

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. $13^{\circ} 32' N$. 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 $\frac{1}{2}$ 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. $25^{\circ} N$. (*true*) distant 7 miles, and the eastern Table island S. $30^{\circ} W$. (*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 $\frac{1}{2}$ a mile, and the breadth $\frac{1}{4}$ 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. $13^{\circ} 17' N.$, 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 $3\frac{1}{2}$ fathoms, extends nearly $\frac{1}{2}$ 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 $1\frac{1}{2}$ 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. $13^{\circ} 43' N.$, 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 Buton, 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 $2\frac{1}{4}$ 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. $12^{\circ} 29'$ 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. $12^{\circ} 45'$ 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. $12^{\circ} 3' N.$, 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 N.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. $11^{\circ} 44'$ 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

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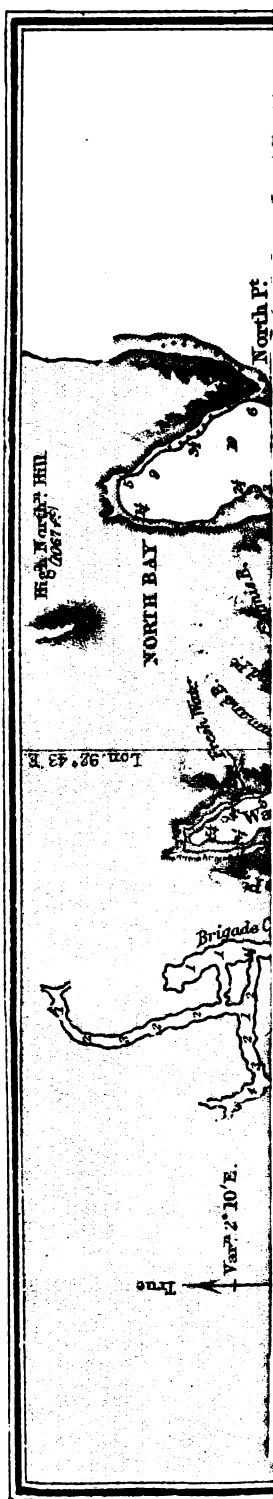
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islet named Ross, the western side of which has a reef extending from it some distance; upon this reef the depth is 2 to 4 fathoms. Within the bay is an island called Chatham. The country surrounding the inlet is extremely fertile, and there is much 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 shallowest 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 P'ediar, 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 $3\frac{1}{2}$ 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 $92^{\circ} 44' 40''$ E. (Madras Observatory, $80^{\circ} 14' 19''$ 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. $13^{\circ} 2' N.$, and is believed to be dangerous,—the north end is in Lat. $13^{\circ} 25' N.$ 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 $4\frac{1}{2}$ 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. $13^{\circ} 0' N.$, 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, $7\frac{1}{2}$, 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 $4\frac{1}{2}$ 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. $13^{\circ} 12'$ to $13^{\circ} 36' N.$, 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. $31^{\circ} 50' N.$, and between Longitudes $92^{\circ} 16'$ and $92^{\circ} 32' E.$ 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. $12^{\circ} 34' N.$, and is only 4 miles within the edge of the bank of soundings.

PORT CAMPBELL.—Port Campbell, the entrance to which is in Lat. $11^{\circ} 59' N.$, 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 $1\frac{1}{2}$ 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. $11^{\circ} 34' N.$, Long. $92^{\circ} 27' E.$ †

* "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. *Por*, 1848, tend to show that the whole of the southern islands of the Andamans are placed in that chart 13 miles too far eastward, hence the correct longitude of this island is probably $92^{\circ} 15' E.$ (Madras Observatory being in Long. $80^{\circ} 14' 19'' E.$)

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. $10^{\circ} 53' N.$; and its south end in Lat. $10^{\circ} 26' N.$ * 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. $10^{\circ} 58' N.$ 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. $92^{\circ} 30' 17'' E.$, dependent upon Fort Cornwallis, Penang, being $100^{\circ} 20' 10'' E.$ The latitude was not stated.

† This does not agree with the Admiralty chart No. 825.

1½ 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 ¼ of a mile are soundings of 4½ 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.‡

* See the Admiralty chart, No. 823.

† Dependent upon Fort Cornwallis, Penang, being 100° 20' 10" E. MR. BRADLEY, of H.M.S. *For*, 1848, made the island in Long. 93° 53' 45" E.

‡ See a very interesting description of Barren Island in the "Nautical Magazine," 1864. 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 $11^{\circ} 28' N.$, and Longitudes $93^{\circ} 31\frac{1}{2}'$ and $93^{\circ} 45' E.$ 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. $11^{\circ} 8' N.$, and Long. $93^{\circ} 40' E.$,* 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 rippings 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. *Seafarer*, 1806—namely, Lat. $11^{\circ} 17' N.$, Long. $92^{\circ} 29' E.$, which nearly agrees with what MR. BRADLEY, of H.M.S. *Fox*, supposes to be its correct position—namely, $92^{\circ} 26' E.$

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. $9^{\circ} 14' 8''$ N., and Long. $92^{\circ} 44' 53''$ 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 $1\frac{1}{2}$ 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 $9\frac{1}{2}$ fathoms at 1 mile distance, the north point bearing N.E. $\frac{1}{2}$ N., the south point W. by S., with 30 fathoms of cable out—a rock was seen under the ship, having only $7\frac{1}{2}$ 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. $8^{\circ} 49'$ N., Long. $92^{\circ} 51' 30''$ E.‡ Its height is 150 to 200 feet; in shape it is nearly quadrangular, and it is not more than $1\frac{1}{2}$ 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.

* Assuming the observatory at Madras to be $80^{\circ} 14' 19''$ E.; —all the *Novara's* longitudes of the Nicobar Islands are dependent upon this meridian. The *Novara* anchored in $14\frac{1}{2}$ 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. $9^{\circ} 12' 43''$ N., Long. $92^{\circ} 43' 20''$ E., dependent upon Fort Cornwallis, Penang being $100^{\circ} 20' 10''$ 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. $8^{\circ} 50' 4''$ N., Long. $92^{\circ} 49' 35''$ 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 $1\frac{1}{2}$ miles westward from it 47 fathoms, and at a mile eastward from it $7\frac{1}{2}$ to 10 fathoms.

TSCHAURA is distant 24 miles S.S.E. $\frac{1}{2}$ E. from Batti Malve, its east end (according to the observations of the *Galathea*) being in Lat. $8^{\circ} 25' N.$, Long. $93^{\circ} 3' 37'' E.$ It is only $1\frac{1}{2}$ 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 $\frac{1}{2}$ to $\frac{3}{4}$ 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 $2\frac{1}{2}$ 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. $8^{\circ} 18' 45'' N.$, Long. $93^{\circ} 5' 29'' E.$ 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 Teresa 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 Teresa, is not more than two

* This bank on the Austrian chart is inserted as uncertain, and the soundings are 9, $8\frac{1}{2}$, 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 Teresa, 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. $8^{\circ} 32' 29''$ N., Long. $93^{\circ} 34' 14''$ 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 Nangcoovri 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. $8^{\circ} 14' 5''$ N., Long. $93^{\circ} 31' 11''$ 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 Nangcoovri 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 *Novara*, but the chart of the Nicobars from the observations of the surveying officers of that ship has it in Long. $93^{\circ} 36'$ E. The *Novara* 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 $2\frac{1}{2}$ 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 $2\frac{1}{2}$ 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 $5\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $\frac{3}{4}$ 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. $7^{\circ} 43' N.$, 2 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 $19\frac{1}{2}$ 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. $\frac{1}{2}$ 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. $7^{\circ} 12' 17''$ N., Long. $93^{\circ} 39' 55''$ 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. $6^{\circ} 48' 26''$ N., Long. $93^{\circ} 49' 45''$ 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. $7^{\circ} 12' 50''$ N., Long. $93^{\circ} 43' 31''$ 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. $6^{\circ} 43' 49''$ N., Long. $93^{\circ} 50' 40''$ 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 at 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 season, 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 Ulåla 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 Ulåla 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 Little 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. $34^{\circ} 21' S.$, Long. $115^{\circ} 6' E.$, 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.

