

of the barometer were reduced to what they would be at the temperature of melting ice. The following are the mean heights of the barometer, deduced from these observations :—

New Moon	29·743
First octant	29·761
First quarter	29·740
Second octant	29·716
Full moon	29·736
Third octant	29·751
Last quarter	29·772
Fourth octant	29·744

According to these observations, the height of the barometer is least about four days before full moon, and greatest six or seven before new moon. These times approximate to those at which the investigations of SCHUEBLER give the greatest and least quantity of rain; and, since the fall of the barometer generally (but not always) indicates a tendency to rain, the results are so far in accordance. But, at the same time, it must be admitted that the variation of the barometer is in this case so minute that a sensible effect could hardly be expected from it; still, though minute, it is quite distinct and decided.

M. FLAUGERGUES also observed the mean height of the barometer when the moon was at her greatest and least distance from the earth, and found that at *perigee* it was 29·713, and at *apogee* 29·753. And thus, so far as this small difference can be supposed to indicate anything, it would indicate a greater prevalence to rain at *perigee* than at *apogee*, which is in accordance with the observations of SCHUEBLER.

Any theory of the moon's attraction applied to explain atmospheric tides similar to those of the ocean would lead to the conclusion that the height of the barometer observed at noon when the moon is in her quarters, would be less than its height at noon at new and full moon; observation, however, shows the very reverse as a matter of fact. FLAUGERGUES found the mean height of the barometer at quadratures 29·756, and at new and full moon 29·739, the height at quadratures being in excess to the amount of 0·017. This result was further confirmed by the observations of BOUVARD, at the Paris Observatory. He found the mean height of the barometer at the quarters 29·786, and at new and full moon 29·759, the excess at the quarters being 0·027.

ARAGO also submitted to rigorous investigations a series of barometric observations made in relation to the lunar phases at the Paris Observatory, and continued for twelve years. He found that the effect of the lunar attraction on the barometer at the epochs of the high and low atmospheric tides could not have exceeded the one-sixthundredth of an inch—a quantity such as could produce no conceivable effect upon the weather, and showing that it has no influence on the atmosphere analogous to that which produces the tides of the ocean.

CAPTAIN BYRON DRURY, R.N., in his observations on the meteorology of New Zealand, says, "We are not able to state that particular phases of the moon are coincidental with changes in the weather; indeed, after having kept a careful register every two hours, night and day, in these seas during four years, we could not recognise elemental changes corresponding with lunar phases."

In connexion with these remarks may be introduced an extract from the work of

CAPTAIN FLINDERS, who, during his six years' captivity in the Mauritius, never lost an opportunity of communicating the results of investigation. In his "Voyages," vol. ii., p. 444, after noticing the hurricanes that island is so liable to, he says—"An opinion commonly entertained in Mauritius, that hurricanes are little to be apprehended except near the time of full moon, does not seem to be well founded."

The so-called "Herschel's Weather Table" is a fiction of the most absurd character, and requires no comment; it was never issued by the authority of either of the illustrious astronomers whose name it bears.

So with regard to all other "predictions" *a year or more in advance*. The periods of atmospheric disturbance are generally given—according to the phases of the moon and its position in apogee and perigee—for intervals of six or seven days, and are further stated to apply to all parts of the earth's surface; this is a very safe way of stating the case; for, as HUMBOLDT said of earthquakes, "if we could obtain information regarding the daily condition of all the earth's surface, we should probably discover that it was almost always undergoing shocks at some point or another;" so we may with tolerable certainty predict that a gale or considerable atmospheric disturbance is every day taking place at some part or another of so large a superficial area as 197 millions of square miles.

The "forecasts" of ADMIRAL FITZROY are of a character totally distinct from these: they rely mainly on the indications of the barometer, thermometer, &c., together with other meteorological observations obtained from distant stations and forwarded to the central office,—these only profess to be valid for a brief interval in advance.

CHAPTER VI.

HURRICANES OR CYCLONES,—AND THE LAW OF STORMS.

113. Revolving Storms, which partake of a twofold motion—one of *rotation*, as it were on an axis, and another of *progression*—and which, originating within the Tropics, generally invade the extra-tropical and temperate regions of the globe, have already been briefly discussed in connexion with DOVE's "Law of Gyration," pp. 8-12. They are known as HURRICANES in the West Indies and South Indian Ocean, as CYCLONES in the North Indian Ocean, and as TYPHOONS in the China Sea; they are also occasionally encountered in the Pacific Ocean.

The names most familiar to seamen in connexion with the history and origin of hurricanes or cyclones, are REDFIELD, REID, and PIDDINGTON; but there are also others who, in their various works at different times, have done good service in elucidating what has been aptly termed the "LAW OF STORMS"—these are CAPPER, THOM, SIR J. HERSCHEL, ESPY, MELDRUM, FITZROY, and BIET. It is the *result* of the labours of these men which will, in the first place, be collected together, and the *well-established laws of rotatory gales as developed in both hemispheres* brought briefly under the notice of the navigator; after which the storms of the Indian Ocean and China Sea will receive some special remarks—those relating to the Southern Indian Ocean, derived chiefly from the observations of that able meteorologist, MR. C. MELDRUM (of the Mauritius Observatory), who has done so much towards investigating the origin of hurricanes in the Monsoon region.

114. Veering of the Wind-Vane.—Reverting to what has already been said (pp. 7-12), it appears that when the storm is an equatorial one, whirlwinds are produced in the Northern Hemisphere in a direction contrary to that in which the hands of a watch move, and in the Southern Hemisphere in the same direction as the hands of a watch; and hence the following shiftings of the wind-vane:—

1. In the *Northern Hemisphere*—

- (a) When the vortex (or centre) of the storm passes to the westward of the place of observation, the rotation is $\Rightarrow$ S., W., N., E., S., $\Rightarrow$ with the sun.
- (b) When the vortex of the storm passes to the eastward of the place of observation, the rotation is $\Rightarrow$ S., E., N., W., S., $\Rightarrow$ against the sun.

2. In the *Southern Hemisphere*—

- (a) If the vortex of the storm passes to the westward of the place of observation, the rotation is $\Rightarrow$ S., E., N., W., S., $\Rightarrow$ with the sun.
- (b) If the vortex of the storm passes to the eastward of the place of observation, the rotation is $\Rightarrow$ S., W., N., E., S., $\Rightarrow$ against the sun.

Thus, in both hemispheres, the passage of an equatorial whirlwind storm on the west side of the place of observation produces normal revolutions (*i.e.*, revolutions in accordance with the Law of Gyration); while on the other hand, its passage on the east side produces anomalous revolutions (*i.e.*, contrary to the Law of Gyration).

When the vortex of a whirlwind storm passes over the place of observation the vane may shift, after a brief interval of calm, from one direction to that immediately opposite to it.

Bearing in mind, therefore, the direction of the rotation of the wind in each hemisphere—viz., against watch hands in the Northern, but with watch hands in the Southern Hemisphere,—certain portions of the storm are characterized by certain *hurricane winds*; and dividing the storm-area at any given place by diameters drawn from the northern to the southern margin, and again from the eastern to the western margin, we find that, in the Northern Hemisphere, on the northern margin the wind will be *easterly*; on the eastern margin, *southerly*; on the southern margin, *westerly*; and on the western margin, *northerly*. (See Plate XII., fig. 5.)

The relation of the winds to the margins in the Southern Hemisphere will be exactly the reverse of their relations in the Northern: thus, it is the southern margin of the storm, south of the Equator, that exhibits an *easterly* wind; the western margin a *southerly*; the northern margin a *westerly*; and the eastern margin a *northerly* wind. (See Plate XII., fig. 6.)

Hence each portion of the hurricane has its appropriate wind.

115. The Bearing of the Storm's Centre.—From this fact there results a very simple *Rule for determining the bearing of the Centre* of the storm from the ship—viz.,—*Look to the wind's eye and set its bearing by compass, the EIGHTH point to the RIGHT thereof, when in the NORTHERN HEMISPHERE, but to the LEFT of the wind's direction when in the SOUTHERN HEMISPHERE, will be the bearing of the storm's centre.*

Thus, in the NORTHERN HEMISPHERE, from an *easterly* wind which characterizes the northern margin of the storm, its centre will bear *south*; from a *northerly*

FIG. I
[Northern Hemisphere]



FIG. III.
[Northern Hemisphere]

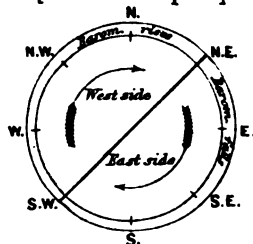


FIG. IV
[Southern Hemisphere]

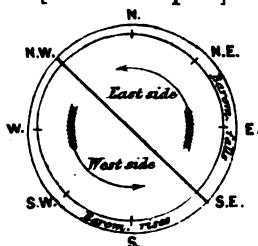


FIG.V
[Northern Hemisphere]

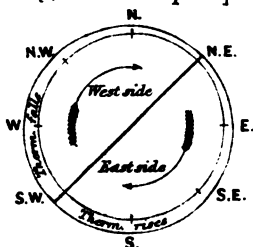
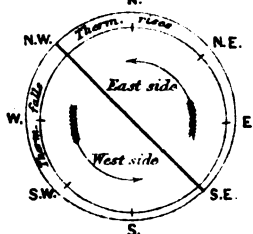


FIG. VI
[Southern Hemisphere]
N.



STORM WAVES

The diagram illustrates the concept of storm waves. It features a central point from which several concentric circular arcs radiate outwards, each with an arrow indicating a clockwise direction of travel. A shaded, wedge-shaped area extends from the center towards the right, representing the path or area of influence of the storm. The background is filled with a dense, wavy pattern of lines, suggesting the surface of the ocean or the intensity of the storm's effects.

wind the centre will bear *east*; from a *westerly* wind it will bear *north*; and from a *southerly* wind, *west*.

But, in the **SOUTHERN HEMISPHERE**, from an *easterly* wind, the centre of the storm bears *north*; from a *southerly* wind the centre bears *east*; from a *westerly* wind, *south*; and from a *northerly* wind, *west*.

