* on Isabella shoals, and the *Saracen* anchored for the night 2 miles S.W. of Tercoli island.

Pulo Tercoli is low, flat, and about 30 feet high, and like the other islands entirely covered with trees. Bintang hill, rising from a broad base, is visible in clear weather throughout the strait. Its flat peak bore when in line with the extremes of Tercoli, N.E. ¼ E. and N.E. ½ E.

Pulo Pankel at a distance makes as two distinct round hills; on a nearer approach a sandy beach will be seen at its south end, from which rocks and fishing stakes extend nearly ¾ of a mile.

Mobat Islands.—At 2¾ miles westward of Pankel is the largest and highest of the two Mobat islands, readily distinguished by its prominent position, and the deep inlets to the west and south. It rises to a round peak, with the greatest

declivity on its west side; whilst the smaller island, or West Mobat, is considerably lower towards its centre.

In the inlet to the southward of these islands are two prominent rocks, bearing a striking resemblance to boats under sail. Great Garras island has a flat summit, terminating with abrupt points. Little Garras, lying off its south-east end, is of a triangular shape.

The **Topies** are a cluster of small round islets and rocks, similar in form and appearance; the northern, 112 feet high, and the southern, about the same height, are the largest of the group. When approaching the latter from the northward, it appears of a crown shape, and in clear weather may be seen 10 miles off.

Alligator Island, off the west end of Pulo Siolon, trends nearly north and south, and its highest part, 162 feet high, is at its northern end. Approaching from the northward, it appears to have a gradual declivity to its southern end; but when abeam, it shows as three round lumps.

Pulo Siolon.—South-west hill, at the south-west end of this island, when seen from the northward, makes with a peaked top about 246 feet high; but when viewed from the southward, it assumes more of a double peaked hill, terminating to the westward in a point which forms the south-west extreme of Siolon or Apen island.

At 4 miles eastward of South-west hill is Siolon hill, which has a flat table summit, and is remarkable from its being the highest in Siolon island. It rises abruptly from the northward to an elevation of 537 feet, and terminates to the southward in a bluff point, close to which is Segai islet, which is lower than the adjacent land. At a distance of 12 miles to the southward, both Siolon and South-west hills, owing to the land between them being low, appear as islands.

Pulo Talang may be known by a square hillock over its south-east end, which with a sharper peak west of it, forms a saddle. The land from thence to the western end of the island is of nearly the same elevation.

Pulo Dumpo, a small round island, on the west side of entrance of Rhio strait, and to the southward of this, the high conical peak of Rodong, the only hill of this feature in the vicinity, with South-west hill on Siolon, Pulo Talang, and the extreme land to the eastward (Pulo Gin, with a flat peak near its centre) will, at a distance of 14 miles, readily show the approach to Rhio strait, whilst, at a nearer distance, the Topies, Alligator, and other islands just described, cannot fail to point out the southern extreme.

Hendrik Jan Rock, on which a Dutch ship of that name struck in February 1861, is a dangerous pinnacle, off the South entrance of Talang island nearly awash at low water, and steep-to, having 9 and 10 fathoms close around it. It lies S.E. $\frac{3}{4}$ of a mile from south-east point of Talang, with the summit of South-west hill just shut in by south-west extreme of Talang.

This rock is of small size, and there was great difficulty in finding it. Several other shoal patches were found in the channel between Talang and Pulo Gin; but they all, except the Hendrik Jan, lie out of the track of ships, unless this channel is mistaken, in thick weather, for the entrance of Rhio. Vessels should

give these islands a berth of 2 miles in passing, and not bring Polo Terobi east of E. ¼ N., until South-west hill comes well open of Pulo Talang.

Durian Strait.

The *Saracen* left Banka strait on 24th December for Singapore, and worked to windward along the Sumatra shore, filling in the soundings and contour of the 3-fathoms line to Tanjong Bon. Here, as was anticipated, a spit of 3 fathoms was found at 10 miles S.E. of this point projecting nearly 3 miles east from the ordinary depth inshore.

During the prevalence of strong northerly winds in the months of December and January, sailing vessels will save much time by adopting the route through Brahalla and Durian straits to Singapore, for here they will have smooth water, good anchorage, and but little tide, whereas on the east side of Linga at this season of the year, there is generally a heavy sea, and a southerly current sometimes running at the rate of 3 knots. In Brahalla strait vessels will also be greatly assisted by the squalls from the Sumatra coast.

Bank off False Durian.—Caution should be used in approaching Durian strait, as a bank of sand and shells, carrying a depth of 3 fathoms, lies 1 mile South from the rocky islet off the east extreme of False Durian. Near the centre of the bank the high peak of Great Durian is just open east of this rocky islet, and False Durian peak bears N.W. ¼ W. Vessels from the southward after passing South Brother island should give the south side of False Durian a berth of 4 miles, as other shoals extend nearly this distance on the above bearing.

All these dangers will be avoided by keeping South Passage island, or west end of Little Durian, open east of the rocky islet off east extreme of False Durian; or by not bringing the latter north of N.N.W. until nearly abreast of it, when it may be approached to 2 cables.

Prince Island, on the west side of Durian strait, is a coral formation not much above high water, but having some soil between the rocks. It is covered with trees, and their height being about 100 feet the island has a round and conspicuous appearance. On the eastern side there is a coral ledge, nearly awash at low water, extending 3 cables beyond the trees, and E.S.E. from the south extreme of the island.

Dangers Eastward of Bintang.

Panjang Island must be approached with great caution, especially off the north-east point, where rocks extend 1 mile from the shore. On the north-east side of the island the coral reef (which as a rule fringes all the other islands and east coast of Bintang) is absent, leaving a small sandy bay, where vessels may anchor in 8 or 9 fathoms, about ¾ of a mile from the shore. As the bottom in parts of this bay is foul, great care must be taken to keep two rocks, named in the

Admiralty charts Bare rocks, open of a small islet with a single tree on it, forming the south extreme of the bay. Wood and water may be procured in this bay, and boats may approach close to the beach at all hours of the tide.

Pulo Ruig or Ragged Island, appropriately named from the irregular appearance of the trees on its summit, is the outer and easternmost island of those off the east coast of Bintang. This island is about the same size and height, 315 feet, as Pulo Borean, and is steep at 3 cables off. There is a coral bank with 3 to 5 fathoms over it, and about 1 mile in extent, with Pulo Ruig bearing E.N.E. distant 5¼ miles. Pulo Borean, or Saddle island (from its shape), bearing S.S.W. clears the eastern side of this reef.

A rocky patch, with 3 fathoms over it, also lies with the Boat rocks, bearing N.W. by W., distant 1 mile.

Raleigh Bank, the position of which is marked in the Admiralty chart as doubtful, with 4 fathoms over it, carries only 2 fathoms over a coral bottom. Pulo Borean, or Saddle island, bears from it W. by N. ½ N., distant 5 miles; and Pulo Ruig N. by E., 11 miles.

The Bank South of Saddle Island, placed in the chart as having 7 and 9 fathoms on it, carries only 2 fathoms over coral and sand. This shoal is nearly a mile in length, and ½ a mile in breadth; from the centre of the shoal Pulo Borean, or Saddle island, bears N.W. ½ N., distant 4½ miles.

Several other knolls with 4 and 5 fathoms over them lie between this shoal and the Geldria bank, of which they are considered to be a continuation; they should be avoided by vessels of heavy draught. Pulo Terobi, the southern islet off Pulo Gin, bearing W. ¼ S., clears the south extreme; and the Boat rocks in line with Pulo Borean (Saddle island) W. by S. ¾ S., or Pulo Ruig N.N.W. ¼ W., clears the north extreme. No good near marks can be given to clear the eastern side, which is steep-to, but the high peak of Linga bearing S.S.W. ½ W. is a broad and distant clearing mark, and leads over a large bank carrying 7 to 10 fathoms.

Frederick Reef, awash at low springs, consists of two rocks about a cable apart, near the middle of a coral bank 3 cables in length north and south, and nearly 2 cables in breadth, having 20 to 22 fathoms all round, except at the north-east side, where irregular soundings from 10 to 13 fathoms extend ½ a mile from it. From the centre of this reef Pulo Ruig, or Ragged island, bears N.W. ½ N., 23¾ miles, and Pulo Borean, or Saddle island, W.N.W. 21⅔ miles.

In the vicinity of this dangerous reef in light winds the discolouration of the water is the only guide, and in fresh breezes it is difficult to distinguish breakers from the swell. Breakers on the reef can only be distinguished when the tide is setting against the wind with a comparatively smooth sea. Off Bintang island at the change of the monsoon in April, the flood runs for 8 hours, and the ebb 6 hours. In June the tides are reversed, consequently a tide against the wind will only take place a few hours each day.

As this most dangerous reef lies in the direct track of vessels, the utmost care is necessary to avoid it. A vessel will clear it to the eastward by not going into less than 25 fathoms, and to the westward by keeping Gin peak, (a conspicuous hill, 337 feet high,) Gunong Kwas (857 feet high, on Bintang,) and Pulo Borean well in sight, until the latter bears W. by N. The high peak of Linga island S.S.W. ½ W., or Pulo Ruig bearing from N.N.W. to N.W. by N. will also lead clear.

From a close examination, and soundings having been taken in every direction to the extent of 7 miles eastward, and from 4 miles south of the reef to the Geldria bank, Mr. STANTON is led to believe that this reef is the only danger in that vicinity.

The reef is in Lat. 0° 39′ 4″ N., Long. 105° 10′ E., or 41 miles eastward of Great Bintang hill.

Sand Bank South of Pulo Gin.—A bank carrying 7 and 8 fathoms over it lies S.S.E., 16 miles from Pulo Gin. It is 17 miles in length in a N.N.E. and S.S.W. direction, with its eastern side steep. At the northern end of the bank Pulo Ruig bears N.N.W. ¼ W., which clears also the Geldria and Frederick reefs. In the N.E. Monsoon much rain and thick weather is experienced, and this bank is a good guide to clear the reefs and will save anchoring in deep water.

Brakit Rock, a cable in length, in a N.W. and S.E. direction, and ½ a cable in breadth, with 2 fathoms over it at low water, lies N.N.E. ¾ E., 2¾ miles from Tanjong Brakit, the north-east point of Bintang, having 10 to 12 fathoms close to it all round.

At the southern and shoalest part the north extreme of Pulo Sumpat appears in line with the apex of Little Bintang hill S.W. ¼ S. A conspicuous double tree on a long hill 4 miles from Tanjong Lokan appears just inside the point bearing S. ½ W. This tree kept well open of Tanjong Lokan clears the eastern side; Pulo Panjang peak S.E. ½ S. will clear both the eastern and northern sides; Barbukit hill, about 4 times its own breadth open eastward of Horsburgh lighthouse, will also lead a vessel northward; and Little Bintang hill well open north of Pulo Sumpat clears the western side of this rock.

Pulo Sumpat, a small island 178 feet high, will be known by its saddle shape. The four wrecks shown on the chart off Brakit point have disappeared.

The Coast.—Pulo Cocob, forming the eastern side of Brakit point, may be approached within ½ a mile; from thence southward to Black rock, which is steep-to, the soundings shoal gradually, and the lead is a good guide.

Black Rock may be approached to 2 cables. At nearly 3 miles S.S.E. ½ E. from the Black rock, in a direct line to Pulo Soto or Volcanic island, is a dangerous pinnacle rock awash at low water with 10 and 11 fathoms close to it. By not bringing Black rock to bear northward of W. by N., a vessel will pass well to the northward of it, or keep without the direct line between Volcanic island and Black rock.

Pulo Suto, or Volcanic island, is steep-to on its north side, but a reef of coral extends ½ a mile from its southern extreme.

Tides.—It is high water at full and change at Horsburgh lighthouse at 10h. 10m. p.m.; at Tanjong Brakit at 11h. 0m.; at Pulo Suto at 3h. 40m.; at Pulo Panjang at 4h. 20m.; at Pulo Borean at 6h. 0m.; and at Pulo Terabi at 1h. 0m. p.m.; and the rise is 9 feet, but on some extraordinary occasions it rises 12 feet.

FORMOSA ISLAND:—SOUTH AND WEST COASTS.*

Between South Cape and Ta-kau-kon.

South Cape or Nan-Sha in Lat. 21° 54′ N., Long. 120° 50′ E., gradually slopes down from a peculiarly rugged hill, the summit of which is distant 4 miles, and 1,035 feet high. With the exception of a few bare patches which have been burnt, the whole of the cape is thickly wooded. The cape or point is fringed by coral.

South-West Point bearing W. by N., 7 miles from South Cape, is the termination of the Gooswa promontory, an almost level ridge 500 to 600 feet high, which extends 7 miles in a N. by W. direction.