Geographic 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. $34^{\circ} 20' S.$, Long. $114^{\circ} 54' E.$; 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. $33^{\circ} 32' S.$, Long. $114^{\circ} 55' E.$, 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. $33^{\circ} 15' S.$, Long. $114^{\circ} 58' E.$

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. $33^{\circ} 19' S.$, Long. $115^{\circ} 37' E.$ (*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 Elliott hill (190 feet high) one mile southward of the point. A bold reef, breaking with even a moderate sea, projects N.E. by N. $\frac{1}{4}$ 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 $\frac{1}{4}$ 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 $\frac{1}{2}$ of a mile long, is about $1\frac{1}{2}$ miles off the nearest shore and S. by W. $\frac{1}{4}$ W. $2\frac{1}{2}$ 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. $32^{\circ} 21' 26''$ S., Long. $115^{\circ} 44' 22''$ 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 $\frac{1}{2}$ 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. $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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. $32^{\circ} 19' 24''$ S., Long. $115^{\circ} 39' 22''$ E., is small and sometimes uncovers; it lies S.W. $\frac{1}{4}$ S. $4\frac{1}{2}$ miles from cape Peron summit and $2\frac{1}{2}$ 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. $32^{\circ} 15' 48''$ S., Long. $115^{\circ} 42\frac{1}{2}'$ E., and $1\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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. $32^{\circ} 9' S.$, Long. $115^{\circ} 40\frac{1}{2}' E.$

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 $3\frac{1}{2}$ miles S.W. by W. $\frac{1}{4}$ 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, $\frac{1}{2}$ of a mile to the westward of Swan river lighthouse,—Lat. $32^{\circ} 3' 18''$ S., Long. $115^{\circ} 45' 30''$ 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. $\frac{1}{2}$ 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 $2\frac{1}{2}$ 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. $32^{\circ} 0' 21''$ S., Long. $115^{\circ} 31' 12''$ 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 Rottneest 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 Rottneest 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 Rottneest 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 Rottneest 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 Rottneest 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 Rottneest 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 Rottneest 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. $\frac{1}{4}$ S. $1\frac{1}{2}$ miles from Rottneest 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. $\frac{1}{4}$ N. nearly 4 miles from Parker point to cape Vlaming, are foul and rocky.

Rottneest 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 Rottneest 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 $3\frac{1}{2}$ 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. $\frac{1}{4}$ E. half a mile from Champion rock, the eastern 5-fathoms edge of the foul ground of Stragglers reef trends nearly S.E. $2\frac{1}{2}$ 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. $7\frac{1}{2}$ miles from Rottneest 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. $\frac{1}{4}$ S. 12 miles from Rottneest 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. $\frac{1}{2}$ E. $3\frac{1}{2}$ 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. $\frac{3}{4}$ N. 2 miles from Swan river lighthouse, and $1\frac{1}{2}$ miles from the beach, is a rocky patch about 1 cable in extent, with $3\frac{1}{2}$ 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.

Minor rocks form a 12-feet patch, not exceeding 120 yards in extent, lying N.W. $\frac{1}{2}$ N. $1\frac{1}{2}$ 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 $3\frac{1}{2}$ fathoms on it, lies N.W. by W. $\frac{1}{2}$ 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. $\frac{1}{4}$ 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 $4\frac{1}{2}$ 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. $\frac{1}{2}$ 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 $4\frac{1}{2}$, 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 Horsehoe 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. $\frac{1}{2}$ 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. $\frac{1}{4}$ 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 strewn 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, Rottneest 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**, $\frac{1}{2}$ 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 $2\frac{1}{2}$ miles southward of the east extreme of Rottneest 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 Rottneest 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. $\frac{1}{4}$ N. $2\frac{1}{2}$ 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 southernmost 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. $\frac{1}{4}$ 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 $\frac{1}{2}$ 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 $2\frac{1}{2}$ 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 $\frac{1}{4}$ 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. $\frac{1}{4}$ 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 $2\frac{1}{2}$ fathoms to the north-westward 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. $\frac{1}{4}$ 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 Rottneest 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. $\frac{1}{4}$ 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 Rottneest 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 Rottneest island, which will lead through the Five-fathoms channel, and at a $\frac{1}{2}$ 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. $\frac{1}{4}$ 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. $\frac{1}{4}$ 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. $\frac{1}{2}$ N. until within $1\frac{1}{2}$ 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. $\frac{1}{2}$ W.; this will lead across the bank at half a mile eastward of Carnac isle, in 14 feet water; and when it deepens to $3\frac{1}{2}$ 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. $24^{\circ} 43' S.$, Long. $113^{\circ} 9' E.$, 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 $29^{\circ} 45' S.$, 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 $28^{\circ} 10'$ and $29^{\circ} S.$

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. $28^{\circ} 18' 5''$ S., Long. $113^{\circ} 36' 33''$ E. The north extreme of Rat island (Easter group), in Lat. $28^{\circ} 42' 49''$ S., Long. $113^{\circ} 47' 41''$ E. And the S.E. extreme of Pelsart isle in Lat. $28^{\circ} 59' 14''$ S., Long. $113^{\circ} 58' 10''$ E.

Snapper bank, the most distant detached shoal from the Houtman rocks, lies S.E. by E. $7\frac{1}{2}$ miles from the dead coral islet N.E. of Easter group, and N. by W. $6\frac{1}{2}$ miles from the north-easternmost of the Pelsart group; this is a 6-fathom coral bank, $1\frac{1}{2}$ miles long north and south, by $\frac{1}{2}$ 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. $\frac{1}{4}$ 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. $\frac{1}{2}$ 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 $2\frac{1}{2}$ fathoms on it, lies N.E.-ward 7 or 8 miles from cape Inscription, and in the fairway of the channel.

Geographic 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. $113^{\circ} 22'$ E.), which is high and rocky, a low sandy coast trends to cape Farquhar, N.N.E. $\frac{1}{2}$ 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. $28^{\circ} 47' 8''$ S., Long. $114^{\circ} 36' 20''$ E.

open bays. From point Cloates to the North-West cape of Australia the distance is 52 miles N.N.E. $\frac{1}{2}$ E.

The **North-west cape** is a low sandy point in Lat. $21^{\circ} 47' 40''$ S., Long. $114^{\circ} 2' 15''$ 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 $17^{\circ} 40'$ S., and the meridians of $118^{\circ} 50'$ and $119^{\circ} 40'$ 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. $20^{\circ} 41'$ S., Long. $114^{\circ} 17'$ E.

A coral reef, on which the ship *Lively* was lost, is said to lie in Lat. $16^{\circ} 30'$ S., Long. $119^{\circ} 36'$ 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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. $20^{\circ} 16' 30''$ S., Long. $115^{\circ} 8' 30''$ 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 $19^{\circ} 50'$ 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. $\frac{1}{2}$ 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, $\frac{1}{2}$ 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 $\frac{3}{4}$ 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 $2\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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, $16\frac{1}{2}$ 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. $20^{\circ} 37' 15''$ S., and Long. $117^{\circ} 9' 45''$ E.—assuming Arthur head, West Australia, to be $115^{\circ} 45\frac{1}{2}'$ E. Variation $1^{\circ} 30'$ 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. $34^{\circ} 21'$ S., Long. $115^{\circ} 6'$ E., to point D'Entrecasteaux, in Lat. $34^{\circ} 52'$ S., Long. $116^{\circ} 1'$ 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. $35^{\circ} 2\frac{1}{2}'$ S., Long. $116^{\circ} 29'$ 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. $\frac{1}{2}$ N. 18 miles from Chatham island, and S.E. $\frac{1}{2}$ S. 15 miles from point D'Entrecasteaux. The soundings at 18 to 20 miles southward of these rocks are 65 fathoms, white sand.