The above rule is perfectly clear and definite, but as it is especially important to avoid the centre of the storm, the following Table shows at a glance its relative bearing in each hemisphere:—

IN THE N. HEMISPHERE.		IN THE S. HEMISPHERE.	
If the Wind be	The centre of the Storm will bear from the Ship	If the Wind be	The centre of the Storm will bear from the Ship
North . . .	East.	North . . .	West.
N. by E. . .	E. by S.	N. by E. . .	W. by N.
N.N.E. . . .	E.S.E.	N.N.E. . . .	W.N.W.
N.E. by N. . .	S.E. by E.	N.E. by N. . .	N.W. by W.
N.E.	S.E.	N.E.	N.W.
N.E. by E. . .	S.E. by S.	N.E. by E. . .	N.W. by N.
E.N.E. . . .	S.S.E.	E.N.E. . . .	N.N.W.
E. by N. . . .	S. by E.	E. by N. . . .	N. by W.
East	South.	East	North.
E. by S. . . .	S. by W.	E. by S. . . .	N. by E.
E.S.E.	S.S.W.	E.S.E.	N.N.E.
S.E. by E. . .	S.W. by S.	S.E. by E. . .	N.E. by N.
S.E.	S.W.	S.E.	N.E.
S.E. by S. . .	S.W. by W.	S.E. by S. . .	N.E. by E.
S.S.E.	W.S.W.	S.S.E.	E.N.E.
S. by E. . . .	W. by S.	S. by E. . . .	E. by N.
South	West.	South	East.
S. by W. . . .	W. by N.	S. by W. . . .	E. by S.
S.S.W.	W.N.W.	S.S.W.	E.S.E.
S.W. by S. . .	N.W. by W.	S.W. by S. . .	S.E. by E.
S.W.	N.W.	S.W.	S.E.
S.W. by W. . .	N.W. by N.	S.W. by W. . .	S.E. by S.
W.S.W.	N.N.W.	W.S.W.	S.S.E.
W. by S. . . .	N. by W.	W. by S. . . .	S. by E.
West	North.	West	South.
W. by N. . . .	N. by E.	W. by N. . . .	S. by W.
W.N.W.	N.N.E.	W.N.W.	S.S.W.
N.W. by W. . .	N.E. by N.	N.W. by W. . .	S.W. by S.
N.W.	N.E.	N.W.	S.W.
N.W. by N. . .	N.E. by E.	N.W. by N. . .	S.W. by W.
N.N.W.	E.N.E.	N.N.W.	W.S.W.
N. by W. . . .	E. by N.	N. by W. . . .	W. by S.

To those who prefer it, the rule just enunciated may be put in another form, not, however, equally clear to all—the *centre of a revolving storm bears eight points from the direction of the wind at the ship, reckoned with the apparent course of the*

sun; and in this view, one rule holds good for both hemispheres, for though the bearings are precisely the reverse in the one hemisphere, of those in the other, so is the apparent motion of the sun also reversed, since in the southern hemisphere that luminary rises in the east, *culminates in the north*, and sets in the west.

Thus from the direction of the wind *only*, in a revolving storm, two very important points are made known—the exact position of the ship in the Hurricane or Cyclone, and the bearing of the storm's centre from the ship.

116: The Rotatory and Progressive Motions of Hurricanes.—From the very nature of whirlwind storms the wind has a rotatory motion, as it were, on an axis. But the body of the storm has a progressive motion, generally from the Equator towards the Pole, at first with westing, but as the storm advances towards the Tropics it recurves, and then moves polarwise with easting.

The hurricane is impelled to the *west* in *low* latitudes because the tendency of the two currents of air (polar and equatorial) is in those regions to the westward *along the surface*; the equatorial current *is much less so*, and diminishing until actually altered to easterly, near the Tropic, after which its preserved equatorial rotatory force becomes more and more evident, while the *westwardly* tendency of the polar current *diminishes*; as a consequence, near the Tropic, the whirlwind ceases to move westward—it recurves—and then in its polarwise progression moves towards the eastward. (Admiral FITZROY.) Thus, in general terms, the progressive motion of the Hurricane in the NORTHERN HEMISPHERE is from S.E.-ward to N.W.-ward; and after recurving, from S.W.-ward to N.E.-ward. (Plate XIII., fig. 1.) In the SOUTHERN HEMISPHERE from N.E.-ward to S.W.-ward; and after recurving, from N.W.-ward to S.E.-ward. (Plate XIII., fig. 2.) The place of recurvature is very dangerous, for the hurricane-winds are deceptive, owing to the storm being comparatively stationary for a brief period.

The area over which these rotatory storms have been known to expand—i.e., where the rotatory winds prevail—varies from 30 or 40 to 1000 miles; but while the diameter of the storm, so long as it is within the Tropics, expands very gradually, it suddenly increases in a remarkable manner after recurving.

The rate at which a Hurricane travels onward also varies greatly not only in different parts of the globe, but even in the same locality and at the same season: in general, however, the progressive motion is greater after, rather than before, its recurvature.

117. Upon combining the Rotatory with the Progressive Motion, some very valuable Rules may be deduced,—the path which the axis of rotation describes is not inappropriately termed the *axis line*, and this divides the cyclone into *two semicircles*,—the right or *starboard* semicircle, and the left or *port* semicircle; there are consequently three divisions of a storm, each characterized by different phenomena. In the right hand semicircle, the hauling of the wind resulting from the passage of a cyclone in the Northern Hemisphere is in the same direction as the apparent course of the sun; but in the left hand semicircle it is reversed, being against the apparent course of the sun. On the axis line there is no change of wind *until the centre has passed*, when, after a brief interval of calm, the wind springs up with great fury from the opposite quarter.

Thus, the direction of the wind at the ship gives her position in the storm as re-

HURRICANE PATHS

FIG. I.

[NORTHERN HEMISPHERE]

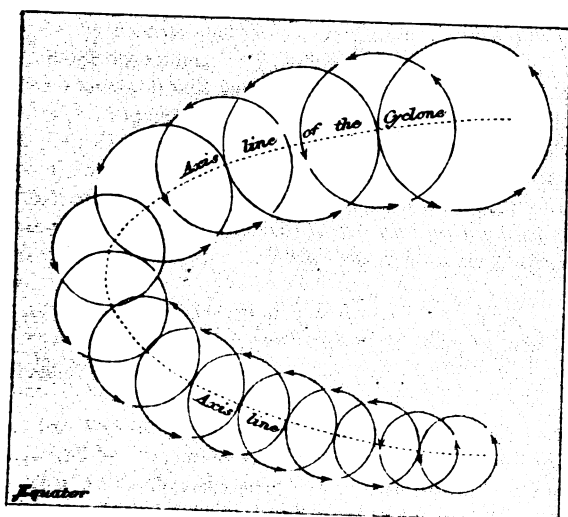
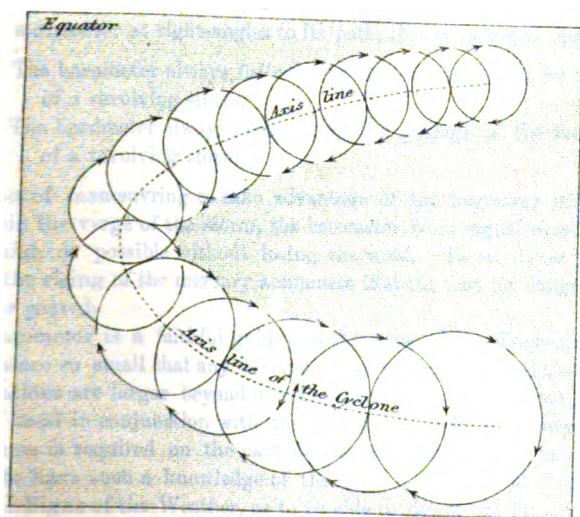


FIG. II.

[SOUTHERN HEMISPHERE]



ferred to the points of the compass, and what is of the greatest importance—the bearing of the centre from her; the hauling of the wind announces her position relatively to the axis line of the storm, which, combined with her track through the cyclone, will give the progressive direction of the storm itself; if the wind be found to increase in force *without hauling*, the ship is on the axis line; and if a calm occur, succeeded by a terrific and violent wind from the *opposite quarter*, the ship has passed through the centre.

From these remarks it will appear evident, that in manœuvring a vessel when overtaken by a rotatory gale IN THE NORTHERN HEMISPHERE, if she receive the wind on her *port* side, her head is directed (more or less) *towards the centre*; but if she receive it on her *starboard* side, her head is turned *from the centre*: and these facts indicate the means to be adopted to draw from the centre when lying-to;—if, with the ship's head from the centre, she receives the wind on the starboard side, then in lying-to (or drawing from the centre) she must be trimmed on the *star-board tack*.

IN THE SOUTHERN HEMISPHERE the reverse of this takes place;—a vessel sailing *out of* the gale receives the wind on her *port* side, and she must therefore be trimmed on the *port tack*.

118. On the Use of the Barometer in a Hurricane or Cyclone.—It was long ago remarked by PIDDINGTON, that “he who watches his barometer, watches his ship.” This invaluable instrument, if well understood, invariably announces the approach of a revolving storm,—shows whether the vessel is plunging into the vortex, or if she be receding from it;—and hence, by carefully noticing its indications, the disastrous consequences of a hurricane may, to a great extent, be avoided—for the laws of its oscillations are very distinctly marked. The barometer often stands unusually high before the commencement of a cyclone, and frequently (if not always) just *around* the storm; and conceiving the cyclone to be divided into two parts by a diameter at right-angles to its path, it may be noted that—

- (a) The barometer always *falls* during the passage of the *advancing* semicircle of a revolving storm.
- (b) The barometer always *rises* during the passage of the *receding* semicircle of a revolving storm.

In cases of manœuvring to take advantage of the hurricane winds and to keep just within the verge of the storm, the barometer is of signal benefit,—it should be kept as high as possible without losing the wind. In whatever position the ship may be, the rising of the mercury announces that the first (or dangerous) half of the storm has passed.