Kwa-Leang Bay formed between the South Cape and South-west points, runs up on the western side to a distance of more than 2 miles. At the head is a white sandy beach, which being under the dark land shows out conspicuously. To the eastward and towards the South Cape are alternate sandy bays and prominent points, three conspicuous black rocks, about 10 feet above high water, lie almost equi-distant from each other, and ½ a mile off shore, they are easily distinguished, and steep-to. On the west side between the points of the bay the depth is 66 fathoms, 1½ miles from the shore. On the eastern side and at the same distance the water is much shoaler, there being only 28 fathoms.

Anchorage.—In the N.E. Monsoon good anchorage will be found anywhere on the north and north-east sides of the bay, in 10 or 12 fathoms, about ½ a mile off shore. The *Dove* anchored on two occasions; on the first at ½ a mile northward of the South cape, and on the second at ½ a mile off the middle sandy bay. In anchoring near the South cape care should be taken as the ebb tide sets with a velocity of 4 knots to seaward and the tide ripple off the point is very heavy.

Caution.—The natives of Kwa-leang bay are hostile to strangers. During the survey the *Dove's* boat was attacked, one man was wounded, and the surveying party narrowly escaped being cut off. It has been, however, reported that Europeans have been kindly treated when in distress.

Gooswa Promontory extends in a N. by W. direction, 7 miles from South-west point. There is little difference in elevation, the southern summit being 538 feet high, and the northern 627. The most conspicuous feature is a sand beach in Chim-kong-o bay, a mile north of South-west point. When approaching the promontory from the northward it appears as an island; the shore is steep-to; at 2 miles off there are 200 fathoms water, and at a ¼ of a mile, 50 and 60 fathoms.

Lung-Keaou Bay is formed between the north extreme of the Gooswa peninsula, and a sugar-loaf hill (411 feet high) and is 4 miles in extent; from the middle of the bay is a projecting sandy point, with low water rocks extending 2 cables from it. A small walled town stands at the back of the bay about a ¼ of a mile from the beach.

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* These remarks on the south and west coasts of Formosa (or Taïwan,) between the South Cape and Ta-kau-kon, and between Ka-kaou and Wanckan,—also on the Formosa banks, are by the officers of the *Dove*, tender to H.M. surveying-vessel *Swallow*.

To the northward of Gooswa promontory the coast is inhabited by Chinese, the natives living in the mountains, and seldom visiting the coast; perpetual warfare is carried on between the two, and whilst surveying the coast the travelling parties of Chinese met with were always armed with gingalls and swords.

Anchorage.—Good anchorage may be found in this bay in from 5 to 10 fathoms during the N.E. Monsoon; with the sandy point bearing N.E., distant ¾ of a mile, there is good holding ground, as also midway between the point and the sugar-loaf, in 8 or 9 fathoms.

Le-Lieng-Swa is the northern termination of the higher mountains of Formosa, and rises to the height of 2,365 feet. There is but little difference in the elevation of this range through an extent of 5 miles. The highest summit, when seen from the north and west, makes as a pap.

Che-Tong-Ka projects half a mile from the foot of the high land, and bears N. by W., 13 miles from Gooswa promontory; the coast is bold and steep-to, the hills descending almost to the water's edge. Vessels can anchor anywhere along the coast in 8 or 9 fathoms, finding good shelter from winds ranging from North round to S.S.E. Two miles north of Che-tong-ka the bold land terminates at the front of a hill 1,340 feet high, whence the mountain range trends to the N.N.E., and the shore, which is low and level, to the N.W.

Lambay Island is the only island on the west coast of Formosa. Its summit is flat, the most elevated part being 258 feet, this is in Lat. 22° 20′ 30″ N., Long. 120° 22′ 30″ E. The island is 2½ miles long in a N.E. direction with an average breadth of a mile, its shores are fringed with coral; the northern shore is rugged with a few small sand beaches, the south-eastern has a sand bay half a mile in extent near the middle. The most conspicuous point is the north-eastern, which is round, and composed of fine white sand. Houses, inhabited by fishermen, are scattered over the island. No anchorage can be obtained near this island, as within a ¼ of a mile there are 30 and 40 fathoms water.

Tang-Kang River has its entrance N.N.E., 7 miles from the north point of Lambay island; at low water there are only 4 feet on the bar, which shoals suddenly from 20 and 30 fathoms. The entrance generally can be distinguished by the junks which are moored on the north bank of the river, as also by a clump of trees which is seen a little distance to the eastward and about 2 miles inland. The town stands on the south side of the river near the entrance, and has about 20,000 inhabitants. The principal export is rice, which is carried in junks of small size. Between Tang-kang and Lambay is a remarkable depression in the sea bed, being in some places nearly 200 fathoms in depth. Abreast of the river is the only place between Ta-kau-kon and Lung-keaou bay where a ship cannot find good anchorage in the N.E. Monsoon.

Hong-Pe-Taou, a rocky point between Ta-kau-kon and Tang-kang, is the termination of the smooth and slightly-rounded Hong-swa, which is 468 feet high. Between the hill and point is a well-marked saddle hill 259 feet high; which, when seen from the north or south, appears as two chimneys. Towards Ta-kau-kon the coast is low and bushy, and is inhabited by fishermen who live in scattered houses. The large lagoon which terminates the harbour of Ta-kau-kon, stretches up to within 2 miles of Hong-swa, leaving only a narrow slip between it and the coast.

Ta-Kau-Kon, the Consular port of Tai-wanfu, is the only harbour on the west coast of Formosa available for vessels of 12 feet draught; the entrance is midway between Saracen's head and Ape hill, and the fair channel is only 200 feet wide. The bar is ½ of a mile off the entrance, and has 10 and 11 feet at low water spring tides. Immediately inside, and facing the entrance, is a sand spit with 7 feet on it at low water, which narrows the harbour to 200 feet, and ships being towed in or out frequently ground on it.

Directions.—Vessels making for this port will easily distinguish the entrance. Ape hill, with its flat top. 1,110 feet high, and large white landship facing to seaward, can be seen in clear weather upwards of 30 miles. To the southward is Saracen's head, appearing as a detached portion, and the small gap between the two is the entrance to the harbour. If obliged to run for the entrance in bad weather, bring it to bear E. by S. ½ S., and run boldly in, keeping the northern shore close aboard. As the rocks are neared, starboard the helm and round the northern head close-to, shooting into a little sandy bay, where a vessel may touch the ground with her forefoot without sustaining any damage, afterwards hauling into a berth, mooring head and stern. Small vessels drawing 8 and 9 feet can run past the moored shipping, keeping the northern head on a West bearing, anchoring in less than 2 fathoms, and veering chain just sufficient to swing clear.

Sugar and rice are the chief exports; barques of 400 tons load to the draught of 12 feet, completing the cargo in the roadstead. The harbour is filled with 14 or 15 vessels. There is a good Chinese pilot, who also supplies catamarans for towing vessels in or out.

Coast between Kakaou and Wanckan Reef.

To the northward of Fort Zealandia the coast has no distinguishing feature, the highest bushes and huts being but a few feet above the low level land.

Kakaou, in Lat. 2a° 13′ N. Long. 120° 3′ E., is a temporary fishing village, standing on the north bank of a small and narrow inlet, in the entrance of which there are 8 feet at low water; only boats can enter this inlet, and when blowing a strong monsoon it is attended with difficulty, as the sea breaks the whole way across.

Paw-tay-chui bears from Ka-kaou N.N.E. ¼ E., distant 11 miles. The coast between is a low narrow strip of land, which is only 4 or 5 feet above high water. The town is a mile from the entrance, the inhabitants of which are piratical, and often bid defiance to the mandarins. The entrance to this small inlet is from the N.N.W., and also difficult of access when the monsoon has any strength. S.S.W. of the town of Paw-tay-chui is the most conspicuous landmark between Wanckan and Kakaou; it is a mound 1¼ miles inland, and covered with trees and huts; the native name is Ang-hay-kang. West of this a spit extends for nearly a mile off shore.

From the entrance of Paw-tay-chui the coast stretches in a N. ½ W. direction 6 miles; the trees inland are thicker and more continuous than to the southward, and when seen from that direction the northern extreme appears as a bluff.

Wanckan Reef or Chin-ne-ya is the westernmost part of the island of

Formosa. The small sandy patch on the south end, on which a hut is erected, is only 1 or 2 feet above high water, and is in Lat. 23° 31′ N., Long. 120° 2′ E. To the southward at low water the reef dries nearly 2 miles and continuous in a N. by E. direction. S.S.W. from the hut, distant 3 miles, is a patch with only 4 feet on it at low water. The Wanckan reef may be considered the great danger in the Formosa channel, and the Chinese say that there are many junks and ships lost on it during the year. When coming from the north or south there are no land marks to guide the navigator, and the strong tides experienced render a ships' position at all times doubtful. Running parallel with the dry part of the reef, and 3 miles distant, is a long patch, with from 2 to 3 fathoms on it; this in the S.W. Monsoon breaks with great violence. The *Swallow* and *Dove* whilst sounding the channel in September 1864, anchored in 20 fathoms off the reef, and saw nothing but one continuous line of breakers as far as the eye could reach.

Ay-aw Bay, formed by the Wanckan reef and the low opposite shores, runs north and south for a distance of 4 miles, and in some places it is 2 miles wide. A narrow channel with 10 feet depth of water can be traced out, which for junks and small vessels affords anchorage and shelter. In the S.W. Monsoon entering the inlet would be attended with almost certain destruction, but in the N.E. Monsoon good shelter can be obtained outside. Sugar is the principal export, which is shipped in junks of about 200 tons burden. This small place has much deteriorated during the last few years.

S. by E. 7 miles from the hut on Wanckan reef, and W.N.W. 4 miles from Paw-tay-chui is a sandy patch with 2 fathoms on it at low water, which must break heavily in the S.W. Monsoon. The depths on the coast are 8 and 9 fathoms at 3 miles West of Kakaou, 9 and 10 fathoms 6 miles off Paw-tay-chui; and 5 miles West of Wanckan reef there are 40 fathoms fine dark sandy bottom.

Tides.—It is high water full and change at Wanckan at 10h. 10m., and springs rise 5 to 6 feet. The tide turns with high and low water by the shore, the flood running 3½ knots, and setting to the N.N.E., the ebb in an opposite direction, and not quite so strong. Between Wanckan and Kakaou the tides do not attain a greater velocity than 1½ to 2 knots, and run parallel to the shore.

Remarks on Formosa Banks:—Considering the limiting edges of the Formosa banks to be a depth of 20 fathoms, their northern edge will be in Lat. 23° 28′ N., Long. 118° 25′ E., and their eastern side in the parallel of 23° N., and Long. 119° 15′ E. The western edge of the bank can scarcely be delineated, as it stretches from the Lamock islands without any marked irregularity in depth. The shoalest part, 5 fathoms, is in Lat. 23° 1′ N., Long. 118° 29′ E. The banks are formed of coarse white sand, with patches or mounds with from 7 to 10 fathoms water on them, these patches lie between the parallel of 22° 40′ and 23° 15′ N., and between the meridians of 118° 10′ and 119° E. When sailing slowly through the water and sounding, it was frequently found to shoal suddenly from 18 to 8 fathoms, increasing in depth again as rapidly. Heavy overfalls generally indicate these sudden variations in depth. Fish abounds in large quantities; immense shoals were seen in the months of April and May. The current during those two months was generally found setting to the N.E., 1 mile an hour, increasing in strength as the coast of Formosa was approached.

General Remarks:—Vessels trading between Ta-kau-kon and the port of Amoy should endeavour to sight Junk island, which is the most southern of the Pescadores; the course between is N.W. and S.E., which leads 10 miles to the northward of the Formosa banks. If making the passage from Amoy, Ape hill will be visible shortly after Junk island is passed, as it can be seen in fine weather upwards of 30 miles. Should the weather be thick, and the ships' position uncertain, the lead can then be relied on. If abreast of Ta-kau-kon, or to the southward, 100 fathoms and upwards will be obtained; if off Tai-wanfu or Kok-si-kon, 70 or 80 fathoms will indicate the position. The nature of the bottom can scarcely be depended on, as it varies from mud to fine dark sand and shells.

Vessels leaving Ta-kou-kon for Amoy in the N.E. Monsoon will gain most ground by working up the Formosa coast, as they are then enabled to stand through the Rover channel, after which, a moderate sailing vessel will be able to fetch Amoy.

Ships making the passage from Hong Kong to Shanghai during the S.W. Monsoon should sail through the Pescadores channel, as the current is steady in strength, seldom running more than a mile an hour, and the channel, compared with that of Formosa, is free from danger. Vessels from Hong Kong, bound to the northern ports, in the latter part of the N.E. Monsoon, with the intention of beating up east of Formosa, will sometimes meet with a south-easterly breeze off the South cape; should this happen it will be prudent to run up the west coast, taking care, after passing Ta-kau-kon, to sight the Pescadores, which will insure clearing the Wanckan reef.