Muyts point, a clifty headland projecting 3 miles beyond the line of coast, lies E. by S. 7 miles from Chatham island. Thence to the sharp, clifty cape, **West Cape Howe**, in Lat. $35^{\circ} 8\frac{1}{2}'$ S., Long. $117^{\circ} 40'$ E., the coast trends irregularly to the eastward. The next prominent point is **Peak head**, 4 miles E.N.E. $\frac{1}{2}$ E. of which is **Bald head** (in Lat. $35^{\circ} 6\frac{1}{2}'$ S., Long. $118^{\circ} 0\frac{1}{2}'$ 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. $\frac{1}{2}$ S. from Bald head, and S.E. by E. $\frac{1}{2}$ E. $2\frac{1}{2}$ miles from Peak head; it is steep on every side, and the soundings give no warning.

Maude reef ($\frac{1}{2}$ of a mile in diameter) is outside of Vancouver reef, and nearly in a line with it and Bald head, at the distance of $6\frac{1}{2}$ miles from the latter; it is also 4 miles S. $\frac{1}{2}$ 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 $1\frac{1}{2}$ miles long, E.N.E. and W.S.W., by $\frac{1}{2}$ 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. $8\frac{1}{2}$ miles, and from West Cape Howe E.S.E. $\frac{1}{2}$ 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 $\frac{1}{4}$ 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. $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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. $35^{\circ} 4' 18''$ S., Long. $118^{\circ} 3' 20''$ 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. $7\frac{1}{2}$ miles from Breaksea island lighthouse, and its position is Lat. $35^{\circ} 2' 35''$ S., Long. $117^{\circ} 55' 12''$ 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. $34^{\circ} 55'$ 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. $121^{\circ} 35'$ E. to Long. $124^{\circ} 4'$ E., is fronted by a dangerous labyrinth of islands and reefs, called the **Recherche Archipelago**.

Termination island, in Lat. $34^{\circ} 30'$ S., Long. $121^{\circ} 58'$ 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. $33^{\circ} 55'$ S., Long. $123^{\circ} 28'$ 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. $34^{\circ} 35' S.$, Long. $123^{\circ} 26' E.$, or 14 miles S. $\frac{1}{4}$ W. from the largest of the South-east isles. CAPT. BETHUNE, of H.M.S. *Conway*, in 1838, made it in Lat. $34^{\circ} 34' S.$, Long. $123^{\circ} 25' E.$; the sea broke heavily over a space of about a $\frac{1}{4}$ 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. $\frac{1}{4}$ 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. $35^{\circ} 45\frac{1}{2}' S.$, Long. $136^{\circ} 38' E.$

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. $35^{\circ} 1' S.$, Long. $135^{\circ} 54' E.$, 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. $35^{\circ} 18' S.$, Long. $136^{\circ} 55' E.$ 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 $1\frac{1}{2}$ 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. $2\frac{1}{2}$ miles from the N.E. end of William's island, and nearly 2 miles S.E. $\frac{3}{4}$ 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 $\frac{1}{2}$ a mile to 2 miles wide; the south point, off which is a small islet surrounded by breakers, is in Lat. $35^{\circ} 6' S.$, Long. $136^{\circ} 11\frac{1}{2}' E.$

Neptune isles lie between the the parallels of $35^{\circ} 12'$ and $35^{\circ} 22' S.$, and between the meridians of $136^{\circ} 1'$ and $136^{\circ} 9' E.$; 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. $35^{\circ} 22' 15'' S.$, Long. $136^{\circ} 7' 45'' E.$

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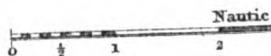
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* For the navigation of Spencer Gulf it is indispensable to have Admiralty Charts and 1061.

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White Sand Hill
(30 ft)

WALLAROO

Railway to Kooragang
and the Mines

detached reefs among the low northern islets constituting the group;
and be avoided during the night. CAPT. J. L. STOKES places the southern
in Lat. $35^{\circ} 22' 15''$ S., Long. $136^{\circ} 7' 45''$ E.

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. $35^{\circ} 11' S.$, Long. $136^{\circ} 29' E.$, 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. $34^{\circ} 52' S.$, Long. $137^{\circ} 3' E.$, 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. $34^{\circ} 28\frac{1}{2}' S.$, Long. $137^{\circ} 21' E.$, 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. $34^{\circ} 10' S.$, Long. $137^{\circ} 27' E.$ 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. $\frac{1}{4} S.$; 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 $4\frac{1}{2}$ 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. $\frac{1}{2}$ E. direction; the extreme breadth from east to west nearly 2 miles.

"The soundings on the reef vary:—in some places there being $1\frac{1}{2}$ 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. $\frac{3}{4}$ E.

"A *red* nun buoy has been placed off Long point in 3 fathoms, with the following bearings:—Elizabeth point, S. $\frac{1}{2}$ E.; Long point, E. by N. $\frac{1}{2}$ N.

"Vessels rounding the south part of the reef should not bring Elizabeth point to bear to the southward of S.E. by E. $\frac{1}{2}$ 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. $\frac{1}{2}$ 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 $4\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 $\frac{1}{2}$ 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. $1\frac{1}{2}$ 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. $33^{\circ} 53'$ S., Long. $137^{\circ} 38'$ 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. $\frac{1}{2}$ E., point Lowly is directly in line.

The following directions were issued in 1862, the result of the survey by COM-MANDER 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. $\frac{1}{2}$ E., $\frac{1}{10}$ 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 $2\frac{1}{2}$ 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. $21^{\circ} 10'$ 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 $1\frac{1}{2}$ miles (N. by E. $\frac{1}{2}$ E.) beyond.

Douglas Point is N. $\frac{3}{4}$ E., $2\frac{1}{2}$ 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. $2\frac{1}{2}$ 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. $\frac{1}{4}$ 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 $\frac{5}{10}$ 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 $2\frac{1}{2}$ 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 $\frac{1}{10}$ 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 8 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-foot bank runs half a cable off the S.E. side of the sand islet knoll between Curlew and Orchard points, and a 7-foot 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. $\frac{1}{4}$ W., 4 cables from the flagstaff, the 9-foot bank shoals out on the west side, leaving the 12-foot channel less than half a cable in width.

5. S.W. $\frac{1}{4}$ S., 2 cables from the flagstaff, is the 5-foot shelf on which the barque *Bangoon* 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. Fire-wood 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. $32^{\circ} 29' 42''$ S.; the Longitude is not yet determined. The variation in 1862 was $4^{\circ} 36'$ 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. $\frac{1}{2}$ 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. $\frac{1}{2}$ W., until the northern extreme of Bluff range comes on with Two Hummock point (extreme) bearing N.N.W. $\frac{1}{4}$ 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. $\frac{1}{2}$ 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 $3\frac{1}{2}$ miles nearly; then the course is N.W. $\frac{3}{4}$ 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. $\frac{1}{2}$ E., alter course to N. $\frac{1}{4}$ 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. $\frac{1}{2}$ S., then steer N. by W. $\frac{1}{2}$ W. through the first part of Snapper reach: just before you round Commissariat point the soundings decrease to $3\frac{1}{2}$ 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. $\frac{1}{4}$ 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. $\frac{1}{2}$ 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. $\frac{1}{2}$ S., and not coming into less than 9 fathoms. When mount Gullet bears E. $\frac{1}{2}$ S., haul out from the land N. by E., till the inshore hummock comes on with the south part of Two Hummock point, W. $\frac{1}{2}$ 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. $\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 Jorda, the N.W. point of Kangaroo island, is in Lat. $35^{\circ} 45\frac{1}{2}'$ S., Long. $136^{\circ} 38'$ 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. $35^{\circ} 34\frac{1}{2}'$ S., Long. $137^{\circ} 43\frac{1}{2}'$ 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. $\frac{1}{2}$ 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. $\frac{1}{2}$ W. round by the eastward to S.W. by W. $\frac{1}{2}$ W.; position, Lat. $35^{\circ} 51' 33''$ S., Long. $138^{\circ} 10' 50''$ 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 Jarvis, 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 $\frac{1}{4}$ 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 Jarvis N.W. by N., and the southernmost Page islet E.S.E. $\frac{1}{2}$ 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 Jarvis; the southern islet is low, and has a reef extending $1\frac{1}{2}$ 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. $36^{\circ} 4'$ S., Long. $137^{\circ} 33'$ E., to the N.W. of which is a deep bight, called Vivonne bay.