The barometer is a faithful guide; in the zone of the Trade-winds its ordinary variations are so small that any deviation from the normal height requires attention; its fluctuations are larger beyond the Tropics, but the indications are scarcely less certain if used in conjunction with the thermometer and hygrometer,—hence, more watchfulness is required on the part of the navigator, and it is of the utmost importance to have such a knowledge of the Law of Storms, of Storm Instruments, and of the Signs of the Weather, as to be able to detect the presence of a hurricane (or cyclone), when as yet sky and sea betoken but little of that wild fury during the height of which it is so difficult to guide the vessel in safety: one great advantage

of such knowledge is a quick apprehension of the indications which forewarn to make all snug *in time*.

119. Meteorological Signs preceding a Hurricane.—The meteorological signs indicating the approach of a hurricane or cyclone have been collected from various sources by Mr. BIRT,* and are enumerated and classed according as the phenomena may be presented to the external sensations of feeling, sight, or hearing.

Meteorological signs recognised by the feelings—

1. A sultry, oppressive state of the atmosphere.
2. A calm.

Meteorological signs recognised by the eye—

3. A remarkably clear state of the atmosphere, so that the stars may be seen to rise and set with nearly the same distinctness as the sun and moon.
4. A peculiar white appearance in the zenith, more or less of a circular form.
5. A remarkably red or fiery appearance of the sky. This is not unfrequently of such intensity as to tinge all the surrounding objects with a deep crimson; and when this is observed, there can be no question that the violent portion of the cyclone is not far from the vessel. When this red light is seen at night, the impression on the seaman's mind is, that "day has broken before its time."
6. A peculiar colouring of the clouds, more especially of an olive green. This is generally the precursor of a most violent and terrific hurricane.
7. A thick, hazy appearance in that quarter of the horizon in which the cyclone is raging.
8. A remarkable and peculiar appearance of the heavenly bodies. When shining through a haze, they are said to shine with a pale, sickly light, and are not unfrequently surrounded by rings of light, or halos. Some observers describe the stars as "looking big with burrs about them." Others speak of their dancing, and, generally, they have been noticed as being remarkably bright and twinkling.
9. The sun on some occasions has exhibited a blue appearance, and white objects have been seen of a decided light-blue colour. The sun has also been observed of a pale and somewhat similar appearance to that of the full moon.
10. A dense, heavy bank of cloud in the direction of the hurricane.
11. A peculiar appalling appearance in this bank, more particularly as if it were a solid wall drawing down upon and closing around the ship.
12. A darting forward of portions of this bank, as if torn into rags and shreds by some violent force, and driven before, *not borne* by, the wind. When this indication is distinctly recognised, a run of about two hours *towards the centre* will involve the vessel in a destructive hurricane.
13. A peculiar motion exhibited by small bodies, as branches of trees, when

* "Handbook of the Law of Storms; being a Digest of the Principal Facts of Revolving Storms." By W. R. Birt. 1883.

agitated by the wind, consisting of a sort of whirling, *not a bending forward, as if bent by a stream of air.*

14. Lightning of a remarkably columnar character, shooting up in stalks from the horizon, with a dull glare; also like flashes from a gun, and sparks from a flint and steel.

Meteorological signs recognised by the ear—

15. A distant roar (probably of the hurricane itself), as of wind rushing through a hollow vault.
16. A peculiar *moaning* of the wind, indicative of the close proximity of the violent portion of the hurricane.

The meteorological phenomena accompanying a revolving storm may also be enumerated thus:—

1. A very rapid motion of the air, constituting the hurricane, and increasing in velocity as the centre is approached.
2. A fitful variation of intensity in the force of the wind, which sometimes blows with fearful violence, carrying away everything that opposes its progress, then sinking to a gentle breeze, or even lulling to a calm, but almost immediately afterwards springing up with greater violence than before. The hurricane winds are nearly, if not entirely, without exception puffy, violent, and blowing in gusts.
3. An immense condensation of aqueous vapour, forming large banks of cloud, which precipitate torrents of rain. The condensation appears to be so exceedingly rapid that large quantities of electricity are generally developed, giving rise to incessant flashes of lightning.
4. A general darkness and gloominess within the area of the cyclone, relieved only by the fitful glare of the lightning, or the appearance of the imperfect circle of light near the centre or axis of the storm.
5. A separation of the clouds in or near the centre of the hurricane, so as to produce in the immediate neighbourhood of the axis a clear sky, through which the sun and stars are often seen with great brilliancy.
6. A calm in the centre of the cyclone.

Indications of approaching or existing hurricanes manifested by the ocean, of special utility to vessels at anchor in roadsteads, &c.:—

1. A swell produced by the storm-wave rolling in upon the shore, at first of a gentle character. The direction of this swell will pretty surely indicate the bearing of the storm, and its changes will point out, in some localities, the course the hurricane may be pursuing.
2. A swell rolling in, *without changing its direction*, may be regarded as indicative of a hurricane *approaching* the shore. The same phenomenon met with at sea (the ship's course being taken into account), will indicate the bearing down of the cyclone on the vessel.
3. A dirty green appearance of the ocean; on some occasions its assuming a muddy or brown colour, on others its being remarkably clear; its temperature increasing, and its smelling stronger than at other times, are all indications of the proximity of a cyclone.

120. The Storm-Wave.—The rotation of the wind in a hurricane violently agitates the surface of the ocean in the direction of the wind, producing a *swell* or **STORM-WAVE**, the undulations of which roll on to an extraordinary distance; the wave thus propagated advances as a tangent to the whirlwind. The wind, however, veers; and thence there results a series of undulations rolling from the margin of the storm, both in advance and regression of the storm itself, and the succession of undulations encountering each other produces, in the area of intersection, *cross seas* more or less dangerous according as they are met in advance of or behind the hurricane. It is easy to see that such a series of undulations must always *fringe* the storm's wake, and be found to the right and left of the path over which the cyclone has advanced; while the long rolling swell generally precedes it, and thus indicates the approach of the gale many hours—if not a day—before it is encountered by the ship. In the **NORTHERN HEMISPHERE** it is on the *left* side of the storm's wake, in the **SOUTHERN HEMISPHERE** on the *right* side of the storm's path, that the cross pyramidal sea is found; and when a ship meets with such a sea, it may be taken as a tolerably certain indication that a rotatory gale has passed over the locality. Generally the storm-waves undulate in a direction which, the further they are from the vortex, is more at right-angles with the direction of the wind: in a heavy gale they merely proceed in the direction of the gale itself.

DOVE says, that the undulations of the waves, during a whirlwind storm, proceed from the centre in such directions that the farther they are from it the less is their radial difference; thus their course is from the centre of the storm to its circumference—in a direction somewhat inclined forward in relation to the gyration of the cyclone wind, and to which REID's attention was particularly called; consequently, the three descriptions of storms more closely examined differ in the following manner, viz. :—

1. In a whirlwind storm the waves undulate in a direction which is more at right angles with the direction of the wind the farther they are from the vortex.
2. In a heavy gale they proceed in the same direction as the gale itself.
3. In a gale which arrests the progress of a wind blowing from the opposite quarter, seamen say that the two winds are fighting.

121: Rules for Trimming the Ship in a Hurricane.—PIDDINGTON long ago said that all *positive* rules for manœuvring tend to mislead; every ship must have its own peculiar management depending on the four great elements of the problem, which are—1, the ship and her sea-room; 2, the track of the cyclone; 3, its rate of travelling; and 4, the ship's run and drift; while on the part of the commander, caution and watchfulness are essentially requisite. Still, all the circumstances being favourable, *rules* may be given in a very brief compass *for trimming a vessel to the hurricane-winds*; these are embodied in the following Tables, where the directions of the wind-vane as set down in the first column, are tangents to the whirlwind in its course—these indicate the quarter from which the storm sets in; the points of the compass in the second column show the position of the storm's centre as regards the vessel; the fourth column gives the direction in which to steer when the wind shifts as indicated in the third column; but if it shifts, as indicated in the fifth column, then bear away, as told in the sixth column.

1. FOR THE NORTHERN HEMISPHERE:—

Direction of Wind at commencement of Storm.	If the Centre (or Vortex) bears	And the Wind shifts from	Steer	But if the Wind shifts from	Put the Ship on the Starboard Tack.
N.W.	N.E.	N.W. to W.	S.E.	N.W. to N.	
N.W. by N.	N.E. by E.	N.W. by N. to W.	S.E. by S.	N.W. by N. to N.	
N.N.W.	E.N.E.	N.N.W. to W.	S.S.E.	N.N.W. to N.	
N. by W.	E. by N.	N. by W. to W.	S. by E.	N. by W. to N.	
N.	E.	N. to W.	S.	N. to E.	
N. by E.	E. by S.	N. by E. to N.	S. by W.	N. by E. to E.	
N.N.E.	E.S.E.	N.N.E. to N.	S.S.W.	N.N.E. to E.	
N.E. by N.	S.E. by E.	N.E. by N. to N.	S.W. by S.	N.E. by N. to E.	
N.E.	S.E.	N.E. to N.	S.W.	N.E. to E.	
N.E. by E.	S.E. by S.	N.E. by E. to N.	S.W. by W.	N.E. by E. to E.	
E.N.E.	S.S.E.	E.N.E. to N.	W.S.W.	E.N.E. to E.	
E. by N.	S. by E.	E. by N. to N.	W. by S.	E. by N. to E.	
E.	S.	E. to N.	W.	E. to S.	
E. by S.	S. by W.	E. by S. to E.	W. by N.	E. by S. to S.	
E.S.E.	S.S.W.	E.S.E. to E.	W.N.W.	E.S.E. to S.	
S.E. by E.	S.W. by S.	S.E. by E. to E.	N.W. by W.	S.E. by E. to S.	
S.E.	S.W.	S.E. to E.	N.W.	S.E. to S.	
S.E. by S.	S.W. by W.	S.E. by S. to E.	N.W. by N.	S.E. by S. to S.	
S.S.E.	W.S.W.	S.S.E. to E.	N.N.W.	S.S.E. to S.	
S. by E.	W. by S.	S. by E. to E.	N. by W.	S. by E. to S.	
S.	W.	S. to E.	N.	S. to W.	
S. by W.	W. by N.	S. by W. to S.	N. by E.	S. by W. to W.	
S.S.W.	W.N.W.	S.S.W. to S.	N.N.E.	S.S.W. to W.	
S.W. by S.	N.W. by W.	S.W. by S. to S.	N.E. by N.	S.W. by S. to W.	
S.W.	N.W.	S.W. to S.	N.E.	S.W. to W.	