ON THE PASSAGE THROUGH TORRES STRAITS.

[The best directions for the route through Torres strait will probably be the description given by a well-known and experienced shipmaster.]

Captain Charles Harrold, writing to the *Mercantile Marine Magazine*, June 1860, says:—"Having made the passage from Australia to India through Torres straits upwards of a dozen times, and hence having had considerable experience of this route, probably the following remarks may prove acceptable to those commanders who have not been through before.

A ship leaving Sydney early in the season, from the beginning of April to the middle of May, should at once get an offing; later in the season (and with strong westerly winds) it is better to keep the land on board as far as Solitary isle or mount Warning; but should the wind veer to the southward with a rising glass, shape a course at once to pass 40 or 50 miles to the eastward of Cato bank; steering on a northerly course, keeping at least a degree to the eastward of Kenn reef, after passing which, a north-westerly course may be pursued, taking care to give the Alert and Lihou reefs a good berth of 50 or 60 miles. After leaving these dangers, there is nothing on the track to the Great Barrier;—the Osprey reef, and some others to the south-eastward are quite out of the way, and a ship has no occasion to go near them.

In approaching the Great Barrier, considerable care is necessary, if no observations for latitude have been taken; and an allowance must be made for the north-westerly set, so as not to get to the northward of Raine island *beacon*. The plan I always adopted was—*not* to run down on the Barrier and work to windward all night, but should the ship be upwards of 200 miles off at noon, and not be able to enter the next day, I would reduce sail at once and steer slowly on a course from 2 to 5 knots, according to distance, so as to reach within 30 miles of the Great Detached reef by the second morning, at daylight. Should no observations for latitude have been taken (or whether or no,) when breakers are sighted from the masthead, ahead of the ship or a little on the port bow, as you draw towards the reefs, or should you see them on the starboard bow as far as can be seen from the masthead, you may be sure you are to the northward, and should haul up immediately on the port tack; and if the wind is far enough to the eastward to lay along the reef, you will soon see clear water, and sight the *beacon* from the masthead; or should it be the Great Detached reef that you sight, clear water will be seen on the starboard bow, and by edging to the W.N.W. you will shortly see the *beacon*. I have always found this a good guide for Raine's island, for if you get too far down towards the reef before you find out your mistake, you will have great difficulty in working to windward. Should you be to the southward, which will rarely happen when steering for the Great Detached reef, you will be sure to see Yule's reef, and could then take Stead's passage, which, however, is not very easy to make.

After making the *beacon* and steering down with it, a little on the starboard bow, the edge of the Great Detached reef will be distinctly seen, also the reef off Raine's island; when the *beacon* bears North, haul up S.W. by W.; after a few miles a very small sand bank will be visible from the masthead, on the starboard bow, and if you see it distinctly from the deck of a small vessel you are falling to leeward, and should haul up more to the southward. This is one place, I think, that should have a mast with a sort of basket-top placed on it as a beacon; it would be a good guide for ships entering late in the afternoon; for, after passing this, you are near the edge of soundings, and with night coming on, after getting on soundings, you should haul well to the southward and bring up at dark, taking care to give at least 60 or 70 fathoms of cable, as the holding ground is very bad (hard coral). From this anchorage keep well to windward of the course until you sight either Ashmore banks or Middle banks. Ashmore banks show much higher out of the water and whiter than the Middle banks, which latter are at high water nearly covered; this also would be an excellent place for a mast-beacon. If there is sufficient daylight to reach Ashmore banks or under the lee of Cockburn reef, a better anchorage may be obtained. Or if it should be blowing a gale with squally weather, good anchorage in smooth water may be obtained under the lee of Sir Charles Hardy's isles; in going in, keep close to the weather island and anchor well to windward in a small sandy bay,—by so doing you will be in a better position for weighing in the morning. In anchoring here one voyage the chain fouled on the windlass, and before the other anchor was let go, we were mid-channel. Next morning the tide would not let the ship cant any other way than head to the northward, the topsails were single reefed and yards hoisted to the masthead before we commenced heaving; the ship broke ground with the 15-fathom shackle in the hawse, and before we got the anchor off the ground and sail made we were close down on the leeward island, and only cleared it by

scarcely a stones throw. In coming out from here you will have to keep N.E. by N. for a few miles, and might have to tack should the wind be to the eastward, but you can see the Middle and Ashmore banks quite plainly. If there is sufficient daylight to reach Cockburn reef, it will be found a still better anchorage than under Ashmore bank. It is quite smooth, especially at low water, although you require a good scope of cable, as the ground appears to be hard coral. In weighing from here you will soon see the edge of the reef that stretches to the N.W.. and you may run down towards it until you can see it distinctly from the deck; then edge away along the reef, and, as you draw towards the end, you will see two sand-banks; the nearest one is small, and probably may be covered at high water, although I have never seen it quite covered, but you will be sure to see it from the fore-yard before you get too close, and very likely before they see it from the masthead. If bound to Bird islands, haul close round the small sand-bank, leaving the large bank on the starboard hand; this bank is high out of the water, with an extensive reef running off the weather side of it, which is also seen distinctly from the deck. This track I prefer to going close round the end of Cockburn reef, and having to haul to the southward. If bound on to Cairncross islands, leave the large bank also on the port hand, and, steering for Hannibal island, reefs V. and W. will be seen, also the Boydong cays; reef V. has a small sand bank on it.

After passing V. and W. reefs, the greatest danger of Torres straits is past, and all sail may be carried down to cape York; or anchor at Cairncross, and the next day, with a fresh breeze, you will get out in good time.

If the wind should be light, and a ship not able to reach cape York or mount Adolphus before dark, anchor close under the lee of a small sandbank at the end of reef X, which is far preferable to Turtle island; but should the night be fine and moonlight, having reached thus far, a ship could run on, and passing Albany isle, anchor round cape York. If rounding this cape in daylight, anchor abreast of two rocky islets, a short distance past the cape, in 7 or 8 fathoms water cape York bearing E. ½ N. and Peaked hill S.S.W.,—this is a very good anchorage and you will be in a position to choose either Prince of Wales passage or Endeavour strait.

If intending to pass through the Prince of Wales channel, (which is as good as buoyed and beaconed by the Hammond rock and the Ipilli and North-West reefs, with no danger excepting a strong tide), should the wind be light and contrary, after passing the Albany isles steer to pass Ince point one mile off, taking care to avoid rock (*a*); the north-west reef can be seen from the mast-head a long while before you reach the point; at any rate, should it be hazy or squally, by passing point Ince, close, the North-West reef will be avoided, and Hammond rock will be seen; steer to pass close to, and before reaching it the Ipili reef will be distinctly visible, the rocks on it sticking up above water. Borrow towards the Ipili reef to clear the Sunk reefs; after passing this danger, the last in the strait, Booby island will be seen. Should you intend to anchor, leave the island on your port hand as the reef extends to some distance off the other side. The landing is very bad at low water, but you can pull close to the entrance of the cave at high water. I was once detained from noon till 9 P.M. landing a few casks of water sent by the Government.

If intending to go by Endeavour straits, which is quite safe, after passing Possession isle, you are soon out of the strong tide. I have always passed close

to a high rugged island (Entrance island) west of Great Woody isle, as far preferable, and it leads you clear of M'Kenzie and Gibson rocks. My last voyage I towed through with the boat a-head, and shortly after a breeze came from the S.W., and squally, and we worked down within 3 or 4 miles of Red Wallis island, and brought up when the tide turned. Should the weather be fine and clear as you draw abreast of Red Wallis island, a good mark for mid channel is cape Cornwall on with Peaked hill, from which, steer to pass out to the south of Rothsay banks.

For Stead's passage no better directions can be given than those of Captain Towns, written upwards of twenty years ago, and which have, I believe, been printed in Horsburgh's Directory. The other passages to the southward are no doubt very good, but I cannot see the advantage of taking them, unless a good channel were surveyed in-shore towards the Bird islands, without having to go *via* Hardy isles and Cockburn reef. The Black rock, Captain Blackwood says is the best passage, but gives no directions for proceeding after entering.

In conclusion, I again repeat, that in running for the Great Detached reef, 25 to 30 miles is quite close enough to come to it until daylight; for if a ship get to either Ashmore bank, or Cockburn reef the first night, or even only just on soundings, she will reach Cairncross island the next day, and out clear the day following,—and she would not do any better by getting in earlier; she might reach Bird island the first night, but she would have to anchor under cape York the next, unless she were a very fast ship, and had wind and tide in her favour, —she then *might* get through: but it rarely happens that a ship gets through with once anchoring; and it is certainly not worth the risk of running down close on the barrier for the sake of 12 hours. I have often gone through it in 48 hours, viz.—26 at anchor, and 22 under-weigh. I am satisfied, that nearly all the wrecks have taken place through the anxiety of masters to get in early, and thus running down too close on the Barrier: the wrecks inside I attribute to going off the tracks laid down, and running in squally and thick weather. Great improvements might be made by placing a few mast beacons (with basket-tops to distinguish them by) and buoys at various places, which would render the passage by Raine island much easier for a stranger going through the first time.

ON THE PASSAGE THROUGH TORRES STRAITS BY BLIGH'S ENTRANCE.

Captain W. S. Croudace, writing to the *Mercantile Marine Magazine*, October 1864, says:—"As the great N.E. or Bligh's channel of Torres strait is evidently becoming the favourite passage to and from India, &c., in preference to the Raine island route, and has already called forth through your pages, as well as elsewhere some very excellent articles on its superiority over the latter, I forward the following notes (which were published in the *Sydney Empire*) in reference to the same subject. The comparatively easy navigation of this channel cannot be too widely made known, and I would just observe in passing, that I am quite of the opinion of your correspondent, Captain James Turnbull, of the *Glen Clune*,

as well as with many others with whom I have spoken, that the extravagant rates of insurance demanded for vessels navigating Torres strait, might at once be abolished, if ships were bound to adopt the N.E. or Bligh's channel in passing through that strait.

"Left Sydney July 1st, 1860, becalmed 40 miles from the heads for five days; then a nice westerly breeze took us down to the Trades; pursued the new route, as published by Captain Denham, R.N., through the Coral sea, as far as Lat. 18° S., Long. 155° E., from which point, instead of steering for Raine island, we shaped a direct course N.W. ¾ W. by compass, to pass midway between the Eastern Fields shoals, and the coast of Guinea, and on the morning of July 17th, at 7 o'clock, we sighted the breakers on East cay, having seen nothing from the above given point of departure, until sighting the cay itself; the weather was very hazy on this run of nearly 700 miles, and the nights very cloudy; we felt little or no current, and the ship made the course good very accurately; we ran down fearlessly until we sighted the cays, never having reduced sail; at 8 A.M., the 17th, we were abreast of Anchor cay, the opening to the great N.E. channel, and having passed it, we hauled up, and by 6 P.M. (same day) we had reached Dove islet, and anchored under the lee of an island (without a name) bearing E. by N. from Dove islet; the next day the weather was very unsettled and squally, with showers; remained at anchor, having been joined by the ship *Storm Cloud*;—on Thursday 19th, at 5 A.M., we both weighed and proceeded for Prince of Wales channel, passing close round Bet rock or islet; and thence close past Ninepin rock. The course from this rock to the entrance of the Prince of Wales channel is S.W. ½ S. by compass, and by reference to the Chart sheet No. 1, Admiralty, latest edition, there appears to be no dangers in the way, with depths of 8 and 9 fathoms. As we neared Double island, and mount Earnest, the look-out from the fore-topsail yard, reported breakers on the starboard bow, and as we approached them, the ship's position was taken as accurately as the opportunity afforded by prismatic compass, and the shoal at the same instant being judged nearly one nautical mile distant, was placed as follows:—A line drawn from the centre of Double island to the centre of mount Earnest, will pass through the centre of the new reef (now called Campbell reef), and it is 6¾ miles from the former, and 5¼ miles from the latter; it appeared to trend S.W. and N.E., about 1 mile long, and very narrow; should say it may have 4 to 6 feet over it when smooth water. It lays much in the track of vessels coming up from the great N.E. channel; reference to the chart above named will show that in the position we have given it, no soundings have been taken. Captain CAMPBELL, of the *Storm Cloud*, who passed it at the same time, assigns the same position to it. Both ships anchored at Booby island at 1.30 P.M., having come from our last anchorage—80 miles—in 7½ hours. For large, or indeed for any ships, I consider the great N.E. channel preferable to the Raine island passage, there being no sunken reefs or dangers, and smooth water anchorages the entire length, with a bank of soundings as you approach the entrance of the channel; no embarrassment from the glare of the sun, as in the passage from Raine island. As a general rule also, a ship will only require to anchor once, and even that may not always be necessary, for, if taking the channel early, as we did for example, had the wind been more easterly, we should have passed all the narrows before dark, and could then have hove-to until daylight, keeping mount Adolphus in sight, or any of the islands in that locality; but being the syzigy we found the weather unsettled, and the winds far from the south."