Felorus 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 $2\frac{1}{2}$ miles, and cape Willoughby N.E. by E. $\frac{1}{2}$ E. 31 miles. Some covered **rocks**, not always indicated by broken water, lie E. $\frac{1}{2}$ 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. $\frac{1}{4}$ W., 7 miles from cape Bouguer, a projection 15 miles westward of cape Kersaint. Off cape Couedie, 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. $36^{\circ} 20\frac{1}{4}'$ S., Long. $137^{\circ} 52\frac{1}{2}'$ E., and bears S.W. $\frac{1}{2}$ W. 48 miles from cape Willoughby, and S. $\frac{1}{4}$ 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 *Phæbe Dunbar*; it is stated to be in Lat. $36^{\circ} 33' S.$, Long. $136^{\circ} 31\frac{1}{2}' E.$, and 30 miles to the S.S.W.-ward of cape Couedie; 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. $35^{\circ} 56' S.$, Long. $136^{\circ} 36\frac{1}{2}' E.$ To the southward and N.W.-ward, rocks project from it to the distance of $1\frac{1}{2}$ to $2\frac{1}{2}$ miles.

Troubridge Hill, in Lat. $35^{\circ} 11' S.$, Long. $137^{\circ} 41\frac{1}{2}' E.$, 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 $\frac{1}{2}$ a mile long, visible 4 or 5 miles; there is also a dangerous detached reef about $\frac{1}{2}$ a mile from the rocks, on the southern edge of the western shoal, and S. $\frac{1}{2}$ 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. $35^{\circ} 7' 50'' S.$, Long. $137^{\circ} 52' E.$ 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. $\frac{1}{2}$ N. bearing, and steer E.N.E. $\frac{1}{2}$ N. to pass it at a distance of 7 miles, bringing it to bear W. by N. $\frac{1}{2}$ N.; thence a course N.E. $\frac{1}{2}$ 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.

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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. $35^{\circ} 38' S.$, Long. $138^{\circ} 9' E.$, 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. $34^{\circ} 30' S.$

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. $34^{\circ} 59\frac{1}{2}' S.$, Long. $138^{\circ} 33' E.$; 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. $34^{\circ} 50' S.$, Long. $138^{\circ} 31' E.$

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. $34^{\circ} 49' S.$, Long. $138^{\circ} 30' E.$

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. $\frac{1}{2}$ 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 $34^{\circ} 49' S.$ 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. $35^{\circ} 10' 20''$ S., Long. $138^{\circ} 30' 30''$ 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.

* "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. $35^{\circ}28'20''$ S., Long. $138^{\circ}21'30''$ 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 $1\frac{1}{2}$ inch chain, stretched north and south, having 2 buoy chains of 15 fathoms each, of $1\frac{1}{2}$ inch chain. Small craft, using these moorings, may shackle on their cable to the buoys, and veer away towards the jetty.

Second Valley.—Lat. $35^{\circ}31'10''$ S., Long. $138^{\circ}17'0''$ 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 $1\frac{1}{2}$ 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 Jervia 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. $35^{\circ}35'20''$ S., Long. $138^{\circ}40'10''$ E. High water, full and change, 11. 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 $1\frac{1}{2}$ 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 1½ inch chain.

The mooring-bridle at the outer buoy, consists of 12½ fathoms of 1½ 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 L'acépède 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 **Gutchen Bay**, which, though open to the west, affords good shelter in 5½ to 6 fathoms 1½ 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 Laced  de 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. $\frac{1}{2}$ 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. $38^{\circ} 3' S$, Long. $140^{\circ} 37' 45'' E$.

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. $\frac{1}{2}$ 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. $38^{\circ} 6' S$, Long. $140^{\circ} 52' E$, and $4\frac{1}{2}$ 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. $38^{\circ} 21\frac{1}{2}' S$, Long. $141^{\circ} 24' E$), is a bold clifly 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. $\frac{1}{2}$ E. from cape Nelson is **cape Sir William Grant**, off which, in an E. by N. direction $2\frac{1}{2}$ 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. $38^{\circ} 26'$ S. and Long. $142^{\circ} 1'$ 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. $38^{\circ} 22'$ S., Long. $141^{\circ} 39'$ 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. $\frac{1}{2}$ 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. $\frac{1}{2}$ 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. $\frac{1}{4}$ W. 13 miles is Percy island, lying 5 miles off shore. It has a table appearance, and is very steep.

Nine miles N.E. $\frac{1}{2}$ 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 $1\frac{1}{2}$ 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. $38^{\circ} 24'$ S., Long. $142^{\circ} 20'$ 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. $\frac{1}{4}$ 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. $38^{\circ} 26' S.$, Long. $142^{\circ} 32' E.$ From the lighthouse the south-east extremity of the reef bears S.E. by E. $\frac{1}{4} E.$, distant half a mile; and the southern extreme of Hopkins reef, E. $\frac{1}{4} S.$, 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. $\frac{3}{4} S.$; nor to the westward of N.W. by W. $\frac{1}{4} W.$ 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. $\frac{1}{4} E.$, 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. $38^{\circ} 51' S.$; Long. $143^{\circ} 33\frac{1}{2}' E.$

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. $\frac{1}{2} E.$, 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. $\frac{3}{4} N.$, distant $4\frac{1}{2}$ miles, and the east extreme N.W. by W. 4 miles; Navarino shoal N.E. by N. $2\frac{1}{2}$ miles; and south extreme of New Year islands S.W. $\frac{1}{4} S.$, 9 miles, and north extreme S.W. $\frac{1}{4} W.$ $7\frac{1}{4}$ miles. Position about Lat. $39^{\circ} 35' S.$, and Long. $143^{\circ} 57' E.$

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 between 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 clifty 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. $38^{\circ} 30'$ S., Long. $144^{\circ} 54'$ 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. $\frac{1}{4}$ 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. $38^{\circ} 55'$ S., Long. $145^{\circ} 56'$ 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., $5\frac{1}{2}$ 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. $39^{\circ} 9'$ S., Long. $146^{\circ} 27'$ 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. $\frac{1}{2}$ E., the light will be *eclipsed* by the south part of Cleft island; when N. $\frac{1}{2}$ E., by centre of Rodondo island; when N. $\frac{1}{2}$ W., by Ten-foot rock; when N.W. $\frac{1}{4}$ N., by West Moncur island; when N.W. $\frac{3}{4}$ W., by East Moncur island; when S.W. $\frac{1}{4}$ S., by Clifty, or South Seal island; when S.W. by S., by North Seal island; and when S.S.W. $\frac{1}{4}$ 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 Clifty and the other Seal islands.

* 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. $38^{\circ} 18' S.$, Long. $144^{\circ} 38' E.$, 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 $1\frac{1}{2}$ 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.

* See Admiralty Charts, Nos. 1171A and 1171B.

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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. $\frac{1}{2}$ 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. $\frac{1}{2}$ 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. $\frac{3}{4}$ 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. $\frac{1}{4}$ W.; this clears the bank between Shortland bluff and Swan island spit in 3 fathoms. Immediately

* 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 *fired* 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 *fired 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 Schank, Port Phillip heads, Hobson bay, and Melbourne.

GEE LONG, 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 **Wchnapper 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 $29\frac{1}{2}$ 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 **Monocour 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 1867 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. ¼ E. from Curtis island; it is a small, bare, but conspicuous rock, frequented by birds, with no dangers near it.