2. FOR THE SOUTHERN HEMISPHERE.

Direction of Wind at commencement of Storm.	If the Centre (or Vortex) bears	And the Wind shifts from	Steer	But if the Wind shifts from	Put the Ship on the Port Tack.
S.	E.	S. to W.	N.	S. to E.	
S. by E.	E. by N.	S. by E. to S.	N. by W.	S. by E. to E.	
S.S.E.	E.N.E.	S.S.E. to S.	N.N.W.	S.S.E. to E.	
S.E. by S.	N.E. by E.	S.E. by S. to S.	N.W. by N.	S.E. by S. to E.	
S.E.	N.E.	S.E. to S.	N.W.	S.E. to E.	
S.E. by E.	N.E. by N.	S.E. by E. to S.	N.W. by W.	S.E. by E. to E.	
E.S.E.	N.N.E.	E.S.E. to S.	W.N.W.	E.S.E. to E.	
E. by S.	N. by E.	E. by S. to S.	W. by N.	E. by S. to E.	
E.	N.	E. to S.	W.	E. to N.	
E. by N.	N. by W.	E. by N. to E.	W. by S.	E. by N. to N.	
E.N.E.	N.N.W.	E.N.E. to E.	W.S.W.	E.N.E. to N.	
N.E. by E.	N.W. by N.	N.E. by E. to E.	S.W. by W.	N.E. by E. to N.	
N.E.	N.W.	N.E. to E.	S.W.	N.E. to N.	
N.E. by N.	N.W. by W.	N.E. by N. to E.	S.W. by S.	N.E. by N. to N.	
N.N.E.	W.N.W.	N.N.E. to E.	S.S.W.	N.N.E. to N.	
N. by E.	W. by N.	N. by E. to E.	S. by W.	N. by E. to N.	
N.	W.	N. to E.	S.	N. to W.	
N. by W.	W. by S.	N. by W. to N.	S. by E.	N. by W. to W.	
N.N.W.	W.S.W.	N.N.W. to N.	S.S.E.	N.N.W. to W.	
N.W. by N.	S.W. by W.	N.W. by N. to N.	S.E. by S.	N.W. by N. to W.	
N.W.	S.W.	N.W. to N.	S.E.	N.W. to W.	

122. The following Memoir on the Hurricanes of the Southern Indian Ocean, by Mr. C. MELDRUM, illustrative of the origin of these storms from the antagonism of the N.W. Monsoon and the S.E. Trade, will be interesting to navigators:—

Hurricanes and Weather in the Indian Ocean.

FROM THE 17TH OF JANUARY TO THE 18TH OF FEBRUARY, 1860.

The hurricane of the 8th to the 16th of January had scarcely disappeared when another originated near the same locality, and under similar circumstances. This second hurricane, which was of small extent, but very violent, commenced on the 17th or 18th, and lasted till the 21st or 22nd. The Portuguese brig of war *Mondega*,* with 46 of her crew, went suddenly down on the 22nd; and the *Cossipore* and *Yarra*, the former vessel having on board 350 passengers (chiefly soldiers' wives and children), were in danger of a like fate.

From the 24th to the 29th of the month a third hurricane, also of small extent, but of considerable violence, occurred in almost the same latitudes, to the northward and westward of Mauritius, where it was encountered by the *Atieth Rahaman*, *Gironde*, and other vessels.

The object of this paper is to present some of the leading facts connected with those two hurricanes, and to show that both were cyclones travelling to the south-westward.

We begin with the hurricane of the 17th to the 22nd.

On the 18th the centre of the storm was probably in $15^{\circ} 30' S.$ and $75^{\circ} 30' E.$, between the S.E. Trade and the N.W. Monsoon, the Trade extending from about $30^{\circ} S.$, and the Monsoon (so far as our observations show) to $13^{\circ} S.$

From noon to midnight the *Cossipore* steered N.E. 42 miles, with a falling barometer and an increasing gale from S.E. By 6 P.M. the gale had increased to a hurricane from S.E., with heavy rain, the barometer standing at 28.844. "At 8.30 blew away the mizen staysail. At 9.45 the hurricane still increasing;—blew away the jib and flying boom and sails, bringing the fore-royal mast with them; barometer 28.644. At 11, bar. 28.364. Midnight, the hurricane still increasing (barometer 28.384); blew away the main and mizen topmasts over the side, staving the decks and bursting one of the scuttles; washed away the port quarter-boat, &c."

None of the other vessels had as yet got involved in the storm. The *Uriel*, however, at some distance to the N.E.-ward of the *Cossipore*, had fresh gales from E.N.E., with "doubtful weather," a low barometer (29.50), and a heavy swell from the northward.

The *Yarra* and *Lawrence*, both standing to the W., had the Trade from E. and E. by S. in fresh breezes, but increasing in strength, with rain and an ugly appearance in the afternoon. In the early part of the day the *Yarra* experienced a heavy swell from W. $\frac{1}{2}$ N.

The storm at noon on this day (the 18th) had a diameter of about 240 miles.

South of the 30th parallel, and from $30^{\circ} E.$ to $62^{\circ} E.$, there were several vessels all having Northerly (chiefly N.W.) winds; and west of $30^{\circ} E.$ the winds were Southerly.

The following are the positions of some of the vessels at noon, with the direction

* The *Mondega's* log-book was probably lost at sea.

of the wind, &c. (The force is indicated by BEAUFORT's notation, in brackets, thus (2); BEAUFORT's notation is also used for the *weather* in the Port Louis observations):—

Marquise:— $36^{\circ} 30'$ S.; $6^{\circ} 25'$ E.; wind S.W. (2); cloudy, drizzling rain.

Eagle:— $33^{\circ} 3'$ S.; $14^{\circ} 4'$ E.; wind S. (6); clear.

Therese:— $34^{\circ} 4'$ S.; $18^{\circ} 3'$ E.; wind S.S.E. (9); cloudy, hazy.

Tullochgorum:— $37^{\circ} 40'$ S.; $23^{\circ} 15'$ E.; wind S. (4); cloudy and passing showers.

Jules and Aglaé:— $40^{\circ} 2'$ S.; $33^{\circ} 6'$ E.; wind N.W. (5); cloudy, squally, and heavy sea.

Galatea:— $38^{\circ} 21'$ S.; $36^{\circ} 40'$ E.; wind N.W. (6); bar. 29·919; cloudy, squally.

La Bretagne:— $38^{\circ} 14'$ S.; $39^{\circ} 28'$ E.; wind N. (2); bar. 29·93; ther. 61° fine.

Marguerite d'Anjou:— $38^{\circ} 34'$ S.; $40^{\circ} 51'$ E.; wind N.N.W. (5); fine.

Stag:— $41^{\circ} 31'$ S.; $44^{\circ} 57'$ E.; wind N.N.W. (6); bar. 29·94; ther. 59° ; cloudy, passing showers.

Arthur and Mathilde:— $40^{\circ} 39'$ S.; $44^{\circ} 40'$ E.; wind N.N.W. (6); bar. 29·716; cloudy.

Ambroisine:— $48^{\circ} 33'$ S.; $54^{\circ} 40'$ E.; wind N.N.W. (6); bar. 29·76; ther. 69° ; showers, squally, hazy.

George Washington:— $39^{\circ} 34'$ S.; $61^{\circ} 41'$ E.; wind N.E. (6); cloudy, squally.

These extra-tropical counter-currents of air were observed during the hurricane of the 8th to the 16th of January.

THURSDAY, THE 19TH OF JANUARY:—At noon on this day the S.E. Trade, as observed by eleven vessels, prevailed from nearly 30° S. to 19° S., blowing in strong gales in about 21° S. and 73° E., where it formed part of the cyclone,—the winds to the northward of that position curving from W. to N.W., N., and E.N.E.

The positions, &c., of some of the vessels which had the Trade are as follows:—

Ravenscraig:— 22° S.; $84^{\circ} 5'$ E.; wind E.S.E. (5); bar. 29·898; ther. 78° ; passing showers, squally, hazy.

Cantero:— $24^{\circ} 27'$ S.; 80° E.; wind E.S.E. (6); cloudy.

Lawrence:— $21^{\circ} 27'$ S.; $72^{\circ} 31'$ E.; wind E.N.E. to E. (8); bar. 29·80; squally, rain, very windy appearance.

Yarra:— $20^{\circ} 36'$ S.; $73^{\circ} 27'$ E.; wind E. by S. to E. (8); bar. 29·91; cloudy, rain.

Thomas Blyth:— $23^{\circ} 44'$ S.; $62^{\circ} 9'$ E.; wind E. by S. to E. (2); bar. 30·15; fine clear weather.

Lucy:— $20^{\circ} 28'$ S.; $59^{\circ} 33'$ E.; wind E.S.E. (1, 2); fine and clear.

Australia:— $18^{\circ} 28'$ S.; $62^{\circ} 18'$ E.; wind E. to S.E. (5); fine.

The winds and weather to the north of the *Lawrence* and *Yarra* were as follows:

Walmer Castle:— 15° S.; $71^{\circ} 15'$ E.; wind W. (2); cloudy, heavy swell from southward.

Hyderée:— $14^{\circ} 14'$ S.; $73^{\circ} 10'$ E.; wind N.W. (4); bar. 30·044; fine; midnight, lightning.

Cossipore:— $17^{\circ} 35'$ S.; $74^{\circ} 19'$ E.; wind N.N.W. to N.; bar. 29·244; hurricane; rain.

Uriel:— $19^{\circ} 19'$ S.; 74° E.; wind E.N.E. to N.N.E. (9); bar. 29·51; ther. 77° squally, rain; terrific sea.