Edmund A. Ankers writes as follows respecting this passage through Torres Strait.—(see *Mercantile Marine Magazine*, February No., 1865, p.p. 45-47.):—The ship *Queen of the East*, under my command, left port Jackson on the 29th June 1864, with horses, bound to Madras, and, although I had never been through Torres strait, I determined to take that route rather than attempt a winter passage round cape Leeuwin in a large ship with the (almost) certainty of losing some of the horses. I accordingly took the ordinary route to the northward, but owing to a succession of very light winds, and four days calm, I did not sight the "Eastern Fields" until the 14th July, and from the same cause did not pass Bramble cay until day-light on the 16th, having passed the north end of Portlock reef on the previous evening. The sea breaks high on both Portlock reef and the Eastern Fields, and they are plainly visible from the mast-head at the distance of 6 or 7 miles in clear weather.

July 16th, at 7 A.M.—Bramble cay bearing North, half a mile distant, Darnley Island peak being clearly visible bearing S.S.W., steered a direct course for Stephen island, making due allowance for the tide (the flood setting pretty strong on the weather beam)—the shoal patches northward of Darnley island showing quite plain, being covered with a white sand or ground coral. Carried all sail during the day with studding sails on the port side, the wind being light from E.S.E. at 3 P.M. the weather thick and squally, the rain at times completely obscuring the land, I anchored in 9 fathoms water, the N.E. end of Stephen island on with the peak of Darnley island, about half a mile off shore, the water smooth, and the holding-ground good.

Sunday, 17th July.—Got under weigh at daylight with a fine breeze from E.S.E. and clear weather. Set all sail and proceeded, giving her all studding sails as we went along, passing south of Dalrymple island, and north of Campbell, Marsden, Rennel, and Arden isles, between Dove and Cocoanut islands, and north of the Three Sisters—Bet, Sue, and Poll. The extensive reef running out to the eastward from the northernmost of the sisters (Bet) is steep and free from outlying dangers; I sailed along within a cable of it in order to give a good berth to some shoal patches to leeward, which are, however, plainly visible from the mast-head. After rounding Bet, the Ninepin rock and Saddle island can be seen, if the weather be at all clear—the Ninepin being not unlike a vessel under sail; I then passed between the Ninepin and Harvey rocks; it is better to keep close to the Ninepin in order to avoid some shoal patches which lie to the north of Harvey rocks, some portions of which are only awash at low water. I then steered down for Double island, where I anchored at 11 P.M. in 7 fathoms of water, half a mile off shore.

Monday, 18th July.—Got under weigh at daylight, made all sail and steered down for the Prince of Wales channel, rounding Wednesday spit at the distance of 80 yards, found the tide running like a mill-stream; rounded Hammond rock at 30 yards distance, the eddies so strong that the helm was almost useless. From the top-gallant yard I conned the ship through between Ipilli and Sunk reefs, keeping within 40 yards of the edge of Ipilli reef,—as Sunk reef being covered renders it the more dangerous of the two.

The Prince of Wales channel, which I thought the best, out to the westward, requires very great caution; in passing Hammond rock and Ipilli reef, I feel certain the ship was going over the ground at the rate of 10 knots per hour, the current having such power on the ship that I was compelled to assist the helm

by working the sails, although I had a good breeze at the time. I should therefore consider it advisable, especially if the wind be light and baffling, to take the Prince of Wales channel as near slack water as possible, and am of opinion that a Commander would be justified in sacrificing a few hours in order to accomplish that object, especially in a dull sailing or bad steering ship, rather than run the risk of touching on the reefs just as the passage of the strait may be said to be accomplished. I reached Booby island at noon, hove-to, and deposited a few necessaries in the cave for the use of those less fortunate than myself.

In conclusion, I must express my opinion that with a clear head, a good nerve, and the aid of the excellent and valuable charts published by the Admiralty, no navigator of ordinary capacity need hesitate to take this passage. Every reef, rock, island, and shoal, being as correctly laid down on those charts as the milestones on the Queen's highway.

From Swan River to Singapore.—In both Monsoons adopt the route through Sunda strait, making the land to the eastward in the S.E. Monsoon, but to the westward in the N.W. Monsoon; then pass through Banka strait.

From Singapore to Swan River.—Between November and March, from Singapore strait, proceed S.E.-ward through Karimata strait, and across the Java sea, then through Sapoedie and Baly strait. Between April and October, proceed southward through Banka and Sunda straits.

From Swan River to China.—From April to September, shape a nearly direct course for Sunda strait. From October to March, steer for the N.W. cape of Australia, and take the *eastern route* by Allass and Macassar straits in October and November; but by the Ombay and Gillolo passages from the middle of November to the middle of March.

Of the **three entrances into the China Sea,** that by Stanton channel and Banka strait is unquestionably the safest, considering that both Gaspar and Karimata straits are comparatively unsurveyed,—and this is especially the case when intending to beat against the N.E. Monsoon, or if the weather is variable with calms.

Bound to Singapore vessels will invariably take the Stanton channel and Banka strait, they may then proceed (1) by the *Outer route*—eastward of Linga and Bintang, and making Horsburgh lighthouse enter Singapore strait from the eastward;—or (2) by the *Middle route*, eastward of Linga, and westward of Bintang, through Rhio strait into the middle of Singapore strait;—or (3) by the *Inner route*, westward of Linga, through Varella and Durian straits, past the Raffles lighthouse and entering Singapore strait from the westward. The *Middle route* is generally safe, and having been buoyed and beaconed by the Dutch Government is easily navigable; the *Outer route* is exposed in both Monsoons; the *Inner route* is adopted during the N.E. Monsoon.

CATALOGUE, 1873.

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WORKS ON NAVIGATION,

AND

NAUTICAL INSTRUMENTS,

&c. &c. &c.

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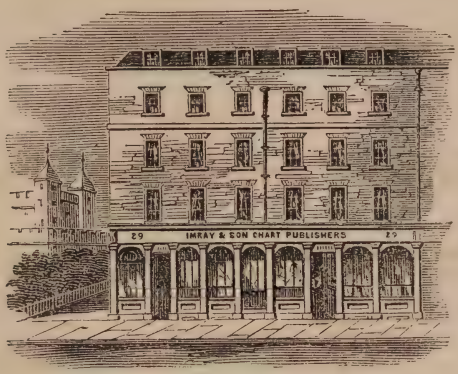

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NOTE.—This chart and the charts of the Estuaries of the Thames, Nos. 8, 9, or 10, will show the navigation from Dover and London to Hull, on a very large scale.

23. **ENGLAND (East Coast of), from Orfordness to Flamborough Head.** On one sheet. Drawn from recent Admiralty Surveys 4/–
On cloth for Captains' use 5/3

24. **EAST COAST OF ENGLAND, from Orfordness to the River Tyne,** with plans on a large scale of the River Humber, Yarmouth Roads, Bridlington Bay, Sunderland, Whitby, Scarborough, Hartlepool, and the River Tyne. On three large sheets. With descriptive notes of the harbours, views of headlands, and of the coast. Accompanied with a Book of Sailing Directions ... 10/–
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NOTE.—This chart, with Nos. 8, 9, or 10, will show the navigation from London or the Downs to Newcastle on a very large scale.

25. **YARMOUTH and LOWESTOFT ROADS.** A small plan chart, showing all the leading marks, lights, &c. 1/–

26. **ENGLAND and SCOTLAND (East Coast of), from Flamborough Head to Cape Wrath and the Orkneys,** with plans of all the principal harbours. On three large sheets. With a book of Directions 10/–
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27. **ENGLAND and SCOTLAND (East Coast of), from Flamborough Head to the Orkney Islands,** with plans of Harbours, and a full description of the signals exhibited at Sunderland and Hartlepool. Compiled from recent surveys. One sheet. 4/–
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29. **FIRTHS of FORTH and TAY.** It shows the rivers on a very large scale and contains plans of the harbours of Leith, Granton, Burntisland, Anstruther, Crail, Pittenweem, Kirkcaldy, Dysart, Buckhaven, Elie, St. Andrew's, Dundee, Arbroath, &c., &c. Accompanied by a Book of Sailing Directions, which contains Coloured Drawings of the Signals used at the various Ports. On two sheets 8/–
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31. **WEST COAST and ISLANDS of SCOTLAND** (from the Mull of Cantyre to Cape Wrath and the Lewis Islands). On three large sheets. With plans of harbours. Accompanied with a Book of Directions 12/–
On cloth for Captains' use 15/9

32. **NORTH COAST of SCOTLAND** (Cape Wrath to Pentland Firth) including the Orkney Islands. One large sheet 5/–
On cloth for Captains' use 6/3

33. **SEA NORTH-WEST of the BRITISH ISLANDS,** including plans of the Caledonian Canal and Rockall Bank. This chart is specially adapted to the use of Shipmasters frequenting the Rockall Bank in pursuit of the Fishery, as it shows the Bank on a large scale. On two large sheets. Limits; latitudes 53° 50′ and 63° 35′ N., longitudes 0° 30′ and 15° 40′ W. 8/–
On cloth for Captains' use 10/6

34. **WEST COAST of the BRITISH ISLANDS.** The same chart as No. 33 (Sea north-west of the British Islands), but with an additional sheet. This chart shows the whole of the Irish Channel, the coast round Ireland, the Bristol Channel, and the English Channel west of the Isle of Wight; it also exhibits the navigation west of the British Islands between the English Channel and the Færoe Islands. Limits: latitudes 48° 20′ and 63° 35′ N., longitudes 0° 30′ and 15° 40′ W. On three sheets 10/–
On cloth for Captains' use 13/9

35. **FÆROE ISLANDS to the BAY of BISCAY.** In four large sheets. 12/–
On cloth for Captains' use 17/

Northern Navigation; comprising the North Sea, Kattegat, Baltic, &c.

36. **NORTH SEA,** on two large sheets, showing the navigation between the coasts of England and Scotland, and the opposite coasts of France, Holland, Jutland, and Norway. With plans of harbours. Illustrated with numerous views of the Lighthouses. Accompanied with a Book of Directions 8/–
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37. **NORTH SEA.** The same chart as the preceding, but with the addition of a half sheet to show the coast of Norway as far as Drontheim. Illustrated with numerous views of the coast, and improved by a full description of the Currents, Tides, &c., and remarks on the passage across the North Sea. Accompanied with a Book of Directions 10/–
On cloth for Captains' use 13/9

38. **SOUTHERN PART of the NORTH SEA** from Dungeness to Flamborough Head on the English side, with the opposite coasts of France, Holland, &c., from Calais to Hamburg. With a large plan of the Flemish Banks. On three sheets. Accompanied with a Book of Directions 10/–
On cloth for Captains' use 13/9
On cloth and rollers for Counting-house, coloured and varnished; size 5 ft. 2 in. by 3 ft. 3 in. 26/–

39.* **FLEMISH BANKS, &c.** A large chart, on two sheets, showing the navigation between the River Thames and the ports on the north coast of France (Calais, Ostende, Dunkerque, &c.), the River Schelde to Antwerp, Rotterdam, &c. It comprises the North Sea south of latitude 52° 23′ N., and is accompanied with a Book of Sailing Directions 8/–
On cloth for Captains' use 10/6

40.* **NORTH SEA (Rivers Thames and Maas to the Texel).** A large chart, on two sheets, showing the navigation north of the chart of the Flemish Banks, &c., just described, and comprising all the sea included between Orfordness and Yarmouth Roads and the Texel 8/–

41.* **NORTH SEA (Coast of Holland and Prussia from the Texel to Hamburg).** A chart, on three large sheets, showing the entrances to the Rivers Elbe, Weser, Ems, Jade, and Hever. Compiled from recent surveys. Accompanied with a Book of Directions 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 8 in. by 3 ft. 6 in. 31/6

The charts (Nos. 39, 40, and 41) are on the same scale, and show the navigation from the English Channel to Hamburg. They form a complete series of charts of the North Sea southward of Hamburg.

42.* **SKAGERRAK, or SLEEVE,** extending from the Naze of Norway to Gothenburg. On a large scale. With numerous plans of harbours. Illustrated with views of Beacons and Headlands. On two sheets 8/–
On cloth for Captains' use 10/6

43.* **KATTEGAT** (the navigation between the Skaw and Elsinore). Compiled from recent Danish surveys. On two large sheets. Illustrated by numerous views of the coast, and accompanied with a Book of Sailing Directions 8/–
On cloth for Captains' use 10/6

44. **KATTEGAT, SOUND, and BELTS,** with plans on a large scale of the Sound and Grounds, part of the Great Belt, Lamsbacka Fiord, and Wœderoe Anchorage. On 2½ sheets. Drawn from recent Danish and Swedish surveys, and accompanied with a Book of Sailing Directions 8/–
On cloth for Captains' use 12/3
On cloth and rollers for Counting-house, coloured and varnished ; size 5 ft. 3 in. by 2 ft. 10 in. 22/6

45.* **THE BELTS.** A large chart, on two sheets, showing the navigation from the Kattegat into the Baltic. This chart is on the same scale as that of the Kattegat (No. 43), and is intended to accompany that chart. It is for the use of such shipmasters as prefer the wide and clear navigation through the Great Belt to the nearer but more confined passage into the Baltic through the Sound. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

* New publications, from recent surveys.