Crocodile Rock, about 8 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. 11½ 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. $39^{\circ} 28' 58''$ S., Long. $147^{\circ} 21' 36''$ E.

Judgment Rocks, so named from the highest resembling an elevated seat, lie W.S.W. $8\frac{1}{2}$ 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. $39^{\circ} 49' S.$, Long. $147^{\circ} 16\frac{1}{2}' E.$, and lies S.S.E. $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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**, $2\frac{1}{2}$ miles from the latter, and in Lat. $39^{\circ} 36' S.$, Long. $147^{\circ} 36' E.$; another reef, just awash at low water, lies E. $\frac{3}{4}$ 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. $40^{\circ} 18' 41''$ S., Long. $147^{\circ} 48'$ 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 $11\frac{1}{2}$ 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 $2\frac{1}{2}$ seconds, at an elevation of 110 feet above the sea, and visible 14 miles. Position—Lat. $40^{\circ} 43\frac{1}{2}'$ S., Long. $148^{\circ} 8\frac{1}{2}'$ 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. $41^{\circ} 3' 35''$ S., Long. $146^{\circ} 48' 15''$ 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, $3\frac{1}{2}$ 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. $38^{\circ} 46'$ S., Long. $146^{\circ} 31'$ 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; Clifty 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. $\frac{1}{2}$ 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 $5\frac{1}{2}$ miles S.W. $\frac{1}{4}$ 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. $\frac{1}{2}$ N. round by North, to S.S.W. Position—Lat. $37^{\circ} 35'$ S., Long. $149^{\circ} 55'$ 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. $43^{\circ} 33\frac{1}{2}'$ S., Long. $146^{\circ} 2'$ E.; and **South cape** in Lat. $43^{\circ} 39'$ S., Long. $146^{\circ} 53'$ 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. $43^{\circ} 44\frac{1}{2}'$ S., Long. $146^{\circ} 23'$ E. To the N.N.W.-ward of the Mewstone between it and the mainland—are the **Maatsuyker islands**, the S.W.-ernmost 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. $43^{\circ} 39'$ S., Long. $146^{\circ} 51'$ 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. $43^{\circ} 51\frac{1}{2}'$ S., Long. $146^{\circ} 59\frac{1}{2}'$ 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. $8\frac{1}{2}$ miles from Pedra Blanca, is the **Sidmouth rock**, 100 yards in diameter, with a reef projecting from it about $\frac{1}{2}$ 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.

Burick rock, or islet, was reported by the Russian ship *Burick*, in 1822; it was

* All the positions in Tasmania are dependent on Fort Macquarie, Sydney, being in Long. $151^{\circ} 14'$ E.

stated to be in Lat. 44° S., Long. $147^{\circ} 45'$ E., or 29 miles E. $\frac{1}{4}$ 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. $43^{\circ} 29\frac{1}{4}'$ S., Long. $147^{\circ} 10'$ 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. $43^{\circ} 34' 50''$ S., Long. $146^{\circ} 56' 30''$ 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. $\frac{1}{2}$ N. $1\frac{1}{2}$ 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 $\frac{3}{4}$ 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. $1\frac{1}{2}$ miles. There is a narrow passage with $4\frac{1}{2}$ fathoms water between the N. end of Sterile island and the southern extremity of the reef extending from Actæon island. At $\frac{1}{4}$ 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. $\frac{1}{2}$ N. $6\frac{1}{2}$ miles, and from Arthur point E. $\frac{1}{2}$ 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 $2\frac{1}{4}$ 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. $6\frac{1}{2}$ miles from South port is the entrance of port Esperance, about $1\frac{1}{2}$

miles wide, and more than $2\frac{1}{2}$ 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 $2\frac{1}{4}$ 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.

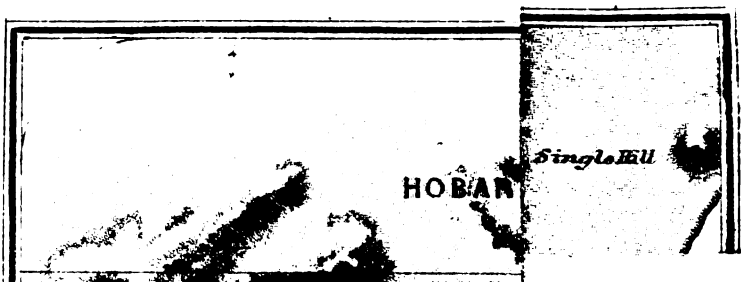
In baffling or contrary winds, vessels should keep to the eastern shore, which may be approached boldly. Several reefs and rocks being on the western shore, higher up than the Actæon reefs, it will be necessary to approach that shore with great caution, until South port, formerly Muscle bay, opens out, 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



W.B.



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. $\frac{1}{2}$ 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 $43^{\circ} 20' 38''$ 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. $43^{\circ} 3' 45''$ S., Long. $147^{\circ} 26'$ 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.

ROBARTON 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.

Mason 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. POLKINGHOENE, H.M.S. *Fantome*, 1852.)

Betsy Island; about 2½ miles to the eastward of cape Direction, is high, and accessible only towards its north end; its length is about 1¼ 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 shoalsens 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 M^r. 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. $\frac{1}{2}$ E. Between these two high columnar capes the shore falls back and forms a bay, called port Arthur. It is about $3\frac{1}{2}$ 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 $3\frac{1}{2}$ 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 $57^{\circ} 24'$ 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 $60^{\circ} 40'$ 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. $38^{\circ} 8'$ N., Long. $34^{\circ} 3'$ 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. $4^{\circ} 54'$ S., Long. $106^{\circ} 36'$ 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, $40^{\circ} 11'$ N., Long. $32^{\circ} 11'$ W.; difference from 8.30 A.M. $8'$ N. $11'$ E.—position of wreck, $40^{\circ} 3'$ N. and $32^{\circ} 22'$ 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 gateway, 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 rippings, 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 (P iceberg)	50 40	53 35	1863
Herron island (P iceberg)	44 41	48 14	1855
Marseveen island (P iceberg)	41 25	20 50	
Denia island (P 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	1743
"	"	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.
<i>Romeiro island</i>	28° 50' S.	70° 10' E.	
Belliqueux soundings	28 43	42 26	1801
<i>Danish bank</i>	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	
Anacreson reef	17 30	65 20	
<i>Brandon shoal</i>	16 20	62 30	
Rajaswarre shoal	11 25	52 2	1858
<i>South Roquipiz island</i>	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
<i>Gama island</i>	2 10	76 10	
<i>Bonvouloir island</i>	0 50 S.	74 55	
Ouro or Grenville island	0 42 N.	80 54	
" "	0 55	81 30	1728
" "	1 0	82 0	1731
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 38½	{ 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	1840
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	38 27	137 2	1817
Brockman's reefs	38 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. $44^{\circ} 41' S.$, Long. $49^{\circ} 51' E.$ 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, $45^{\circ} 50' S.$; position of the land seen at 0.30 P.M., Lat. $44^{\circ} 41' S.$, Long. $50^{\circ} E.$ On the 11th September, the weather was squally and unsettled; ship surrounded with seaweed, 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 $1^{\circ} 46'$ more easterly than its true position, consequently the discovery, if it had been an island, was in Long. $48^{\circ} 14' E.$

As to the probability of islands being near the parallel of $45^{\circ} S.$, and between the meridians of 48° and $52^{\circ} E.$, 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 $3\frac{1}{2}$ 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 1854, CAPTAIN W. PHINNEY, of the *Gertrude* (American), reports kelp and seaweed from October 5th, in Lat. $46^{\circ} 7' S.$, Long. $81^{\circ} E.$ to October 10th, Lat. $45^{\circ} 4' S.$, Long. $103^{\circ} E.$; 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* 1854), in reference to the same subject, says:—"From $66^{\circ} E.$ to $104^{\circ} E.$, on or about the 47^{th} 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. $41^{\circ} S.$, Long. $40^{\circ} E.$ to Lat. $54^{\circ} S.$, Long. $120^{\circ} E.$

CAPTAIN CASS, of the *Caducea*, says:—"We continued to fall in with ice, edging to the northward of the Crozets to get clear. On January 8th, in Lat. $45\frac{1}{2}^{\circ} S.$, Long. $45\frac{1}{4}^{\circ} E.$, 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. $39^{\circ} 52' S.$, Long. $35^{\circ} 13' E.$ "

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. $39^{\circ} 42' S.$, Long. $65^{\circ} 50' E.$ 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. $39^{\circ} 39' S.$ Long. $68^{\circ} 32' E.$ "

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 $60^{\circ} E.$ 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., $20^{\circ} 20' E.$ of the Cape, and $58^{\circ} 25' E.$ of Teneriffe.