From these observations it is evident that there was a revolving storm at noon on this day, having its centre in about $17^{\circ} 15' S.$ and $73^{\circ} 30' E.$

It appears from the log of the *Cossipore*, that "at 1 A.M. (bar. 28.394), the calm centre passed over the ship, the wind then veering to the westward, and blowing as hard as before, with heavy rain. At 2 A.M., wind N.N.W.; course west; barometer 28.364. At 5, barometer 28.444. At 5.30, the mainsail blew away in the gaskets. At 6, barometer 28.644, and at 7, 28.744. At 8, the hurricane still blowing hard, with heavy rain. At 10, the hurricane still blowing at its strength, the sea washing over all; barometer 29.044. At 4 P.M., fresh gales from N., with heavy rain. At 6, barometer 29.644. Midnight, strong gales from N., and heavy rain. Bore away for the Mauritius to refit."

The log does not state how long the calm lasted; but if, as recorded in the log, the wind at 1 A.M. ceased at S.E., and was from N.N.W. at 2 A.M., the duration of the calm cannot have exceeded an hour.

In the centre the barometer apparently stood higher than it did both before and after the calm.

With the *Uriel* the wind veered in the course of the day from E.N.E. to N., and at 11 P.M. was blowing a hurricane, with an awful sea running. The barometer attained its lowest reading (29.48) at 4 P.M.

In the early part of the day the *Yarra* had an increasing gale from E. by S., with heavy rain; and, as she ran W. by N., at the rate of eight knots per hour, the wind veered to S.E., the barometer at 4 P.M. standing at 29.858, and at midnight at 29.608.

As the *Cossipore* was in the central calm, at 1 A.M., in $16^{\circ} 20' S.$ and $74^{\circ} 25' E.$ —the centre travelled from noon on the 18th to that hour, S. $46^{\circ} 50' W.$ 86.24 miles, or at the hourly rate of 6.6 miles.

From 1 A.M. to noon on the 19th the storm travelled S. $48^{\circ} 53' W.$ 69.96 miles, which gives an hourly rate of 6.3 miles.

The course and distance from noon on the 18th to noon on the 19th were S. $47^{\circ} 45' W.$ 156.2 miles; so that the hourly rate of progression for the 24 hours was 6.5 miles.

Although the wind had a circular movement over a space of about 400 miles in diameter, it did not blow hard except near the centre.

The observations taken at Port Louis were:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29.950	81.0	79.5	75.0	Calm	0.00	Fine
9½ "	30.000	85.0	85.0	76.0	N.E.	0.20	"
3½ P.M.	29.956	83.0	81.0	76.0	W.-ward	0.15	o. r.
9½ "	30.030	82.0	81.0	75.0	E.-ward	0.40	c.; fine

These observations gave no indication of the hurricane that raged at a distance of 926 miles.

Between 30° and 40° S., and between 7° and 64° E., the Northerly and Southerly counter-winds were still blowing, generally in fresh breezes, with fine weather; but owing to want of observations from 25° to 37° E., the inner boundaries of the two winds, and the space between them, cannot be determined.

FRIDAY, THE 20TH OF JANUARY:—On this day, the Trade prevailed from 30° to 19° S., except between 68° and 75° E., where the cyclone was still raging. Between those meridians Northerly winds extended as far as 21° S., where they encountered the Trade, and, with it, formed the hurricane. These Northerly winds were probably a continuation of the N.E. Trade which was then blowing fresh in the space from 9° to 6° N. and 80° to 90° E., while in 3° to 5° S. and 70° to 80° E. the wind was N.W.

The winds nearer the storm, on its northern side, were as follows:—

Augusta:— 14° $56'$ S.; 70° $58'$ E.; wind N.E. (4); fine; a swell from southward.

Hyderee:— 14° $38'$ S.; 71° $33'$ E.; wind N.E. by E. (4); bar. 30.044 ; at 6 A.M. lightning; at noon, fine.

Walmer Castle:— 15° $30'$ S.; 70° $59'$ E.; wind N. by W. (2); cloudy, passing showers.

Cossipore:— 18° $2'$ S.; 72° $46'$ E.; wind N. (8); bar. 29.744 ; very squally, much rain.

Uriel:— 21° $12'$ S.; 71° $17'$ E.; wind N. by W.; bar. 29.52 ; ther. 81° ; blowing terrifically.

The *Yarra*, at noon, was in the central calm. Till 1 A.M. she ran to the W. "with square sail, but was then obliged to heave-to on the port tack (wind S.E.). At 2 A.M., a furious gale with a terrific sea; barometer 29.410 . At 3, increased to a hurricane; ship heading S.S.W. At 6, the sails went to pieces; ship under water; shipped some heavy seas. At 8, barometer 28.710 ; bent the storm sail. At 9, the hurricane more furious; the ship lying dead down in the water; the long-boat under water; expecting the ship to go down. From 10 to $11\frac{1}{2}$, the hurricane was at its greatest height; barometer 28.310 ; the lee-side under water; could not say whether there was any sea or not,—it appeared to be smooth, as the ship never moved; could not stand on deck or hold on,—the Captain gave orders for all hands to go into the cabin; the sight was frightful; it seemed as if the sea and sky had met together; the royal braces were carried away with the force of the wind, &c. At $11\frac{1}{2}$, it fell calm; the sea was then running in masses all round, one sea meeting another and making a clean breach over us, on both sides; the barometer suddenly rose to 28.610 ."

Lat., D. R., 20° $46'$ S.;—Long., D. R., 71° $1'$ E.;—"P.M.—Commences with a calm and a fearful sea running in all directions. At 1, blowing a heavy gale from N.N.E., which lasted two hours; it then blew from N.E. and E. At 4, the barometer, which had been gradually going up, went suddenly down to 28.410 ; it then blew another hurricane, but not so furiously as from 10 to $11\frac{1}{2}$ A.M. At 6, the barometer commenced to rise regularly one-tenth an hour, until 2 A.M. (on the 21st), when it went down two-tenths."

While the *Yarra* was becalmed at noon, and the *Uriel* (a few miles to the eastward and southward of her) had a hurricane from N. by W., the *Lawrence*, in 21° $43'$ S. (D. R.) and 70° $49'$ E. (D. R.), had a heavy gale from E., with

terrific squalls and much rain, the wind in the afternoon veering with her to N.E.

On all sides of those vessels, except on the northern, the S.E. Trade was blowing. Thus, the *Ravenscraig* in 19° S. and 83° 54' E. had a strong breeze from the S.E., with cloudy weather and passing showers; in 24° 30' S. and 77° 18' E. the *Cantero* had also strong breezes from E.S.E. and similar weather; and near Mauritius and Rodriguez, several vessels had light winds from the E.S.E.-ward, with fine weather.

The centre of the storm must have been in about 20° 30' S. and 70° 18' E., although the *Yarra's* position, by dead reckoning, would place it a little further E.

From the previous noon, therefore, the storm travelled S. 42° 59' W. 266·5 miles, or at the rate of 11·1 miles per hour.

The revolving body of air had still a diameter of about 400 miles.

It would appear that the barometer of the *Yarra* rose $\frac{3}{10}$ of an inch in the centre, and then fell, just as the *Cossipore's* barometer had done (though not to the same extent) at 1 A.M. on the 19th.

The observations taken at Port Louis were—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb. Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·982	82·0	81·0	75·3	Calm	0·00	c. but fine
9½ „	30·042	82·0	81·0	75·8	E.-ward	0·20	o. g.
3½ P.M.	30·004	84·0	82·0	75·3	„	0·30	o. p.
9½ „	30·060	82·0	80·1	74·3	E.S.E.	1·50	c. but fine

We see from the above Table that the barometer at Port Louis was rising, although the centre of the storm was 200 miles nearer than at noon on the 19th.

From 40° to 50° E. and 36° to 40° S. five or six vessels had light winds from the N.W.-ward, with fine weather; and these N.W.-ly winds extended to at least 48° 59' S. and 64° 44' E. West of those vessels, again, from 11° to 24° E. and from 33° to 39° S., the wind was S. We have still evidence, therefore, of the existence of the oppositely directed Northerly and Southerly winds which were observed on the previous days, although the limits of the space between them are unknown.

SATURDAY, THE 21ST OF JANUARY.—The hurricane still existed; but it was apparently abating. The positions, winds, &c., of some of the vessels, at noon, were as follows:—

Augusta:—15° 30' S., 69° 48' E.; wind N. to N.E. (4); cloudy, passing showers, lightning in the morning.

Walmer Castle:—16° 5' S.; 69° 17' E.; wind N.N.E. (2); cloudy and sultry; swell from southward.

Hyderce:—15° 56' S.; 69° 34' E.; wind N.E. (2); bar. 30·044; fine; at 6 P.M. passing showers, squally, much thunder and lightning.

Cossipore:—18° 2' S.; 70° 51' E.; wind N. (5); bar. at 1 A.M. 29·744; ther. 80°; squally, much rain, heavy sea.

Farra.—21° 31' S.; 70° 31' E.; wind E. by S. (9); bar. 29·51; cross sea; lying to on port tack.

Lawrence.—22° 3' S.; 69° 39' E.; wind E. by N. (9); very squally, rain.

Uriel.—23° 10' S.; 70° 5' E.; wind E.N.E. (9); bar. 29·74; ther. 82°; rain; awful sea.

Cantero.—24° S.; 74° 23' E.; wind E. to E.N.E. (6); bar. 30·134; ther. 78°; cloudy, squally, rain.

As from 10° N. to 6° S. and from 66° to 94° E., the wind, as observed by ten vessels, was from N.E. and N.W., it is probable that the Northerly winds, from 15° to 18° S., experienced by the *Augusta*, *Hyderee*, &c., were a continuation of the N.E. Trade.

The S.E. Trade prevailed both to the east and to the west of the northerly stream of air, as if the latter had penetrated into the former. In 15° 43' S. and 84° 11' E., for example, the *Ravenscraig* had a fresh breeze from E.S.E.; while at Mauritius, and a few degrees to the eastward of it, the wind was also from E.S.E.-ward.

If the storm was a revolving one at noon on this day, its centre was in about 21° 40' S. and 69° 15' E.; but whatever may have been its character near the centre, the winds at some distance were not moving round a central point.