46. **SOUND and GROUNDS,** on a large scale, with plans of the Drogden and harbour of Elsinore ; illustrated with views of the principal Churches, the Observatory, and other objects in Copenhagen. Compiled from recent surveys. One sheet 5/–
On cloth for Captains' use 6/3
On cloth and rollers for Counting-house, coloured and varnished ; size 41 in. by 27 in. 13/–

47. **BALTIC (the Sound to the Gulf of Finland and Gulf of Bothnia).** With plans of harbours. Drawn from the latest surveys made by order of the Governments of Prussia, Sweden, Denmark, and Russia. On two large sheets. A new chart. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6
On cloth and rollers for Counting-house, coloured and varnished ; size 4 ft. 4 in. by 3 ft. 5 in. 21/–

48.† **BALTIC (South Part of),** on three large sheets, and with many plans of harbours. Shows the navigation from the Sound to Danzig, Pillau, Memel, the south end of the island of Gottland, &c. Limits : latitude 53° 45′ to 57° 13′ N. ; longitude 12° 0′ to 21° 55′ E. With a Book of Directions 10/–
On cloth for Captains' use 14/3

49.† **BALTIC (North Part of),** on three large sheets, on the same scale as the preceding chart, and with many plans of harbours. It shows the navigation from the south end of Gottland to Riga, the Gulfs of Finland and Bothnia, Stockholm, &c. Limits : latitude 56° 52′ to 60° 5′ N., longitude 16° 0′ to 24° 40′ E. ... 10/–
On cloth for Captains' use 14/3

These two charts (Nos. 48 and 49) are on the largest scale yet published. Shipmasters bound to St. Petersburg should provide themselves with Nos. 37, 42, 43, 45, 46, 48, 49 and 52 ; or, if bound to the Gulf of Bothnia, Nos. 50 or 51 instead of No. 52.

50.† **GULF of BOTHNIA,** on 2½ large sheets. With plans of the North Quarken and the harbours of Gamla Carleby, and Hudiksvall. Compiled from the recent surveys made by order of the Swedish Government. Accompanied with a Book of Directions 10/–
On cloth for Captains' use 14/3

51.† **GULF of BOTHNIA (South of the North Quarken).** A large chart on three sheets, on the same scale as the preceding charts (North and South Baltic, Nos. 48 and 49) and intended to accompany them. With plans of harbours, and accompanied with a Book of Directions 10/–
On cloth for Captains' use 14/3

52.† **GULF of FINLAND,** on three large sheets, showing the whole navigation between Dager-ort and St. Petersburg. With plans of Kronstat, Port Baltic or Rager Wik, Revel and Hango Harbours. Illustrated with numerous views of the coast, and accompanied with a Book of Directions 10/–
On cloth for Captains' use 14/3

† These are all new charts, engraved in the best and clearest style. They show the navigation from the North Sea to the Gulf of Bothnia or Gulf of Finland on the largest scale yet published.

53. **COAST of NORWAY and WHITE SEA.** Drawn from recent Norwegian and Russian surveys. It shows the navigation from the British Isles to Arkhangel, and contains plans of the vicinity of Hammerfest and Tromsoe, the port of Drontheim, and the bay of Arkhangel. On two large sheets. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

54. **BRITISH ISLANDS to PETSHORA BAY.** The same chart as No. 53, but with an additional sheet to show the navigation eastward of the White Sea. With a large plan of Petshora Bay. With a Book of Directions... ... 12/–
On cloth for Captains' use 15/9

55. **BRITISH ISLANDS to the WHITE SEA (Chart No. 1).** On two large sheets. Limits: latitude 56° 0′ to 63° 5′ N., longitude 9 40′ W. to 9° 40′ E... ... ... 8/–

56. **BRITISH ISLANDS to the WHITE SEA (Chart No. 2).** On two large sheets. Limits: latitude 62° 10′ to 68° 0′ N., longitude 2° 15′ W., to 16° 0′ E. 8/–

57. **BRITISH ISLANDS to the WHITE SEA (Chart No. 3).** On two large sheets. Limits: latitude 67° 10′ to 72° 0′ N., longitude 9° 35′ to 28° 0′ E. 8/–

58. **BRITISH ISLANDS to the WHITE SEA (Chart No. 4).** On two large sheets. Limits: latitude 68° 0′ to 72° 35′ N., longitude 25° 35′ to 44° 0′ E. 8/–

59. **BRITISH ISLANDS to the WHITE SEA (Chart No. 5).** Showing the **WHITE SEA.** On two large sheets. With plans of Arkhangel, Sosnovets, Veshnyak, Nokuev, Sem Islands, Iukanskie and Onega Harbours, the Gulf of Onega, &c. Illustrated with numerous views of the coast, and improved by many explanatory notes. Limits: latitude 63° 46′ to 69° 0′ N., longitude 31° 30′ to 47° 30′ E. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

12. **BRITISH ISLANDS to the WHITE SEA and PETSHORA BAY (Chart No. 6).** Showing the navigation eastward of the White Sea. On two large sheets 8/–
On cloth for Captains' use 10/6

Shipmasters going to Arkhangel should take charts Nos. 54, 55, 56, 57, 58, 59, as those publications exhibit the whole voyage to the White Sea. With the exception of No. 54 (a general chart for the whole navigation) the charts are all on the same scale and each contains many plans of harbours. The series is accompanied with a small Index chart (for which no charge is made), and it is requested that purchasers ask for it, if it be not supplied.

Atlantic, and Islands of the Azores, &c.

60. **ATLANTIC (Northern Part).** On three large sheets. Limits: latitude 31° N. to 61° N., longitude 5° E. to 83° 20′ W. A very useful chart for the North American trade, as it shows the northern part of the Atlantic on an unusually large scale. With plans of the coast in the vicinity of Cape Race (Newfoundland), Sable Island, and St. George's Bank (United States). With a Book of Directions 12/–

61. **NORTH ATLANTIC,** from Greenland to the Equator, on a very large scale; with plans of the harbour of Funchal, Horta and Pim Bays, and Fayal Channel, and Bermuda Islands. Illustrated with some views. This chart contains much valuable information on the winds and currents, and will be found superior to any hitherto published 8/–
On cloth for Captains' use 10/6
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 4 in. by 3 ft. 5 in.... ... ... 21/–

62. **Short Notes on the North Atlantic.** A small pamphlet containing Sailing Directions and remarks on making Passages across the North Atlantic, price 1/6, to accompany this chart.

63. **NORTH ATLANTIC (Chart showing the Currents).** The same chart as No 61, but with the currents distinctly shown in colour, and with an additional sheet of plans, consisting of Track, Magnetic, Tidal and Wind Charts. Accompanied by the pamphlet No. 62 "Short Notes on the North Atlantic" ... 12/–
On cloth for Captains' use 15/9

64. **SOUTH ATLANTIC,** on two large sheets, from the Equator to 65° south latitude, on a very large scale; with plans of the islands of St. Helena, Ascension, Trinidad, Martin Vas, Fernando Noronha, Roccas Reef, &c. Illustrated with some views. Much valuable information on the winds, currents, and temperature of the water is embodied in this chart, and no expense has been spared in producing a good publication 8/–
On cloth for Captains' use 10/6
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 4 in. by 3 ft. 5 in.... ... ... 21/–

65. **Short Notes on the South Atlantic.** A small pamphlet containing Sailing Directions and remarks on making passages across the South Atlantic, price 1/– to accompany this chart.

66. **SOUTH ATLANTIC (Chart showing the Currents).** The same chart as No. 64, but with currents distinctly shown in colour, and with an additional sheet of plans, consisting of Track, Magnetic, Tidal, and Wind Charts. Accompanied by the pamphlet No. 65 "Short Notes on the South Atlantic" 12/–
On cloth for Captains' use 15/9

NOTE.—This chart, with the chart of the North Atlantic, No. 63, shows the whole navigation from Europe and the United States to the Cape of Good Hope and Cape Horn, and will be found very serviceable, as the directions of all the currents are delineated.

67. **AZORES or WESTERN ISLANDS.** One sheet, on a very large scale. With numerous plans of harbours. Drawn principally from recent Admiralty surveys. A beautifully engraved chart 4/–
On cloth for Captains' use 5/3

68. **MADEIRA, PORTO SANTO, and the DEZERTAS,** on one sheet, with a plan of the harbour of Funchal, and illustrated with some views. Drawn from recent Admiralty surveys 4/–
On cloth for Captains' use 5/3

69. **CANARY ISLANDS.** With plans of harbours. Illustrated with some views. 4/–
On cloth for Captains' use 5/3

70. **CAPE VERDE ISLANDS,** on a very large scale. With plans of harbours. Drawn chiefly from recent Admiralty surveys 4/–
On cloth for Captains' use 5/3

West Coast of Africa.

71. **COAST of AFRICA (the Strait of Gibraltar to Sierra Leone).** With many plans of harbours. On three large sheets 12/–
On cloth for Captains' use 15/9

72. **COAST of AFRICA from Sierra Leone to the Bight of Benin.** With plans of the most important harbours and numerous views of the coast. On three large sheets 12/–
On cloth for Captains' use 15/9

Coasts of France, Spain, and Portugal.

73.* **BRITISH ISLANDS TO THE COAST OF AFRICA,** showing the navigation from Liverpool and Ireland to Mogador. With plans of all the principal harbours. On four large sheets. With a Book of Sailing Directions 12/–
On cloth for Captains' use 17/–

74.* **FRANCE, SPAIN, and PORTUGAL (the West Coasts of),** extending from the entrance of the Irish Channel to Gibraltar. With plans of all the principal harbours. Accompanied with a Book of Directions 10/–
On cloth for Captains' use 13/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

* Either of these charts with No. 33, will show the navigation from the Færoe Islands to the Mediterranean.

75. **BRITISH ISLANDS to the MEDITERRANEAN, CANARIES, MADEIRAS, and AZORES.** On two very large sheets, and with plans of harbours. Limits : latitude 26° N. to latitude 56° N. ; longitude 0° 40′ W. to 31° 30′ W. A very useful chart, specially intended for the fruit trade and shipmasters bound to the Mediterranean 8/–
On cloth for Captains' use 10/6

76. **BAY of BISCAY.** Drawn from the recent surveys made by order of the French Government. With plans of the principal harbours. On two large sheets. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

77. **COAST of SPAIN and PORTUGAL (Cape Ortegal to the Strait of Gibraltar).** With plans on a large scale of the principal harbours, &c. Drawn from recent Spanish and Portuguese surveys, and improved by the introduction of descriptive notes, views of Headlands, &c. Accompanied with a Book of Sailing Directions 8/–
On cloth for Captains' use 10/6

This chart and No. 76 preceding (the Bay of Biscay), show the navigation from the English Channel to the Mediterranean on a large scale.

78. **COAST of PORTUGAL and SPAIN, from Cape San Vicente to Gibraltar.** On a very large scale. With plans of the principal harbours, Cadiz, the Rivers Odiel, Guadalquiver, &c. This chart is from recent surveys, and published specially for the trade to Pomeron and Seville. 5/–
On cloth for Captains' use 6/3

Mediterranean.

79. **MEDITERRANEAN.** On four large sheets, and containing about thirty plans of harbours, &c., among which are the following:—Malaga, Alicante, Barcelona, Villefranche, Strait of Gibraltar, Cartagena, Genoa, Hyeres Road, Leghorn, Toulon, Cagliari, Algiers, Strait of Bonifacio, Gulf of Naples, Palermo, Strait of Messina, Valetta, Smyrna, River Danube, Alexandria, Cephalonia, Trieste, Patras, &c. Illustrated with numerous views of the coast, and descriptive notes. Drawn from recent surveys made by order of the British, French, Austrian, and Russian Governments. A beautifully engraved and elegant chart ... 12/–
On cloth for Captains' use 17/–
On cloth and rollers for Counting-house, coloured and varnished; size 8 ft. 4 in. by 3 ft. 4 in. 42/–

This chart may also be had in two Parts, as follows:—

80. **(Part I.)—Gibraltar to the Adriatic,** on two large sheets. This chart shows the navigation between the coast of Spain and the ports in the Adriatic, and contains many plans of harbours 7/–
On cloth for Captains' use 9/6

81. **(Part II.)—Italy to Alexandria,** on two sheets. This chart comprises the navigation between the Adriatic, Black Sea, and the Levant, and contains numerous plans of harbours 7/–
On cloth for Captains' use 9/6

82.* **MEDITERRANEAN (Western Portion of),** on three large sheets, showing the navigation between Gibraltar and Malta on the most extensive scale yet published. With numerous plans of harbours. Accompanied with a Book of Directions. (A new chart.) 12/–
On cloth for Captains' use 15/9

83.* **MEDITERRANEAN (Eastern Portion of),** on four large sheets, showing the navigation between Sicily and Malta and the coast of Egypt and Syria, on a very large scale. With numerous plans of harbours. Accompanied with a Book of Directions. (A new chart.) 12/–
On cloth for Captains' use ... ... — 19/–

* These two charts (Nos. 82 and 83) show the whole navigation from Gibraltar to Alexandria and the coast of Syria, on a very large scale. The chart No. 83 being very large, may be had in two parts, as in Nos. 84 and 85.