Albion bank.—Reported in 1822 as seen by the *Albion*; its N.W. end in Lat. $38^{\circ} 20' S.$, Long. $17^{\circ} 3' E.$; and its S.E. end in Lat. $38^{\circ} 29' S.$, Long. $18^{\circ} 58' E.$; 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. $37^{\circ} 57' S.$, and Long. $23^{\circ} E.$ 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 $4\frac{1}{2}$ 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 $\frac{1}{2}$ 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. $33^{\circ} 43' S.$ (mer. alt.), and Long. $36^{\circ} 30' E.$ 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. *Leis*, 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. $9^{\circ} 54'$ S., Long. $97^{\circ} 50'$ 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 *Phoenix*, 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. $9\frac{1}{2}^{\circ}$ S.

For **St. Michael's bank**, **George island**, **Roquix** or **Bridgewater island**, **Rose Galley rocks**, and **Swift bank**, see the remarks p. 263.

London bank, **Caddy island**, and **Ada 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 $0^{\circ} 42'$ N., Long. $80^{\circ} 54'$ 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. $0^{\circ} 16' N.$ and $0^{\circ} 2' N.$ The accounts published represent it to be in Lat. $0^{\circ} 55' N.$, Long. $81^{\circ} 30' E.$

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. $1^{\circ} N.$ and Long. $82^{\circ} E.$

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. $9^{\circ} 19' N.$, Long. $76^{\circ} 21' E.$; 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. $10^{\circ} 10' N.$, Long. $63^{\circ} 40' E.$ 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), $10^{\circ} 10' N.$, Long. (by account), $62^{\circ} 57' E.$ Steered S. $88^{\circ} E.$ 35 miles.

“ 8.0 A.M., Lat. by account, $10^{\circ} 11' N.$, Long. chron., $63^{\circ} 24' E.$ Steered E. 16 miles.

" 9.45 A.M.—Lat., by account, $10^{\circ} 11' N.$; Long., chron., $63^{\circ} 40' E.$ Steered N. 10 miles.

" Noon.—Lat., observed, $10^{\circ} 18' N.$; Long., chron., $63^{\circ} 40' E.$ 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. $88^{\circ} E.$ 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. $\frac{1}{4}$ E. (true) 9 miles till noon, when being in Lat. $4^{\circ} 16' N.$, Long. $83^{\circ} 39' E.$, 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. $\frac{1}{4}$ 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. $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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. $5^{\circ} 18' N.$, and Long. $88^{\circ} 20' E.$ 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. $\frac{1}{2}$ N., Long., by chronometer, $97^{\circ} 10' E.$, and Lat., deduced from noon, $10^{\circ} 24' N.$ Roe's bank is $96^{\circ} 45' E.$, and $10^{\circ} 20' N.$, 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 11 h.; 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. $16^{\circ} 1' N.$, Long. $84^{\circ} 51' E.$, approaching the position in the bay of Bengal marked 'Rocky Breakers (D);' from noon till 2 h. 45 m. 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."

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 $17^{\circ} 11' N.$, and Long. by D. R. $85^{\circ} 48' E.$ 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. $85^{\circ} 51' E.$;—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 Polestar, which gave the Latitude $17^{\circ} 30' N.$ and $17^{\circ} 31' N.$, 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. $17^{\circ} 26' N.$, and Long. (brought forward from 4 P.M.), $85^{\circ} 51' E.$ "

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	31.1
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	183	33.2	62	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	32.3

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 $26^{\circ} 10' W.$ in $16^{\circ} 15' N.$: they were occupied $7\frac{1}{2}$ days sailing from $10^{\circ} N.$ to the Equator, which they crossed in $23\frac{1}{2}^{\circ} W.$;—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 $26^{\circ} 35' W.$ in $14^{\circ} 5' N.$: they were occupied $8\frac{1}{2}$ days sailing from $10^{\circ} N.$ to the Equator, which they crossed in $24^{\circ} 36' W.$;—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 $26^{\circ} 50' W.$ in $14\frac{1}{2}^{\circ} N.$: they were occupied $10\frac{1}{2}$ days sailing from $10^{\circ} N.$ to the Equator, which they crossed in $22^{\circ} 25' W.$;—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 $26^{\circ} 40' W.$ in $13^{\circ} 5' N.$: they were occupied $11\frac{1}{2}$ days sailing from $10^{\circ} N.$ to the Equator, which they crossed in $25^{\circ} 50' W.$;—making the passage from the Channel to the Line in $34\frac{1}{2}$ 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 $22^{\circ} 36' W.$ in $4^{\circ} 48' N.$: they were occupied $8\frac{1}{2}$ days sailing from $10^{\circ} N.$ to the Equator, which they crossed in $22^{\circ} 48' W.$;—making the passage from the Channel to the Line in $30\frac{1}{2}$ days.

April, May and June; from the log-books of 33 vessels:—

The mean position of the vessels north of the Line was $22\frac{1}{2}^{\circ}$ W. in 7° N.: they were occupied $10\frac{1}{4}$ days sailing from 10° N. to the Equator, which they crossed in $23^{\circ} 6'$ W.;—making the passage from the Channel to the Line in $29\frac{1}{4}$ 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 $9\frac{1}{4}$ days sailing from 10° N. to the Equator, which they crossed in $21^{\circ} 36'$ W.;—making the passage from the Channel to the Line in $30\frac{1}{4}$ days.

October, November and December; from the log-books of 51 vessels:—

The mean position of the vessels north of the Line was $22\frac{1}{2}^{\circ}$ W. in $12^{\circ} 6'$ N.: they were occupied $12\frac{1}{4}$ days sailing from 10° N. to the Equator, which they crossed in $24^{\circ} 18'$ 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, $43\frac{1}{2}$ 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. $30^{\circ} 36'$ W. in Lat. $17^{\circ} 36'$ 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. $37^{\circ} 11'$ S.; lowest, Lat. $31^{\circ} 2'$ S.; highest, Lat. $42^{\circ} 15'$ S.

The mean position of 376 vessels bound to the Australian colonies, Lat. $38^{\circ} 36'$ S.; lowest, Lat. $31^{\circ} 33'$ S.; highest, Lat. $47^{\circ} 3'$ S.

Of Dutch vessels bound for the East, 574, taking the *eastern* route, crossed the

Meridian of Greenwich in Lat. $36^{\circ} 15' S.$; 135 vessels by the *western* route crossed the Mer. of Green. in Lat. $40^{\circ} 40' S.$

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, $32\frac{1}{2}$ days. Of the vessels by the western route, mean number of days, 24; shortest, $17\frac{1}{2}$ 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. $33^{\circ} S.$, it was subsequently crossed and recrossed no less than *three* times, the last being in Lat. $40^{\circ} S.$; in another instance, in 1856, it was crossed twice on the same voyage, the first time in Lat. $29^{\circ} S.$; so that it may generally be recommended to take the mean position given above—viz., Lat. 37° to $38\frac{1}{2}^{\circ} S.$

From the Meridian of Greenwich to the Australian Colonies.