Since noon on the 20th the centre travelled S. 39° 35' W. 90·8 miles, or at the hourly rate of 3·8 miles. Its rate of progression had, therefore, greatly diminished.

The gale at noon on this day seems to have extended over an area of about 350 miles in diameter.

The observations taken at Port Louis were—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·992	81·0	80·0	73·0	E.S.E.	2·00	o.; fine
9½ "	30·038	84·0	83·0	75·0	"	3·00	q.; "
3½ P.M.	29·974	86·0	84·5	75·0	"	2·00	q.; "
9½ "	30·044	82·0	80·5	73·5	E.-ward	0·30	b.c. "

Comparing the above observations with those of the 20th, we find that the barometer was now beginning to go down a little, with an *increasing* breeze from E.S.E.

The Northerly and Southerly winds, beyond the S.E. Trade, prevailed in the same locality as yesterday.

SUNDAY, THE 22ND OF JANUARY.—At noon, on this day, we have no observations in the space from 24° to 36° S. and from 60° to 80° E.; but the winds to the northward of 24° S., being from N.E. over eight degrees of latitude, they do not appear to have belonged to a cyclone beyond the Tropic. These N.E.-ly winds were experienced by the following vessels:—

Augusta.—16° 6' S.; 68° 26' E.; wind N.E. (2); cloudy, and much lightning.

Walmer Castle:—16° 25' S.; 68° 9' E.; wind N.E. (1); cloudy, and swell from S.

Hyderee:—16° 58' S.; 68° 28' E.; wind N. by E. (4); bar. 30·064; cloudy, lightning; at 8 P.M. squally, rain, thunder and lightning.

Cossipore:—18° 2' S.; 69° 16' E.; wind N.N.E. (2); bar. at 1 A.M. 29·894; ther. 80°; cloudy, rain.

Lawrence:—22° 3' S.; 66° 21' E.; wind N.E. (4); fine.

Cantero:—22° 52' S.; 71° 29' E.; wind N.E. (6); clear.

Yarra:—22° 57' S.; 70° 11' E.; wind E. by N. (8); clearing up; cross sea.

Uriel:—28° 39' S.; 68° 6' E.; wind E.N.E. (8); bar. 29·98; ther. 79°; moderating.

The N.E. Trade extended as far as 4° S., between 75° and 83° E.; so that the N.E.-ly winds reported by these vessels may have been a continuation of the Trade.

The S.E. Trade existed on each side of the N.E.-ly stream of air, and extended, to the S.W.-ward of Mauritius, as far as 29° S.

The observations taken at Port Louis were—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·990	81·0	79·1	72·8	E.-ward	0.40	Fine; light q.
9½ „	30·036	83·0	83·1	74·3	„	1.00	c.; fine.
3½ P.M.	29·988	86·0	84·1	74·3	„	1.00	„
9½ „	30·040	82·0	80·6	73·3	Calm	0.00	Clear.

It will be seen that the barometer at Port Louis had still a downward tendency.

North of Mauritius, the *Launceston*, in 17° 45' S. and about 57° E. had heavy squalls from eastward and bad weather.

Considering, then, the N.E.-ly stream of air, from 16° 6' S. and 68° 26' E. to 23° 39' S. and 68° 6' E.,—the winds and weather with the *Launceston*,—and the existence of the S.E. Trade at Mauritius and to the S.W.-ward of it,—we may infer the probability of a gyratory movement of the atmosphere on this day, as if another hurricane were being formed to the northward of the island. At all events, we cannot trace the *Yarra's* hurricane beyond this day.

The logs of the following vessels show that between 35° and 44° S. and between 43° and 64° E., there were two contrary currents of air.

Jules and Aglaé:—39° 10' S.; 43° 10' E.; wind S.S.W. (6); squally, and heavy sea.

Royal Bride:—39° 58' S.; 45° 34' E.; wind S.W. (5); heavy sea.

Galatea:—37° 29' S.; 48° 54' E.; wind S. (9); bar. 30·07; hazy, rain.

Marguerite d'Arjou:—35° 46' S.; 51° 11' E.; wind N.E. (2); fine.

Arthur and Mathilde:—35° 38' S.; 52° 37' E.; wind N.W. (2); bar. 30·11; clear.

La Bretagne:—36° 19' S.; 52° 21' E.; wind N.N.W. (2); bar. 29·92; ther. 73°; cloudy, thunder.

Stag :—36° 37' S.; 58° 6' E.; wind N.N.W. (5); bar. 30·06; ther. 67°; fine.

George Washington :—36° 33' S.; 63° 34' E.; wind N.E. (2); cloudy and hazy.

Pharamond :—43° 15' S.; 59° E.; wind N.W. (6); cloudy.

The first three of these vessels had the wind, at the preceding noon, from N.N.E. and N.W., and it veered, or shifted, by the W. With the *Royal Bride* it shifted, at 8 P.M. on the 21st, from N.W. to S.W., in a squall; and it seems to have shifted also with the *Jules and Aglaé* and the *Galatée*. The barometer of the latter vessel rose 0·26 inch with the Southerly winds, it having at the previous noon, with the wind fresh from N.N.E., been at 29·81.

MONDAY, THE 23RD OF JANUARY.—As we have no observations from 23° to 30° S. and from 60° to 80° E., it is impossible to say whether the winds in that locality belonged to a rotatory gale. From 16° to 23° S. and from 64° to 71° E., however, the wind was from N.W.-ward to N.E.-ward,—and at Mauritius and to the S.W.-ward of it, from E.S.E.-ward, as if there were an aerial movement round a central point, not south of the Tropic, but to the northward of Mauritius. This will appear from the logs given below :—

Augusta :—16° 28' S.; 67° 28' E.; wind N.W. (1, 2); cloudy, rain.

Walmer Castle :—16° 55' S.; 67° 3' E.; wind N.W. (4); threatening appearance, rain, thunder.

Hyderee :—17° 36' S.; 67° 5' E.; wind variable (1); bar. 30·064; squally, rain.

Cossipore :—18° 10' S.; 67° 46' E.; wind N. by W. (4); bar. at 1 A.M. 29·944; ther. 82°; at 4 A.M. much thunder and lightning, with rain; noon, squally with rain.

Lawrence :—21° 52' S.; 64° 50' E.; wind N.E. (2, 1); cloudy, showers, dark weather.

Farra :—22° 14' S.; 68° 19' E.; wind N. by E. (8); gloomy, rain and thunder; swell from N. by E.

Cantero :—22° 30' S.; 70° E.; wind N.E. (4); fine; P.M. lightning.

Swallow :—25° 20' S.; 51° 53' E.; wind S.E. (4); fine.

Tyrian :—27° 58' S.; 46° 15' E.; wind E.S.E. (6); hazy, rain.

The barometer at Port Louis was going down, as the following observations show :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb. Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·980	81·0	80·1	72·0	E.S.E.	0·12	Clear and fine
9½ "	30·026	84·0	82·5	74·0	"	1·00	c. g.
3½ P.M.	29·950	86·0	84·5	75·0	"	1·50	b. c.; fine
9½ "	30·000	82·0	80·5	74·0	E.-ward	2·00	c.; l. to N.-ward

In about 17° 40' S. and 58° E. the *Launceston* had an increasing gale from N.N.E.-ward, with heavy rain.

These winds and positions show that the N.W. Monsoon and the S.E. Trade had

at least a tendency to rotate; and we thus obtain some idea of the manner in which revolving storms are generated.

On this, as on previous days, lightning was frequently observed where the Northerly winds prevailed.

In the Eastern part of the Ocean the S.E. Trade seems to have extended from 27° S. and 101° E. to 8° S. and 83° E.

South of the 30th parallel, from 45° to 65° E., the winds were from S.E. to S. and S.S.W., as shown by the logs of nine vessels, the Northerly winds which were found yesterday, at noon, from 51° to 64° E. having either veered, or shifted, through the West. The following were the positions, &c., of the vessels at noon:—

Jules and Aglaé:—39° 9' S.; 45° 2' E.; wind E.S.E. to E. (1); cloudy and heavy swell on.

Royal Bride:—39° 30' S.; 46° E.; wind E. by S. (2); clear and fine.

Galatea:—35° 36' S.; 50° 56' E.; wind S.E. by E. (9); cloudy.

Marguerite d'Anjou:—34° 1' S.; 54° 33' E.; wind S.S.E. (6); fine.

Arthur and Mathilde:—32° 56' S.; 54° 35' E.; wind S.E. (5); bar. 30·11; cloudy, passing showers.

La Bretagne:—33° 34' S.; 55° 24' E.; wind S.E. (5); bar. 30·39; ther. 70°; fine.

Stag:—33° 40' S.; 58° 51' E.; wind S.W. (6); bar. 30·17; ther. 67°; fine.

George Washington:—34° 36' S.; 63° 34' E.; wind S.W. (2); fine.

Pharamond:—42° 12' S.; 64° 34' E.; wind S.W. (6); at 4 A.M. hail; at noon, fine.

These winds were, no doubt, the Trade-wind, stretching, on this day, from 40° S. up to Madagascar and Mauritius; and it is to be remarked that the vessels farthest West (the *Royal Bride* and the *Jules and Aglaé*) had the wind from Eastward.

TUESDAY, THE 24TH OF JANUARY.—The S.E. Trade (so far as our observations enable us to judge) extended, as yesterday, in the Eastern part of the ocean, as far as 8° S. and from 72° to 82° E.,—the N.E. Trade crossing the Equator between the same meridians.

We have also, as yesterday, a S.E.-ly wind from 36° S. and 52° E. to the vicinity of Mauritius; and in about 40° S. and from 46° to 50° E. the *Royal Bride* and the *Jules and Aglaé* which, at the previous noon, had the wind from Eastward, have it now from N.E.-ward, as if this N.E.-ly wind were a deflection of the S.E.-ly wind to the northward of it,—or, it may be, the equatorial winds appearing on the surface.