84. **MEDITERRANEAN (Middle Portion of),** on two large sheets, showing the navigation between Sicily and Malta and the Grecian Archipelago. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

85. **MEDITERRANEAN (Levant Portion).** On two large sheets, showing the navigation between the Grecian Archipelago and the coast of Egypt and Syria. With plans of the most important harbours. Compiled from recent surveys. Accompanied with a Book of Directions... ... ... 8/–
On cloth for Captains' use 10/6

86. **ADRIATIC,** on two large sheets, with numerous plans of harbours and views of the coast. Accompanied with a Book of Sailing Directions 8/–
On cloth for Captains' use 10/6

87. **ARCHIPELAGO and IONIAN ISLANDS.** On two large sheets. With plans of Cervi, Skiatho, and Doro channels, the harbours of Syra, Kalamitza, and Sigri; Salamis and Saloniki bays, the gulf of Smyrna and Khios strait, &c. Drawn chiefly from recent British surveys. Accompanied with a Book of Sailing Directions 10/–
On cloth for Captains' use 12/6
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 4 in. by 3 ft. 5 in. 22/6

88. **GIBRALTAR STRAIT.** A sheet showing the Strait on a very large scale 2/–
On cloth for Captains' use 3/3

89. **COAST of SPAIN (Gibraltar to Cape San Antonio),** with plans of Cartagena, Malaga, Torre Vieja, Alicante, Almazarron, Almeria, Porman, Aguilhas, Portus, Carbonera, Mount Cope, Grosa island, Benidorme, Herradura bay, Ceuta bay, Alboran island, &c. 5/–
On cloth for Captains' use 6/3

90. **COAST of SPAIN (Cape San Antonio to Cape San Sebastian, including the Baleares Islands),** with plans of Barcelona, port Mahon, Valencia, Mattaro, Palma, Tarragona, Alfaques, Salou, Denia, Iviza, Cabrera, Palamos, Fangal, Soller, cape Cullera, Columbretes islands, and the channel between Iviza and Formentera 5/–
On cloth for Captains' use 6/3

91. **ALEXANDRIA (the port of Alexandria and coast in its Vicinity).** A chart showing the coast of Egypt in the vicinity of Alexandria, on a large scale, with plans of Alexandria harbour and New Port. Published specially for the trade to Alexandria 5/–
On cloth for Captains' use 6/3

92. **SUEZ CANAL and PORT SAID.** A large chart on one sheet. With a Book of Directions 3/6

93. **SUEZ CANAL and GULF OF SUEZ.** A chart showing the navigation between port Said and the Upper or Northern (the most dangerous part) portion of the Red Sea. If this chart is taken in connexion with the Admiralty large chart of the Red Sea (No. 8), the navigation from the Mediterranean to the Indian Ocean will be shown on a large scale. With a Book of Directions ... 7/–
On cloth for Captains' use 9/6

94. **DARDANELLES,** on one sheet. With plans of the Tenedos channel, Narrows of the Dardanelles and Lamsaki bay... ... ... 5/–
On cloth for Captains' use 6/3

95. **SEA of MARMORA,** on one sheet. With numerous plans of harbours 5/–
On cloth for Captains' use 6/3

96. **BOSPHORUS.** On a very large scale. With a plan of the Golden Horn and Oumour bay 5/–
On cloth for Captains' use 6/3

97. **RIVER DANUBE (Sulina Harbour to Galatz).** On a very large scale. With a plan of Sulina harbour 5/–
On cloth for Captains' use 6/–

98. **BLACK SEA and SEA of AZOF,** on three sheets. With plans of the Bosphorus and strait of Kertch, Sulina harbour, Kustenjeh, Odessa, Balaklava, Burghaz, Varna, Soujak, Rizeh, Batoum, Trebizond, St. Douka, Ghelenjik, Gherzeh, Ounieh, Anapa, Samsoun, Kaffa, Amastra, and Sinoub. Accompanied with a Book of Directions. A beautifully engraved and elegant chart. 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

99. **SEA OF AZOF.** On two sheets. With plan of Kertch Strait ... 8/–
On cloth for Captains' use 10/6

Shipmasters bound to the Black Sea or Sea of Azof should provide themselves with charts Nos. 82, 83, 87, 94, 95, 96, 97, 98, 99, as they show the navigation on a very large scale.

Coast of North America, the West Indies, etc.

100. **NEWFOUNDLAND and COAST of LABRADOR.** On four large sheets. Drawn from recent English and French surveys. With numerous plans of harbours. Accompanied with a Book of Directions 12/–
On cloth for Captains' use 17/–
On cloth and rollers for Counting-house, coloured and varnished ; size 4 ft. 10 in. by 3 ft. 9 in. 31/6

101.* **SOUTH COAST of NEWFOUNDLAND.** On three large sheets. Compiled principally from recent surveys. This chart contains many plans of harbours, and shows the Banks in an accurate manner, on a very large scale, and will be found extremely useful to those engaged in the Quebec and Montreal trade. With a Book of Directions 12/–
On cloth for Captains' use 9/6

102. **COAST of LABRADOR and North Part of the ISLAND of NEWFOUNDLAND,** on two sheets. With plans, on a large scale, of Croc harbour and the strait of Belle Isle. This chart extends from latitude 48° 30′ to 55° 30′ N., and exhibits the coast of Labrador to that latitude, and will be found very useful to the Labrador fishermen and St. Lawrence traders, as, independent of the plans, it shows the coast on a large scale 7/–
On cloth for Captains' use 9/6

103. **STRAIT of BELLE ISLE to CAPE COD (Gulf and River St. Lawrence, Newfoundland, &c.).** On three large sheets. This chart shows the coast of North America between Belle Isle and cape Cod, and includes, therefore, the island of Newfoundland, the gulf and river St. Lawrence, and coast of Nova Scotia. In it are plans of Halifax, Conception bay, strait of Belle Isle, St. Pierre, Harbour Grace, cape Race, cape Ray, &c. &c. Accompanied with a Book of Directions 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

104. **GULF of St. LAWRENCE,** on two sheets, on a large scale, with plans of numerous harbours. Accompanied with a Book of Directions. Drawn chiefly from the recent surveys of Captain Bayfield, R.N. 8/–
On cloth for Captains' use 10/6

105.* **GULF and RIVER St. LAWRENCE.** A large chart on three sheets, showing the navigation from the west coast of Newfoundland to Quebec. With many plans of harbours, and accompanied with a Book of Directions 12/–
On cloth for Captains' use 15/9

* The charts (Nos. 60, 101, and 105) show the navigation between Europe, the south coast of Newfoundland, and Quebec, on the largest scale yet published. Each chart is on three sheets.

106. **COAST of NORTH AMERICA (Scatari Island to Cape Cod).** On three large sheets. With plans of the harbours of Halifax, Fourchu, Yarmouth, Annapolis, Salem, Portland, Portsmouth, St. John's, and of numerous anchorages on various parts of the coast. Illustrated with views of the coast ... 10/–
On cloth for Captains' use 14/3

107. **COAST of NORTH AMERICA (Cape Canso to New York and the River Delaware).** On three large sheets. With plans of the approaches to Portland, Boston, and New York. Accompanied with a Book of Directions 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

108. **COAST of NORTH AMERICA (New York and the River Delaware to the Strait of Florida).** On three large sheets. With plans of the most important harbours. Accompanied with a Book of Sailing Directions ... 12/-
On cloth for Captains' use... ... ... 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

207. **COAST of NORTH AMERICA (New York to Key West, Havana, Matanzas, Nassau, &c.)** On four large sheets, being the same chart as No. 108, but with an additional sheet to show the navigation through Florida strait. With a Book of Sailing Directions 14/-
On cloth for Captains' use 19/-

28. **COTTON PORTS OF CAROLINA and GEORGIA.** On three large sheets, showing the coast of the United States westward of cape Fear as far as St. Augustine. Compiled from recent surveys made by the United States Coast Surveyors. With a Book of Directions 12/0
On cloth for Captains' use 15/9

NOTE.—These Charts (No. 107 and 207) show the whole of the Atlantic sea-board of the United States, and are intended to accompany each other. They include the various surveys made by the officers engaged in the survey of the coast of the United States, and have been engraved at considerable expense, and the greatest care has been taken in their construction, that they may not be inferior to any published.

109. **BAHAMA ISLANDS and BANKS.** On 2½ large sheets. Showing the strait of Florida and adjacent coasts, with plans, on a large scale, of Key West, east part of Florida reef, Havana, Matanzas, New Providence, &c. Drawn from recent surveys. Accompanied with a Book of Directions 10/-
On cloth for Captains' use 15/-

110. **WEST INDIES and COAST of COLOMBIA.** With plans, on a large scale, of the harbours of Vera Cruz, Port Royal, Chagres, Aspinwall, and Havana. Compiled from recent British, French, and Spanish surveys, and improved by the introduction of views of the coast, descriptive notes, &c., &c. 10/-
On cloth for Captains' use 15/-
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 10 in. by 3 ft. 3 in. 27/-

111. **GULF of MEXICO, and Islands of Cuba, Haiti, and Jamaica, the Caribbees, &c.** On four large sheets. Showing the Windward Passages on a large scale. With a Book of Directions 16/
On cloth for Captains' use 21/-
On cloth and rollers for Counting-house, coloured and varnished; size 8 ft. 4 in. by 3 ft. 4 in. 42/-

112. **GULF of MEXICO, and Islands of Cuba, Haiti, and Jamaica,** being three sheets of Chart No. 111. Drawn principally from recent British and United States surveys. Accompanied with a Book of Directions 12/-
... ... On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

113. **GULF of MEXICO. Chart No. I. (Tampa Bay to New Orleans).** On two large sheets, and containing plans of the harbours of Apalachicola, St. Andrew, Pensacola, Entrance to Mobile bay, and the Passes of the Mississippi 8/-

114. **GULF of MEXICO. Chart No. II. (New Orleans to Tampico).** On three large sheets, and containing plans of the harbours of Galveston, Atchafalaya bay, Sabine Pass, Matagorda bay, Entrance to the Rio Grande, and Tampico. 8/-

115. **BAY OF HONDURAS.** On a very large scale, with plans of Belize and other harbours. Drawn from the recent surveys of Commanders Owen and Barnett, of the Royal Navy. With a Book of Directions 7/-
On cloth for Captains' use 9/6

116. **COAST of COLOMBIA and CARIBBEAN SEA.** On three large sheets. With plans of the harbours of Greytown, Barcelona, Cumana, Porto Cabello, Santa Anna, Sabanillo, La Guayra, Chagres, &c., &c. Drawn from recent British and Spanish surveys. Accompanied with a Book of Directions 12/-
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

117. **CARIBBEE ISLANDS.** Being one sheet of the Chart No. 111. An elegantly engraved chart 5/–
On cloth for Captains' use 6/3

118. **CUBA.** On a very large scale, with plans of Havana and the principal harbours. Drawn from recent Spanish surveys 5/–
On cloth for Captains' use 6/3

119. **HAITI or SAN DOMINGO.** Compiled from recent surveys ... 5/–
On cloth for Captains' use 6/3

120. **PUERTO RICO and the VIRGIN ISLANDS.** On two large sheets. With plans of St. Thomas' harbour, Road harbour, Gorda sound, South-east end of Culebra, Christianstaed, Mona island, Sombrero island, Guanica, Mayaguez, and San Juan harbours 8/–
On cloth for Captains' use 10/6

121. **GUADALOUPE.** A French chart of the island, on a large scale ... 6/–

East and West Coasts of South America, and West Coast of North America.