Admiralty publications still recommend vessels to run down their *easting* on the parallel of $39^{\circ} S.$; 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. $50^{\circ} S.$ ” 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 $44^{\circ} 35' S.$, and the range in latitude is between $38^{\circ} S.$, and $56^{\circ} 37' S.$,—very few, however, higher than 51° or $52^{\circ} S.$

On the parallel of $39^{\circ} S.$, the distance from the meridian of Greenwich to cape Otway, is 6694 miles. From the same meridian, in about $38\frac{1}{2}^{\circ} S.$, to cape Otway, by the composite track, max. Lat. $45^{\circ} S.$, the distance is 6308 miles; by comp. track, max. Lat. $48^{\circ} S.$, the distance is 6161 miles; and by comp. track, max. Lat. $51^{\circ} S.$, the distance is 6049 miles.

On the parallel of $39^{\circ} S.$ 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. $44^{\circ} 35' S.$, 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. $38\frac{1}{2}^{\circ} S.$, pursue the composite route of max. Lat. $45^{\circ} S.$, the difference in the distance in favour of max. Lat. $48^{\circ} S.$, which is 147 miles, and in favour of max. Lat. $51^{\circ} S.$, 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 $39^{\circ} S.$

In our logs we have the *Frances Henty* making her mean of 233 miles per day, for 8 successive days, between 45° and $46^{\circ} S.$; the *Kent* her 227 miles for 10 successive days, between 44° and $45^{\circ} S.$; the *Southern Cross* her 196 miles for 13 successive days, between 49° and $50^{\circ} S.$; and the *Earl of Sefton* her 271 miles for 8 successive days, between 50° and $53\frac{1}{2}^{\circ} S.$,—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. LEE MAN, 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 (P)

"To enable you to judge, I enclose three separate Logs of passages across this space, in the *Emeralda*, 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 (P) 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 (P), 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 P

"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 $38\frac{1}{2}^{\circ}$ 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. $107\frac{1}{2}^{\circ}$ 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. $99\frac{1}{2}^{\circ}$ 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. $94\frac{1}{2}^{\circ}$ 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 $98\frac{1}{2}$ days; of 212 voyages to Sydney, $105\frac{1}{2}$ days.

Of the vessels sailing on or near the parallel of 39° S., the average is $10\frac{1}{2}$ 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 $96\frac{1}{2}$ 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 $45^{\circ} 25' S.$; in 1863, when the *Murray* made her run to Adelaide in 70 days, sailing from Plymouth in July, her max. Lat. was $47^{\circ} S.$

From off Cape Otway to Sydney,—the average, from these logs, is $6\frac{1}{2}$ days, shortest $3\frac{1}{2}$ days, longest $14\frac{1}{2}$ 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 . .	42·0	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 rook (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, Alipay, 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 Réunion:—Steer so as to pass at a distance of about 90 miles from the S.E. part of Madagascar. From the parallel of $26^{\circ} 30'$ 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°	$28\frac{1}{2}$	$26\frac{1}{2}$	$22\frac{1}{2}$	$19\frac{1}{2}$	18°	12°
February .	31	29	26	$23\frac{1}{2}$	$21\frac{1}{2}$	$18\frac{1}{2}$	$12\frac{1}{2}$
March . .	$30\frac{1}{2}$	$28\frac{1}{2}$	25	23	$19\frac{1}{2}$	$16\frac{1}{2}$	$12 \& 9\frac{1}{2}$
April . .	$29\frac{1}{2}$	27	24	$20\frac{1}{2}$	$17\frac{1}{2}$	$13\frac{1}{2}$	$9\frac{1}{2}$
May . .	$29\frac{1}{2}$	$26\frac{1}{2}$	$23\frac{1}{2}$	20	$16\frac{1}{2}$	13	$8\frac{1}{2}$
June . .	$29\frac{1}{2}$	$26\frac{1}{2}$	$23\frac{1}{2}$	19	$15\frac{1}{2}$	$12\frac{1}{2}$	$8\frac{1}{2}$
July . .	29	$26\frac{1}{2}$	23	19	$15\frac{1}{2}$	$12\frac{1}{2}$	$8\frac{1}{2}$
August . .	$28\frac{1}{2}$	$26\frac{1}{2}$	23	$19\frac{1}{2}$	$15\frac{1}{2}$	$12\frac{1}{2}$	$8\frac{1}{2}$
September .	$29\frac{1}{2}$	$26\frac{1}{2}$	23	$19\frac{1}{2}$	$15\frac{1}{2}$	12	$8\frac{1}{2}$
October .	$29\frac{1}{2}$	$27\frac{1}{2}$	$24\frac{1}{2}$	$20\frac{1}{2}$	$16\frac{1}{2}$	$12\frac{1}{2}$	$8\frac{1}{2}$
November .	30	28	$24\frac{1}{2}$	21	17	$13\frac{1}{2}$	$8\frac{1}{2}$
December .	30	$28\frac{1}{2}$	25	$22\frac{1}{2}$	$19\frac{1}{2}$	$17\frac{1}{2}$	$9\frac{1}{2}$

FROM BALLY 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 ⁰	28 ⁰	24 ¹ / ₂	21 ⁰	17 ⁰	16 ¹ / ₂	15 ¹ / ₂	13 ⁰	11 ⁰
December .	30	28	25	22 ¹ / ₂	19 ¹ / ₂	17 ¹ / ₂	16 ¹ / ₂	13	11
January .	30	28 ¹ / ₂	25 ¹ / ₂	22 ¹ / ₂	19 ¹ / ₂	18 ¹ / ₂	17 ¹ / ₂	14 ¹ / ₂	11
February .	31	29	26	23 ¹ / ₂	22	20	17 ¹ / ₂	16	10 ¹ / ₂
March (1st ¹ / ₂)	30 ¹ / ₂	28 ¹ / ₂	25	23	21 ¹ / ₂	20	17 ¹ / ₂	14 ¹ / ₂	12
„ (2nd ¹ / ₂)	29 ¹ / ₂	27	24	22	20 ¹ / ₂	19 ¹ / ₂	16 ¹ / ₂	14 ¹ / ₂	14 ¹ / ₂

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. 488.

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 Sapodie 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. $35^{\circ} 36'$ S. Long. $134^{\circ} 38'$ E.	Feb. 5 Lat. $31^{\circ} 46'$ S. Long. $69^{\circ} 11'$ E.
19 " $35^{\circ} 23'$ " $131^{\circ} 48'$ "	6 " $31^{\circ} 36'$ " $64^{\circ} 42'$ "
20 " $35^{\circ} 40'$ " $128^{\circ} 22'$ "	7 " $31^{\circ} 27'$ " $61^{\circ} 0'$ "
21 " $35^{\circ} 8'$ " $125^{\circ} 46'$ "	8 " $31^{\circ} 19'$ " $58^{\circ} 0'$ "
22 " $35^{\circ} 6'$ " $123^{\circ} 0'$ "	9 " $31^{\circ} 17'$ " $53^{\circ} 28'$ "
23 " $35^{\circ} 6'$ " $121^{\circ} 46'$ "	10 " $31^{\circ} 42'$ " $48^{\circ} 36'$ "
24 " $35^{\circ} 37'$ " $119^{\circ} 36'$ "	11 " $31^{\circ} 52'$ " $44^{\circ} 40'$ "
25 " $35^{\circ} 51'$ " $115^{\circ} 38'$ "	12 " $32^{\circ} 13'$ " $40^{\circ} 30'$ "
26 " $35^{\circ} 21'$ " $113^{\circ} 16'$ "	13 " $32^{\circ} 25'$ " $37^{\circ} 43'$ "
27 " $33^{\circ} 38'$ " $110^{\circ} 0'$ "	14 " $32^{\circ} 56'$ " $32^{\circ} 40'$ "
28 " $31^{\circ} 58'$ " $105^{\circ} 27'$ "	15 " $33^{\circ} 25'$ " $29^{\circ} 28'$ "
29 " $31^{\circ} 6'$ " $100^{\circ} 20'$ "	16 " $34^{\circ} 48'$ " $24^{\circ} 47'$ "
30 " $30^{\circ} 28'$ " $95^{\circ} 45'$ "	17 " $35^{\circ} 51'$ " $22^{\circ} 24'$ "
Jan. 31 " $30^{\circ} 23'$ " $91^{\circ} 45'$ "	18 " $35^{\circ} 32'$ " $21^{\circ} 40'$ "
Feb. 1 " $30^{\circ} 18'$ " $87^{\circ} 5'$ "	19 " $36^{\circ} 42'$ " $19^{\circ} 52'$ "
2 " $30^{\circ} 27'$ " $83^{\circ} 1'$ "	20 " $34^{\circ} 46'$ " $19^{\circ} 30'$ "
3 " $30^{\circ} 36'$ " $77^{\circ} 56'$ "	21 Cape Good Hope N.N.E. 15 miles.
4 " $31^{\circ} 19'$ " $73^{\circ} 47'$ "	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.