The observations taken at Port Louis were as follows:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·928	81·5	80·1	74·3	E.	1·50	c. but fine
9½ „	29·962	83·0	81·6	76·3	„	2·50	c. q.
3½ P.M.	29·900	85·0	83·6	76·8	„	0·40	c. p.
9½ „	29·960	80·5	74·8	74·8	N.E.	2·00	c. q. r.; much t. l. to N.W.

The barometer, which was now going down more rapidly, indicated, with the direction and increasing force of the wind, the existence of a second hurricane, to the Northward of Mauritius.

The *Augusta*, *Hydere*, *Yarra*, and *Cantero*, from $16^{\circ} 29'$ S. and $66^{\circ} 59'$ E. to $23^{\circ} 15'$ S. and 68° E. had the wind light from N.W.-ward, with fine weather—the *Yarra*, in the early part of the day, having had a fresh gale from N.W.-ward, with thunder.

In $17^{\circ} 56'$ S. and about 58° E. the *Launceston* had a gale from N.N.E.-ward.

We have, therefore, as yesterday, signs of a stormy gyration to the Northward of Mauritius.

WEDNESDAY, THE 25TH OF JANUARY.—On this day the N.E. Trade was still crossing the Equator in from 72° to 84° E., and the S.E. Trade seems to have stretched from about 30° S. and 100° E. to 10° S. and 72° E.

The S.E. Trade prevailed also from 30° S. and 60° E. to Reunion and Mauritius.

From 16° to 19° S. and in about 67° E., the *Augusta* and *Hydere* had still light winds from N.W.; and a few degrees farther South the *Yarra* and *Cantero* had light winds from S.W.-ward.

Observations taken at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
$3\frac{1}{2}$ A.M.	29.888	81.0	80.1	74.8	East	3.00	c. p. q.
$9\frac{1}{2}$ „	29.940	82.0	81.6	71.9	„	1.00	c. p.
$3\frac{1}{2}$ P.M.	29.890	84.0	82.1	77.3	E.N.E.	0.20	t. f. r.
$9\frac{1}{2}$ „	29.946	82.0	81.1	75.8	E.S.E.	0.50	c. t. l.

The *Atieth Rahaman*, in $18^{\circ} 40'$ S. and $56^{\circ} 54'$ E., at noon, had a strong breeze from E.N.E., with fine weather. As she held to the Northward (she was bound to Calcutta from Port Louis), the wind increased from E. and E. by S. “At 6.30 P.M., in first reef of topsails. At 8, barometer 29.60 (ind. err. not known). At 9, in mainsail; split mizen topsail, &c. At 10, hauled down fore-topsail, &c.; fore-topgallant mast carried away; barometer still falling. Midnight, in the vortex; heavy cross sea; barometer 29.40.”

The *Launceston* (her position is not given), not far from the *Atieth Rahaman*, had the wind, at noon, strong from E. by N., with squalls and heavy rain,—the wind in the afternoon increasing to a hard gale and veering to E., S.E., S., S.W., &c., till at midnight it was from N.W.

It is probable, therefore, that a revolving storm existed at noon on this day, with its centre in about $16^{\circ} 40'$ S. and 57° E.

Beyond the S.E. Trade the wind, as observed by seven vessels, was from N.E. and N.W.; between 48° and 55° E. it was from N.E., except with the vessel next the Trade, in $32^{\circ} 29'$ S. and $48^{\circ} 26'$ E., where it was blowing a fresh gale from E.; in $37^{\circ} 6'$ S. and $30^{\circ} 55'$ E., it was moderate from N.W.

It is interesting to observe how these N.E.-ly winds appeared to the South-

ward of the Trade whenever the second rotatory gale commenced near its equatorial limits.

THURSDAY, THE 26TH OF JANUARY.—We find that on this day the N.E. Trade was still crossing the Equator, between 73° and 90° E.; and that the S.E. Trade was coming up to within a few degrees of it in that part of the ocean.

From 50° to 70° E., the S.E. Trade was blowing from about 27° S. to the neighbourhood of Mauritius and Reunion, where it formed the Southern and Western sides of the cyclone the existence of which had been noticed since the 24th. The following were the positions, winds, &c., of some of the vessels at noon:—

Hyderee:— $18^{\circ} 39'$ S.; $65^{\circ} 37'$ E.; wind N.E. (4); bar. 30·064; fine.

Stag:— $22^{\circ} 7'$ S.; $58^{\circ} 48'$ E.; wind E.N.E. (5); bar. 29·84; ther. 80° ; fine.

Lawrence:— $24^{\circ} 21'$ S.; $62^{\circ} 54'$ E.; wind N.E. (2); fine.

La Bretagne:— $25^{\circ} 22'$ S.; $59^{\circ} 25'$ E.; wind E. (1); bar. 30·34; ther. 81° ; cloudy and fine.

Arthur and Mathilde:— $25^{\circ} 7'$ S.; $57^{\circ} 29'$ E.; wind E. (5); bar. 29·913; cloudy, squally.

Marguerite d'Anjou:— $26^{\circ} 22'$ S.; $59^{\circ} 2'$ E.; wind E.S.E. (5); cloudy, squally.

Swallow:— 26° S.; $51^{\circ} 30'$ E.; wind S.E. (5); fine.

Nadir:— $20^{\circ} 28'$ S.; $51^{\circ} 43'$ E.; wind Southerly (2); fine.

Auffredy:— $20^{\circ} 46'$ S.; 54° E.; wind S.E. (6); cloudy, squally.

The following observations were taken at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·880	81·5	80·0	74·3	E.S.E.	4·50	Fine
9½ „	29·924	81·5	80·0	73·0	East	4·00	{ o. p. q.; a heavy sea from N.N.W.
Noon	29·920	85·0	...	...	E.b.N.	5·00	„ „
3½ P.M.	29·860	83·0	81·1	75·0	E.N.E.	4·00	„ „
7 „	29·866	79·0	...	...	„	9·00	o. r.
9½ „	29·874	79·0	78·0	75·0	„	5·00	„
Midt.	29·824	78·0	...	...	„	8·00	o. r. t. l.

It would appear from the log of the *Atieth Rahaman*, that at midnight of the 25th she was in the central calm, after having had the wind from E. to N.E. At 1 A.M. on the 26th, the barometer being at 29·25, she had “thick, dark, cloudy weather, with rapid lightning. At 3, the wind from N.W. struck the ship with the force of a hurricane, and laid her on her beam ends; vessel making more water than usual,—obliged to keep the pumps going. At 4, barometer 29·30. At 6, sent hands aloft to secure the torn sails. At 8, sent down main-royal yards, fore-royal and top-gallant yards; barometer 29·40. Noon, still blowing very hard; ship's scuppers under water; ship labouring heavily, and making much water; no sails set; blowing a regular hurricane; barometer 29·40.

“Lat. (D. R.) 18° S., Long. (D. R.) 57° E. P.M.—Wind N. to N.N.W.

Flying jibboom snapped short off; unable to send down fore-topgallant mast and yard, and being afraid of its seriously damaging topmast rigging and braces, cut it away, after having managed to send down top-gallant yards at great risk. Ship labouring heavily, and still lying to under bare poles; blowing a perfect hurricane; hands kept at the pumps. Midnight, no change; barometer 29.40."

The *Launceston*, probably in about 17° S. and 58° E., had a gale from N.N.W., with hard squalls and rain.

From all these observations we infer that the centre of the cyclone was in about 18° 30' S. and 55° 54' E.

Since the preceding noon, therefore, the storm travelled S. 29° 39' W. 126 miles,—or at the rate of 5.2 miles per hour.

Its diameter was at least 400 miles, though the wind did not blow with hurricane force within the whole of that space.

South of the 30th parallel, from 33° to 76° E., five vessels had fresh and moderate breezes from Northward, chiefly from N.N.E.

FRIDAY, THE 27TH OF JANUARY.—On this day there were vessels on all sides of the storm, and showing, in the clearest manner, that the wind was circling round a centre. The following were the winds, &c., of those vessels at noon :—

Launceston :—17° 15' S.; 57° 30' E.; wind N.N.W. (2); fair; made all sail.

Auffredy :—19° 15' S.; 56° 23' E.; wind N.W. (5); cloudy, squally.

Gironde :—19° 50' S.; 55° 30' E.; wind N.W. (11); squally; under bare poles.

Slag :—20° 32' S.; 58° 18' E.; wind N.N.E. (9); bar. 29° 70'; ther. 82°; rain, lightning.

La Bretagne :—22° 37' S.; 59° 50' E.; wind E.N.E. (4); bar. 30.12; ther. 79°; cloudy, rainy.

Arthur and Mathilde :—23° 25' S.; 57° 23' E.; wind E. to E.N.E. (6); squally, rain.

Swallow :—25° 5' S.; 51° 6' E.; wind S.E. (5); fine.

Nadir :—20° 11' S.; 53° 10' E.; wind Southerly (4); cloudy, squally, rain.

With the *Auffredy*, the wind veered from S.W., on the 26th, to S., S.W., &c.; so that the centre passed to the eastward of her.

The *Gironde* left St. Denis (Reunion) early on the 26th, and steered N.E., with the wind from W.N.W.-ward. In the afternoon, she ran S.E. with the wind from N.N.W., but at 5 P.M. hove-to on the starboard tack.

As the direction of the wind is not given in the log of the *Atieth Rahaman*, that vessel has been omitted in the above Table. At midnight on the 26th, she had a hurricane from Northward. "At 3 A.M. (27th) more moderate. At 4, hard gales, with passing rain; barometer 29.50; sent down the mizen top-gallant yards and mizen top-gallant mast. At 6, moderating fast. At 7, set foressail and mizen. At 8, strong breeze and cloudy; barometer 29.60. At 11, set mizen topsail and mainsail. Noon, moderate breeze and cloudy; barometer 29.80. Lat. 19° 19' S.; Long. 57° 12' E.

"P.M. Moderate breeze and fine."—She had, no doubt, the wind still from the Northward.

In the afternoon, the wind and weather with the *Arthur and Mathilde* "assumed every appearance of a storm, and from 4 to 8 the wind blew with extraordinary

violence; the sea high, the sky overcast and gloomy; the breeze always from the same quarter (E.N.E.) without varying. At 9, barometer 29·685; blowing with extreme violence and much rain. Midnight, ditto winds and weather."