122. **COAST of GUIANA, &c. (Trinidad to Cape Cachipour).** Showing the various harbours and rivers of Demerara, Berbice, Cayenne, &c. Drawn from recent surveys. On two large sheets 8/–
On cloth for Captains' use 10/6

123. **APPROACHES to the RIVERS AMAZONA, PARA, &c. (Cape Cachipour to Maranham).** With plans of the Rivers Para and Amazona. Drawn from recent surveys 8/–
On cloth for Captains' use 10/6

124.* **COAST of BRAZIL (Maranham to Rio Janeiro).** On three large sheets. With plans of the most important harbours on the coast. Compiled chiefly from recent surveys made by M. Mouchez of the French Navy, and Don A. Vital de Oliveira of the Brazilian Navy. Illustrated with many views of the coast. Accompanied with a Book of Directions 10/–
On cloth for Captains' use 13/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

125.* **COAST of BRAZIL (Cape Frio and Rio Janeiro to the River Plate).** On two large sheets. In this chart are given plans of the most important harbours, such as Rio Janeiro, Marambaya, Santos, Cananea, Paranagua, Rio Grande, Monte Video, cape Sta. Maria, &c., and there are explanatory notes which add considerably to its value. Compiled chiefly from recent French and British surveys. Accompanied with a Book of Directions 8/–
On cloth for Captains' use 10/6

* These two charts (Nos. 124 and 125) comprise the whole of the coast of Brazil, and are laid down upon the plain scale, not the diagonal.

126. **RIVER PLATE.** A large scale chart, on two sheets, showing the navigation to Monte Video and Buenos Ayres. With plans of Monte Video, Buenos Ayres, Maldonado, &c. Compiled from recent British, French, Spanish, and American surveys. With a Book of Directions... ... ... 7/–
On cloth for Captains' use 9/6

127. **RIVER PLATE and RIVERS PARANA and URUGUAY.** The same Chart as No. 126, but with a supplementary sheet showing the course of the Rivers Parana and Uruguay, from Buenos Ayres to Rosario and Paysandu. With a Book of Directions 10/–
On cloth for Captains' use 13/9
For the convenience of purchasers the Supplementary Sheet (Rivers Parana and Uruguay) is supplied separately, price 4s.

128. **SOUTH AMERICA (COAST of), from Rio de la Plata round Cape Horn to Valparaiso,** on three large sheets. With plans, on a large scale, of Valparaiso and San Carlos Bays, the Strait of Magellan, &c., &c. Drawn from the surveys of Captains Fitzroy and King, of the Royal Navy. A beautifully engraved and accurate chart 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished ; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

129.* **SOUTH AMERICA (EAST COAST of,—Chart No. 1).** Showing the navigation from Rio de la Plata to Magellan Strait and the Falkland Islands. On three large sheets. With numerous plans of harbours. Limits : latitudes, 34° S. to 54° S. ; longitudes, 54° 40′ W. to 69° 30′ W. 10/–
On cloth for Captains' use 13/9

130.* **SOUTH AMERICA (SOUTH COAST of,—Chart No. 2),** including Magellan Strait, the Falkland Islands and Coast round Cape Horn. On three large sheets. With numerous plans of harbours. Limits : latitudes, 50° 30′ S. to 59° S. ; longitudes, 56° W. to 82° 20′ W. 10/–
On cloth for Captains' use 13/9

131.* **SOUTH AMERICA (WEST COAST of,—Chart No. 3),** from Magellan Strait to Valparaiso. On three large sheets. With plans of the harbours of Valparaiso, Concepcion, Valdivia, Chaneral, San Carlos, Barbara, Otway, &c., &c. Limits : latitudes, 53° S. to 32° S. ; longitudes, 71° W. to 85° 50′ W. 10/–
On cloth for Captains' use 13/9

132.* **SOUTH AMERICA (WEST COAST of,—Chart No. 4),** from Valparaiso to Truxillo. On three large sheets. With plans of the harbours of Callao, Pisco Bay (Chinca Islands), Ilay, Papudo, Horcon, Quintero, Coquimbo, Atico, Huasco, Ylo, Arica, Valparaiso, &c., &c. Limits : latitudes, 34° S. to 8° S. ; longitudes, 68° W. to 82° 50′ W. 10/–
On cloth for Captains' use 13/9

* These Charts (Nos. 129, 130, 131, and 132) are all new, and show the navigation from the River Plate round Cape Horn to Truxillo, on the largest scale yet published. They are very clearly and beautifully engraved, are all on the same scale, and no expense has been spared in their production.

133. **SOUTH AMERICA (WEST COAST of,—Chart No. 5).** Showing the navigation between Truxillo and Panama. On two sheets. With plans on a large scale of Panama Bay and Harbour, Bahia Honda, the River Guayaquil, &c., and illustrated with some views of the coast 8/–
On cloth for Captains' use 10/6

134. **CENTRAL AMERICA (COAST of), from Coiba Island to San Blas :** one large sheet. With plans, on a large scale, of the harbours of Sihuatanejo, Acapulco, Guatulco, San Carlos, Realejo, Salinas, Culebra, Punta Arenas, Arenitas, San Blas, and illustrated with some views of the coast. Drawn from the Spanish surveys, and much improved from the observations of Captain Beechey and Commander Belcher, of the Royal Navy 5/–
On cloth for Captains' use 6/3

135. **CALIFORNIA (COAST of), showing the Coast from San Blas to San Francisco Bay,** on two large sheets, with plans of the harbours of Mazatlan, Magdalen Bay, Guaymas, Monterey, San Francisco, &c. Compiled chiefly from the United States Coast survey, the Spanish surveys, &c., &c., and much improved by recent observations made by English and French naval officers ... 10/–
On cloth for Captains' use 12/6

136. **OREGON and VANCOUVER ISLAND (COAST of).** On two large sheets. With many plans of harbours, including St. Juan de Fuca Strait, Port Victoria, Nootka Sound, Port San Juan, Beecher and Pedder Bays, and Esquimault Harbour 10/–
On cloth for Captains' use 12/6

137. **North Pacific Pilot (Part 1).** A Sailing Directory for the West Coast of North America, between Panama and Queen Charlotte Islands. With numerous plans of harbours. Intended to accompany the Charts Nos. 134, 135, and 136. By James Frederick Imray, F.R.G.S. 8/–

Indian Ocean, &c.

138. **INDIAN OCEAN (Cape of Good Hope to Bombay, Madras, Calcutta, and St. George's Sound, Australia).** The limits of the chart are latitudes 27° N. and 50° S., to longitudes 15° E. and 124° E. On two large sheets compiled from recent surveys. Improved by many remarks on the tidal phenomena, currents, winds, &c. 8/–
On cloth for Captains' use 10/6
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 4 in. by 3 ft. 5 in. 21/–

139. **INDIAN OCEAN.** On three large sheets. The same chart as No. 138, but with an additional sheet containing plans of the principal islands, the Maldivh, Chagos, Seychelles groups, &c. 10/–
On cloth for Captains' use 13/9
On cloth and rollers for Counting-house, coloured and varnished 31/6

140. **INDIAN and PACIFIC OCEANS.** The same chart as No. 138, with the addition of a sheet, to show the coasts of Australia, New Zealand, China, and the Philippine Islands. The limits of the chart are latitudes 27° N. and 50° S., longitudes 15° E. and 178° E. With Book of Directions (No. 145) 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

141. **INDIAN and PACIFIC OCEAN.** A chart for the use of shipmasters bound to Australia, who may intend to sail on the arc of the Great Circle. In this chart the best routes are laid down, and the Great Circle Tracks from the Cape of Good Hope to Australia are also shown. Limits, latitudes 27° N. to 62° S., longitudes 15° E. to 178° E. With Book of Directions (No. 145) ... 14/–
On cloth for Captains' use 19/–

142. **INDIAN and PACIFIC OCEANS.** A chart showing the navigation eastward of the Cape of Good Hope to Australia and China, or between latitudes 27° N. and 50° S., longitudes 15° E. and 178° E. With a sheet of plans of the detached groups of islands so profusely scattered over the Indian Ocean. On four large sheets. With Book of Directions (No. 145) 16/–
On cloth for Captains' use 21/–

143. **ARABIAN SEA.** A large chart on two sheets of the Indian Ocean, comprised between the Red Sea, the Gulf of Persia, and the coasts of India and Ceylon. It consequently shows the navigation between Aden, Karachi, Bombay, Colombo, and Pointe de Galle 8/–
On cloth for Captains' use 10/6

144. **ISLANDS, &c., in the INDIAN OCEAN.** On one sheet. Being the additional sheet referred to in No. 139. The plans are Maldivh, Chagos, Seychelles, and Lakdivh groups of Islands; Comoro Islands; Kerguelen Land; St. Paul Island; Cocos Islands; Mahè in Seychelles; and Christmas Harbour in Kerguelen Land. All these are on a very large scale 4/–
On cloth for Captains' use 5/3

145. **Short Notes on the Winds, Weather, and Currents of the Indian Ocean,** together with general Sailing Directions and Remarks on making Passages; with two charts showing the Currents and Tracks through the Ocean. A pamphlet intended specially to accompany the chart of the Indian Ocean. By W. H. Rosser 2/6

146. **SOUTHERN AFRICA and MADAGASCAR.** On three large sheets. Showing the Cape of Good Hope, and Mozambique Passage on a very large scale, and exhibiting the navigation between Table and False Bays, and the islands of Mauritius and Reunion. With a Book of Directions 12/–
On cloth for Captains' use 15/9

147. **COAST of CAPE COLONY (Table Bay to Algoa Bay).** On two large sheets. With plans of Harbours. Compiled from recent British surveys Illustrated with views of the coast 8/–
On cloth for Captains' use 10/6

148. **COAST of CAPE COLONY (Table Bay to Port Natal).** On three sheets. With plans of Harbours 10/–
On cloth for Captains' use 13/9

149. **MAURITIUS.** With plans of Port Louis and Grand Port. In one sheet. Drawn from recently published documents 4/–
On cloth for Captains' use 5/3

150. **GULF of ADEN (Socotra Island to the Red Sea).** With a plan of Aden. Illustrated with views of the land. On a large sheet. Drawn from recent surveys 5/–
On cloth for Captains' use 6/3

151. **GULF OF SUEZ.** A chart on a large scale of the upper (the northern and most dangerous) part of the Red Sea. It accompanies that of the Suez Canal No. 92, and should be used in conjunction with that chart and the chart No. 8, published by the Admiralty, as these three charts will show the navigation from the Mediterranean to the Gulf of Aden in a very satisfactory manner ... 5/–
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152. **INDIA (West Coast of), from Cape Comorin to Bombay.** On two large sheets. With plans of the harbours of Bombay, Cochin, and Calicut, also of the Approaches to Bombay. Improved by the introduction of remarks upon currents, winds, &c. 8/–
On cloth for Captains' use 10/6

153. **INDIA (West Coast of), from Bombay to Karachi.** On two large sheets. With plans of the harbours of Bombay and Karachi 8/–
On cloth for Captains' use 10/6

154. **BAY of BENGAL.** On two large sheets. With plans of Akyab, Bassein, Trincomalie, Colombo, Pointe de Galle, Bassas Reefs, &c., &c. With two small charts attached to it, showing the currents during the South-west and North-east Monsoons 8/–
On cloth for Captains' use 10/6

155.* **BAY of BENGAL. (West part of,—Chart No. 1).** On two large sheets. This chart shows the coast from Cape Comorin to Cocanada, and includes Ceylon With plans of Bassas Reefs, Colombo, Pointe de Galle, Trincomalie, Cocanada Paumben Pass, &c., &c. Limits of chart, latitudes 4° 46′ to 17° 30′ N., and longitudes 76° 30′ to 86° 45′ E. 8/–
On cloth for Captains' use 10/6

156.* **BAY of BENGAL (North part of,—Chart No. 2).** On two large sheets. This chart comprises the coast between Pulicat and Bassein River. With plans of Akyab, Bassein River, Kyou Phiouk, &c., &c. Limits of chart, latitudes 13° 10′ to 23° N., and longitudes 82° to 95° E. 8/–
On cloth for Captains' use 10/6

157.* **BAY of BENGAL (East Coast of,—Chart No. 3).** On two large sheets This chart includes the coast between Bassein River and Penang, the Andamans Nicobars, north coast of Sumatra, &c. With plans of the principal harbours Limits of chart, latitudes, 4° 46′ to 17° 30′ N., and longitudes 91° to 101° 20′ E 8/–
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* These three charts (Nos. 155, 156, and 157) include the whole of the Bay of Bengal, and are on a larger scale than any published. They form an invaluable series of charts for the use of Traders in the Bay.

158. **RICE PORTS OF INDIA.** A chart, on two large sheets, of the east coast of the Bay of Bengal, between latitudes 13° and 21° N., longitudes 92° and 98° E. With plans of Akyab, Kyou Phiouk, Bassein River, Rangoon River, Maulmain, and Kalegouk Island anchorage. A very useful chart for Ship-masters bound to Akyab, Rangoon, or Maulmain, as it exhibits the navigation on a larger scale than any hitherto published 8/–
On cloth for Captains' use 10/6

(All these charts of the Bay of Bengal, (Nos. 154 to 158) are new publications. The publishers feel confident that better or more useful charts cannot be obtained, as resort has been made to every available official survey, and no expense has been spared in their production.)