* 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 easting 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. HOESBUEGH, 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-

ditionous 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. Monsoon, 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 Junkseyon. 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 Junkseyon, 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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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, <i>F. green</i> light.	NATAL:—On the Bluff, <i>Rev.</i> every mi- nute: 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.
CAPE OF GOOD HOPE, p. 286.	MOZAMBIQUE PORT:—St. George or Goa island, <i>building</i> .
SIMONS BAY:—Roman rocks p. 286.	COMORO ISLANDS:—Mayotta road, on the Jetty, <i>F.</i>
MOSSEL BAY:—Cape St. Blaize p. 302.	REUNION:—St. Paul bay p. 520.—St. Denis p. 520.—Bel-Air point p. 520.
CAPE RECIFF, p. 309.	
ALGOA BAY:—Port Elizabeth p. 311.— Bird island p. 322.	
BUFFALO RIVER (East London) p. 329.	

- MAURITIUS:—Port Louis, *light-vessel*, *F.* 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. $12^{\circ} 45' 23''$ N., Long. $45^{\circ} 4'$ 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. $12^{\circ} 40' 20''$ N., Long. $43^{\circ} 25'$ 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. $29^{\circ} 6' 20''$ N., Long. $32^{\circ} 44'$ E.—Suez, *light-vessel* off Gal ul Murkub Point, *F.*, visible 6 miles, Lat. $29^{\circ} 54' 50''$ N., Long. $32^{\circ} 33'$ E.
- KARACHI, p. 404.
- CUTCH GULF, p. 407.
- CAMBAY GULF, p. 407.
- BOMBAY:—Outer *light-vessel*, *F. red* from June 1st 1867.—Inner *light-vessel*, p. 410.—Kolaba Point, p. 410.—Dolphin rock, p. 410.
- KHUNDARI OR KENNERY:—*F.* light to be established, June 1867, on Khundari island, Lat. $18^{\circ} 42\frac{1}{2}'$ N., Long. $72^{\circ} 48'$ E.
- RATNA GHERI OR RUTNAGHERRY:—on S. bastion of fort, *F. red*, elevation 300 feet, visible 18 miles, Lat. $16^{\circ} 59'$ N., Long. $73^{\circ} 15' 47''$ E.
- SEDASHIGUR:—p. 414. now visible 25 miles.—Also, a *red* light in the bay near Koney hill, from the Post office window.
- COUMTA:—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.
- PAUMEN PASS:—p. 447.
- NEGAPATAM:—p. 448.
- CARRICALL OF KARIKAL:—p. 448.
- PONDICHERRY:—p. 449.
- MADRAS:—p. 450.
- PULICAT:—p. 453.
- ARMEGON SHOAL:—p. 453.
- DIVY POINT:—p. 454.
- MASULIPATAM:—454. [p. 456.
- GORDEWARE OR GODAVERY POINT:—COCANADA:—p. 456; it is doubtful if this be lighted.
- SANTIPILLY ROCKS:—Conada Hill p. 458.
- FALSE POINT:—p. 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 KAKALI:—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. $22^{\circ} 20'$ N., Long. $91^{\circ} 47' 42''$ 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 194 feet, visible 19 miles, Lat. $15^{\circ} 52' 30''$ N., Long. $97^{\circ} 36' 30''$ E., a strip of light shows from the Patch buoy, eastward, as far as Amhurst point, p. 483.
- GREAT COCO ISLAND, ANDAMANS:—Table island, *F.*, elevation 200 feet, visible 20 miles, Lat. $14^{\circ} 8\frac{1}{4}'$ N., Long. $93^{\circ} 18'$ 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. $\frac{1}{2}$ W.; and *Red* between N.W. $\frac{1}{2}$ W. and W. by S.; visible 10 miles.

The N.W. $\frac{1}{2}$ 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 vicinity 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*.

DEAL ISLAND:—p. 706.

SWAN ISLAND:—p. 708.

PORT DALRYMPLE:—p. 708.

PORT ALBERT:—p. 709.

GABO ISLAND:—p. 710.

CAPE BRUNY:—p. 711.

HOBARTON:—p. 718.

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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."



LONDON E.:
JAMES IMRAY AND SON,
CHART PUBLISHERS AND NAUTICAL BOOKSELLERS,
MINORIES AND TOWER HILL.

**** COMMUNICATIONS FOR THE FUTURE IMPROVEMENT OF THIS OR ANY OF OUR
WORKS, WILL BE THANKFULLY RECEIVED AND ACKNOWLEDGED.**

**LONDON :
PRINTED AT THE TOWER PRESS, 2, POSTERN ROW,
TOWER HILL.**

P R E F A C E.

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. LMRAY 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 4.

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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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 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.

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 JANSSEN, 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

* Bijdrage Natuurkundige Beschrijving der Zeeën, vertaald door M. H. JANSSEN, Luitenant ter zee.

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 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 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 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."

* 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 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.

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.‡

"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.

* 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 Equinox the tides also turn. The places which have high water by day in one Monsoon get it at night in the other.—JANSEN.

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 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 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."

Banka, Gaspar, and Carimata Straits.—Observations made at PALEMBANG (Lat. $6^{\circ} 52' S.$, Long. $105^{\circ} 16' E.$) 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 $\Rightarrow S., W., N., E.,$ to $S. \Rightarrow$.

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 RHO 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-westerns, 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 **CARIMATA 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 $11\frac{1}{2}^{\circ}$ of lat.—from 7° N. to $4\frac{1}{2}^{\circ}$ 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 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.

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.

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 Manila.

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.

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 : *—

* "Jour. Roy. Geog. Soc.," vol. xxxiii, p. 224. "WALLACE on the Physical Geography of the Malay Archipelago."

"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 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, Lombok, 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 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 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 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. 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 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 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."

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. 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	4398
Lat. 15° to 10° N.	N. 46° E.	S. 45° E.	S. 51° W.	S. 49° W.		
No. of days. . .	185	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. . .	185	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 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. 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. and 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 heat 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.

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 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 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 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 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 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 direction of the winds 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 springs 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 very 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 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.

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.

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 mid-day. 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.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 $\frac{1}{8}$ 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-mentioned, 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 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."

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°

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.

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 commence 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 of 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 Ladrões, 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 versa*. 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 $29\frac{1}{4}$ 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 flues 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. 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.

* "A Voyage to Terra Australis," by MATHEW FLINDERS, Commander of the *Investigator*, 1814. Vol. i. p. 241, et seq.

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 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 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, 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.

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 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 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 *Faracels* (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 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 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.

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 $\frac{3}{4}$ to $2\frac{1}{4}$ knots—in the opposite direction. The mean velocity observed for thirteen consecutive hours was $1\frac{1}{2}$ miles.

“In **Coolan 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 $3\frac{1}{2}$ 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 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 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 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.W.ly direction, passing between the New Hebrides and the Solomon 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 Ladrões, 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 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 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 1864, 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.

"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 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