159. **Sailing Directions for the Bay of Bengal** to accompany the charts of the Bay, particularly describing the Rice Ports. With plans of many of the most important harbours. By James F. Imray, F. R. G. S. 5/–

East India Archipelago, China, &c.

160. **CHINA SEA and EAST INDIA ARCHIPELAGO,** on two sheets. Being a general chart of all the islands composing the Archipelago of the India and China Seas. A track chart, and not intended for navigation purposes; the scale being too limited for insertion of the Reefs with the necessary accuracy. 8/–
On cloth for Captains' use 10/6

161.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 1). Limits, latitudes 2° 50′ and 7° 10′ S., and longitudes 105° 30′ and 110° 50′ E. 7/6

162.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 2). Its limits are, latitudes 3° 0′ S., and 5° 40′ N., and longitudes 103° 20′, and 110° 20′ E. 7/6

163.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 3). Limits, latitudes 3° N., to 16° 20′ N., and longitudes 99° 20′ to 110° E. 7/6

164.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 4). Limits, latitudes 1° 20′ to 11° 52′ N., and longitudes 107° 20′ to 120° 40′ E. 7/6

165.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 5). Limits, latitudes 10° 50′ and 23° 40′ N., and longitudes 104° 45′, and 115° 20′ E. 7/6

166.* **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 6). Limits, latitudes 10° 50′ and 23° 40′ N., and longitudes 112° 10′, and 122° 45′ E. 7/6

* These charts (Nos. 161 to 166) of what is popularly known as the Western Route to China, exhibit the navigation from Sunda Strait to the Coast of China on a very large scale. Each consists of two sheets; the set, therefore, comprises twelve sheets. They have been compiled from the most recent British, French, Dutch, and Spanish surveys. In several of the charts there are notes descriptive of the currents, winds, &c., and remarks upon the courses most advisable to follow at certain periods of the year. If mounted on cloth for Captains' use, the price of each will be 2s. 6d, extra. An Index Chart accompanies the set.

208. **EAST INDIA ARCHIPELAGO** (Western Route to China,—Chart No. 6); with an additional sheet to show the coast of China as far northward as Amoy. Limits, latitudes 10° 50′ and 26° 40′ N., and longitudes 112° 10′ to 122° 45′ E. 10/–

167. **STRAITS of MALACCA and SINGAPORE.** On two large sheets. With plans of Singapore Strait, Singapore Harbour, Penang Island, Strait of Durian, &c. Drawn from recent British surveys 8/–
On cloth for Captains' use 10/6

168. **STRAIT of SUNDA.** On two large sheets. With plans of Harbours 7/–
On cloth for Captains' use 9/6

169. **STRAIT of SUNDA.** On one sheet. The same chart as the preceding, but without the sheet containing Batavia Road 5/–
On cloth for Captains' use 6/3

170. **GASPAR STRAIT.** On one large sheet 4/–
On cloth for Captains' use 5/3

209. **JAVA, LOMBOK, SUMBAYA, and CELEBES.** Showing the navigation between Sunda, Banka, Gaspar, and Karimata Straits, and Makassar at the south-west end of Celebes. Being the same chart as No. 171, but with an additional sheet to include Sunda and Banka Straits. On three large sheets ... 12/–

171.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 1).** This chart with No. 161 (the Western Route to China, Chart No. 1) exhibits the navigation of the Indian Archipelago eastward of Sunda Strait, so far as Makassar Strait. Its limits are latitudes 2° 30′ and 12° 20′ S., and longitudes 110° 10′ and 122° 20′ E. 7/6
On cloth for Captains' use 10/–

172.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 2),** showing the Banda Sea and great island of Timor, Pitts Passage, &c. Limits, latitudes 2° 30′ and 12° 20′ S., and longitudes 121° 30′ and 133° 40′ E. 7/6
On cloth for Captains' use 10/–

173.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 3),** showing the Arafura Sea, Torres Strait, &c. Limits, latitudes 2° 30′ and 12° 20′ S., and longitudes 133° and 145° 15′ E. 7/6
On cloth for Captains' use 10/–

174.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 4.)** This chart shows the sea northward of Chart No. 1, and includes Makassar Strait, Celebes Sea, &c. Limits, latitudes 3° 20′ S. and 8° 40′ N., and longitudes 116° 10′ and 125° 50′ E. 7/6
On cloth for Captains' use 10/–

175.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 5),** showing the Molucca Islands and south part of the Philippines. Limits, latitudes 3 20′ S. and 8° 40′ N., and longitudes 125° and 134° 40′ E. 7/6
On cloth for Captains' use 10/–

176.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 6),** showing the greater part of the Philippines, the Sulu Sea, &c. Limits, latitudes 8° and 17° 40′ N., and longitudes 118° 20′ and 130° 20′ E. 7/6
On cloth for Captains' use 10/–

177.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 7),** showing Formosa, the Majico-sima Islands, &c., also the northern part of the Philippines. Limits, latitudes 16° 30′ and 25° 40′ N., and longitudes 118° 20′ and 130° 20′ E. 7/6
On cloth for Captains' use 10/–

178.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 8),** showing the coast of China from Formosa Island to the Gulf of Pe-chi-li and the western islands of Japan. Illustrated with numerous views of the coast. Limits, latitudes 25° and 41° N., longitudes 117° 30′ and 132° 40′ E. 7/6
On cloth for Captains' use 10/–

179.* **EAST INDIA ARCHIPELAGO (Eastern Passages to China and Japan,—Chart No. 9),** showing the islands of Japan. With numerous plans of harbours. Limits, latitudes 32° and 43° 54′ N., longitudes 127° and 146° E. 7/6
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* These charts of the eastern portion of the East India Archipelago and the Eastern and Yellow Seas, show the various islands and passages on the largest scale yet published. Each consists of two large sheets (double elephant size), so that the whole series is composed of eighteen sheets. They have been compiled from the most recent English, Dutch, French, and Spanish surveys, and no expense has been spared to make them the most complete and accurate charts of these seas in existence. Shipmasters proceeding to Eastern Australia from China and Japan should take, in addition to these charts, those of the Western Pacific Ocean, Nos. 190, 191, 192, 193. An Explanatory Index Chart accompanies each set of charts.

180. **NORTH-EAST COAST OF ASIA (a continuation of the Series of Charts—the Eastern Passages to China).** This chart shows the navigation from the Islands of Japan to the Gulf and River Amur. With plans of harbours. Limits, latitudes 43° 0′ to 55° 38′ N., longitudes 135° 0′ to 150° 8′ E. 8/–
On cloth for Captains' use 10/6

181. **COAST OF CHINA (from Canton River to Shanghae and Adjacent Islands),** on two large sheets, and with plans of the Pratas Reef, the harbours of Hong Kong, Amoy, Shanghae, Tongsang, Hoo-e-tow, &c. Compiled chiefly from recent British surveys 8/–
On cloth for Captains' use 10/6

182. **COAST OF CHINA (from Shanghae to the Gulf of Pe-chi-li).** On two large sheets, and with plans of harbours. Compiled from recent British surveys. 8/–
On cloth for Captains' use 10/6

183. **JAPAN (North part of).** On three large sheeet. It comprises the south coast of Yezo, the strait of Tsugar, the northern half of Nipon, and the opposite coast of the Korea, with plans of Niegata, Endermo, Hakodadi, Yung-hing Bay, and the Eastern Bosphorus—*all included between the limits of* latitudes 36½° and 43½° N., and between longitudes 127° and 144° 40′ E. 10/–
On cloth for Captains' use 13/9

184. **JAPAN (South part of).** On three large sheets. It comprises the southern half of Nipon, Sikok, Kiusiu, with the islands and straits to the southward, and the opposite coast of Korea, and contains plans of Kii Channel, Yedo Gulf, Nagasaki, Hiogo, Simoda, Wadasima, and the bays of Eno, Heda, Arari, and Tago—*all included between the limits of* latitudes 29½° and 37° N., and between longitudes 126° and 143° 40′ E. 10/–
On cloth for Captains' use 13/9

185. **Indian Archipelago.** A work containing a full account of the Winds, Weather, and Currents experienced in the Indian Archipelago, together with general Sailing Directions and Remarks on making passages; to accompany charts of the China Sea, Indian Archipelago, and Western Pacific. With charts to illustrate and explain the subject. By W. H. Rosser 5/–

Pacific Ocean.

186.* **NORTH PACIFIC OCEAN.** (The Equator to latitude 69° N., and from longitude 60° W. to 110° E.) On three large sheets. The plans of islands and harbours are about forty in number 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in.... ... ... 31/6

187.* **SOUTH PACIFIC OCEAN.** On three large sheets. With about forty plans of islands and harbours 12/–
On cloth for Captains' use 15/9
On cloth and rollers for Counting-house, coloured and varnished; size 6 ft. 5 in. by 3 ft. 5 in. 31/6

188. **Pacific. (Short Notes and Sailing Directions, &c.)** A Pamphlet to accompany charts of the North and South Pacific. It contains a description of the winds, weather, storms, currents, &c., together with General Remarks on making Passages at all Seasons, and a complete synopsis of the Ocean Routes. With charts to elucidate the text. By W. H. Rosser 3/6

* These are new publications, and show the great Pacific Ocean on a large scale.

189. **PACIFIC OCEAN (the southern or lower part).** A chart showing the navigation between South-eastern Australia and Cape Horn, giving also the northern limit of icebergs in the Southern Ocean, and specially intended for use as a track chart. The best routes to Cape Horn are laid down. Limits, latitudes 25° S. to 70° S., longitudes 135° E. to 50° W. 8/–
On cloth for Captains' use 11/9

190.* **PACIFIC OCEAN (Western part of,—No. 1).** Shows the navigation between Eastern Australia and New Zealand. With plans of Cook Strait, Port Jackson, Auckland Islands, Port Nicholson, &c. Limits; latitudes 30° to 53° 50′ S., and longitudes 143° E. to 175° 10′ W. 8/–
On cloth for Captains' use 10/6

191.* **PACIFIC OCEAN (Western part of,—No. 2).** Shows the navigation northward from Sydney (Eastern Australia) and New Zealand to Torres Strait, and through the New Hebrides, &c. Limits; latitudes 0° to 38° S., and longitudes 140° to 172° 40′ E. 8/–
On cloth for Captains' use 10/6

192.* **PACIFIC OCEAN (Western part of,—No. 3).** Limits; latitudes 3° S. to 35° 30′ N., and longitudes 150° E. to 177° 20′ W. In this chart there are about forty plans of the principal islands and harbours met with in the route from Australia to China and Japan 8/–
On cloth for Captains' use 10/6

193.* **PACIFIC OCEAN (Western part of,—No. 4).** Shows the navigation from New Guinea to Japan. Limits; latitudes 3° S. to 35° 30′ N., and longitudes 120° to 152° 40′ E. 8/–
On cloth for Captains' use 10/6

194.* **PACIFIC OCEAN (Western part of,—No. 5).** Shows the navigation from New Zealand to the Fiji and Samoa islands, &c. Limits; latitudes 0° to 38° S. and longitudes 172° E. to 155° 30′ W. 8/–
On cloth for Captains' use 10/6

195.* **PACIFIC OCEAN (Western part of,—No. 6).** Shows Tahiti, the Touamotou, Marquesas islands, &c. Limits; latitudes 0° to 38° S., longitudes 157° 30′ to 125° W. 8/–
On cloth for Captains' use 10/6

196.* **PACIFIC OCEAN (Western part of,—No. 7).** Shows the Hawaii islands, &c. Limits; latitudes 3° S. to 35° 30′ N., longitudes 179° 30′ to 147° W. 8/–
On cloth for Captains' use 10/6

* These charts show the island portion of the Pacific on the largest scale yet published. The series consists of seven charts, each consisting of two large sheets; hence it comprises fourteen sheets. The four charts (Nos. 190, 191, 192, and 193) show the navigation between Eastern Australia, New Zealand, and Japan. An Index Chart accompanies the set.

Australia and New Zealand.

197. **AUSTRALIA, TASMANIA, NEW ZEALAND, &c.** A general chart showing the navigation between the various ports of Australia, New Zealand, New Caledonia, and the approaches to Torres Strait, with plans of Bass Strait and Port Philip. On four large sheets. Illustrated with some views of the coast 12/–
On cloth for Captains' use 17/–
On cloth and rollers for Counting-house, coloured and varnished; size 4 ft. 10 in. by 3 ft. 9 in. 31/6

198. **AUSTRALIA (South, East, and West Coasts of).** On three large sheets. With plans of ports Fairy, Stephens, Dalrymple, Botany Bay, Cockburn Sound, King George's Sound, Storm Bay, Port Adelaide, Jervis Bay, Portland Bay, Ports Philip, Jackson, Newcastle, and Moreton Bay. Compiled from recent British surveys. Illustrated with some views of the coast 12/–
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