The following observations were taken at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
1 A.M.	29·816	78·5	...	...	N.E.b.E.	7·00	o. r. o. g. q. r. t. l.
3½ "	29·784	79·0	78·0	75·0	N.E.b.N.	3·00	
5 "	29·810	79·0	...	...	N.N.E.	12·00	"
7 "	29·850	79·0	...	...	N.b.E.	4·00	"
9½ "	29·910	80·0	78·0	76·0	North	4·00	o. g. r. o.; finer
3½ P.M.	29·914	81·0	80·0	76·0	"	2·50	
9½ "	29·986	81·0	79·0	76·5	N.E.	0·20	o. m.

The centre of the storm at noon was in about 20° S. and 55° 30' E.; so that it travelled since the previous noon S. 14° 11' W. 93 miles,—or at the rate of 3·8 miles per hour.

Although the diameter of the whirling body of air was at least 600 miles, the wind did not blow hard over all that space.

The N.E. Trade on this day was extending beyond the Equator between 75° and 82° E.; and the S.E. Trade from 25° S. and 85° E. to about 12° S. and 69° E.

From 60° to 70° E. and from 21° to 17° S. the S.E. Trade was deflected to E. and E.N.E. towards the cyclone.

The south-western side of the cyclone was evidently formed by the Trade.

South of the Trade, in that part of the Ocean, the wind, as observed by four vessels, from 35° to 59° E., was fresh and moderate from Northward, with fine weather.

SATURDAY, THE 28TH OF JANUARY.—The N.E. Trade prevailed in the northern part of the Ocean, and was crossing the Equator in about 80° E.

We have evidence that the wind was still moving round a point to the southward of Mauritius. The storm, however, seems to be dying away. From the following Table it will appear, also, that the Northerly winds extended over several degrees of latitude, as if the cyclone was flattened on its eastern side.

Eastern Empire:—16° 31' S.; 72° 57' E.; wind S.E. (5); bar. 30·07; ther. 83½°; cloudy, passing showers.

Neptune:—14° 43' S.; 68° 47' E.; wind S.E. (6); fair.

Augusta:—18° 9' S.; 61° 53' E.; wind Easterly (2); cloudy; swell from the S.E.

Lawrence:—19° 41' S.; 60° 41' E.; wind E.N.E. (2); fine.

George Washington:—21° 4' S.; 59° 12' E.; wind N.N.E. (4); fine.

La Bretagne:—21° 43' S.; 59° 24' E.; wind N.N.E. (5); bar. 29·95; ther. 82°; fine.

Marguerite d'Anjou:—21° 20' S.; 58° 29' E.; wind N.E. (5); fine; lightning at 5 P.M.

Auffredy :— $19^{\circ} 20' S.$; $57^{\circ} 30' E.$; wind N.W. (6); fine; a sea on.

Gironde :— $21^{\circ} 2' S.$; $56^{\circ} 28' E.$; wind North (6); very heavy sea.

Arthur and Mathilde :— $23^{\circ} 45' S.$; $58^{\circ} 5' E.$; wind North (7); bar. 29.834; squally, rain.

Swallow :— $24^{\circ} 45' S.$; $51^{\circ} 47' E.$; wind E.S.E. (5); squally, rain.

Nadir :— $20^{\circ} 24' S.$; $54^{\circ} 13' E.$; wind S.W. (1); fine.

The S.E. Trade prevailed in the eastern part of the Ocean, and apparently curved away towards the storm, becoming successively an E., E.N.E., N.N.E., and N. wind.

At Port Louis the following observations were taken :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3 $\frac{1}{2}$ A.M.	29.978	80.0	79.0	76.0	E.-ward	0.10	c.; fine
9 $\frac{1}{2}$ „	30.032	82.0	81.0	76.8	N.N.E.	1.00	o.; „
3 $\frac{1}{2}$ P.M.	30.016	85.0	83.1	78.3	N.-ward	0.50	c.; „
9 $\frac{1}{2}$ „	30.088	82.0	80.0	77.0	Calm	0.00	Fine; l. to S.-rd

The *Arthur and Mathilde's* barometer at 1 A.M. was at 29.724, and at 5 A.M. at 29.763,—the weather improving a little. From 4 to 8, the squalls were less violent and at longer intervals, with overcast sky and rain. At 9 A.M. the barometer was 29.842, with the wind squally from North, but the weather improving.

We infer that the centre at noon on this day was in about $24^{\circ} 15' S.$ and $57^{\circ} 18' E.$ Hence the storm travelled, since noon on the 27th, S. $19^{\circ} 59' E.$ 271 miles,—or at the rate of 11.3 miles per hour.

The storm had a diameter of about 450 miles.

As the centre must have passed close to Reunion, information from that island would be interesting.

From 34° to $39^{\circ} S.$, and from 54° to $59^{\circ} E.$, the wind was moderate and fresh from N.E.-ward, with fine weather.

SUNDAY, THE 29TH OF JANUARY.—On this day we have nearly the same winds as on the preceding, except that the cyclone has disappeared.

The N.E. Trade was crossing the Equator in about $80^{\circ} E.$, and the S.E. Trade, which prevailed in the eastern part of the Ocean, was apparently curving towards Mauritius, forming an E.S.E., E.N.E., and then a Northerly wind, as yesterday. The positions, &c., of some of the vessels were as follows :—

Phantom :— $23^{\circ} 23' S.$; $80^{\circ} 46' E.$; wind S.E. by E. (5); bar. 30.206; clear and fine.

Neptune :— $16^{\circ} 59' S.$; $66^{\circ} 59' E.$; wind E.S.E. (5); fair.

Augusta :— $18^{\circ} 33' S.$; $60^{\circ} 7' E.$; wind Easterly (3); fine.

Hydree :— $19^{\circ} 46' S.$; $60^{\circ} 15' E.$; wind E.N.E. (2); bar. 30.144; fine.

Lawrence :— $19^{\circ} 24' S.$; $58^{\circ} 20' E.$; wind E.N.E. (2); fine.

George Washington :— $20^{\circ} 29' S.$; $58^{\circ} 33' E.$; wind N.E. by N. (2); fine.

Gironde:—20° 32' S.; 56° 50' E.; wind North (4); fine; heavy sea.

La Bretagne:—21° 32' S.; 59° 16' E.; wind N.N.E. (2); bar. 30·14; ther. 82°; fine.

Arthur and Mathilde:—23° 46' S.; 58° 27' E.; wind N.N.W. (2); bar. 30·173; weather finer.

Between the *Arthur and Mathilde's* position and 30° S. we have no observations; but in 31° 52' S. and 58° 19' E., the *Galatea* had, in the morning, a fresh gale from the E., and at noon a strong gale from E.S.E., with her barometer at 29·90. In the afternoon, the wind veered to S.S.E.

It is possible, therefore, that the cyclone still existed, having its centre in about 28° S. and 61° E.

South of the *Galatea*, in 38° 10' S. and 56° 20' E., the *Jules and Aglaé* had a fresh breeze from N. to N.N.W., and fine weather.

SUMMARY OF RESULTS.—The *Yarra's* hurricane originated on the 17th of January, between the S.E. Trade and the N.W. Monsoon. Its course, rate of progression, &c., were as follows:—

Date.	Centre at Noon.		Course.	Distance in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S.	E.				
	°	°				
Jan. 18	15 30	75 30				240
„ 19	17 15	73 30	S. 47° 45' W.	156·2	6·5	400
„ 20	20 30	70 18	S. 42° 49' W.	266·5	11·1	400
„ 21	21 40	69 15	S. 39° 35' W.	90·8	8·8	350

The storm, therefore, so far as we have been able to ascertain, travelled a total distance of 513·5 miles, gently curving as it advanced to the southward.

Two vessels, the *Cossipore* and *Yarra*, experienced a calm in the centre of the hurricane.

The *Cossipore* seems to have lost the wind at S.E., and to have got it again at N.N.W., after an interval of nearly an hour; and this, according to the rate at which the meteor was travelling, would give the central calm a diameter of about 7 miles. Ten hours afterwards, the wind with the *Yarra* ceased (probably at E.S.E. or E.), and, after an hour or so, recommenced at N.N.E.; which would make the diameter of the calm space about 13 miles. If these numbers are correct, there must have been a dilatation of the central calm.

It does not appear that this hurricane, except near the centre, was very circular. At its commencement the centre lay between an Easterly and a Westerly stream of air; so that at first the storm was probably flattened on its northern and southern sides. It then became more circular (as on the 19th), and afterwards elongated from N. to S., the Northerly winds extending over several degrees of latitude.

These Northerly winds were an extension of the N.E. Trade; and the storm lay between them and the S.E. Trade.

Although the storm was of small dimensions, it was very violent; and the barometer fell to nearly 28 inches.

The *Cossipore's* barometer fell with the S.E.-ly wind from 29.944 at noon on the 17th, to 28.364 at 11 P.M. on the 18th, shortly before the calm. In the calm it rose to 28.394, and at 2 A.M., with the wind from N.N.W., it again fell to 28.364. It then began to rise, and by 1 A.M. on the 22nd was at 29.894. The total fall, therefore, was 1.58 inches.

The *Yarra's* barometer fell with the S.E.-ly wind from 29.91 at noon on the 19th, to 28.31 at 11½ A.M. on the 20th, just before getting the calm. In the calm it "suddenly rose to 28.61." Shortly afterwards, it "went suddenly down" to 28.41. At length it commenced to rise, and by noon of the 21st was 29.51. The total fall was 1.60 inches, or nearly the same as with the *Cossipore*.

From the 18th to the 21st there was constant heavy rain on all sides of the centre.

On the 17th, lightning was observed nearly on all sides of the space where the storm took its origin; and the weather there was sultry and oppressive, with light winds. Lightning was observed, also, on the following days, in the Northerly winds, particularly by the *Hyderes*.

The Northerly winds advanced as far as the Tropic on the 22nd and 23rd (though the storm cannot be traced beyond the 21st); and much thunder and lightning was observed on the latter day.

From the 17th to the 23rd of the month, a system of Southerly and Northerly winds, travelling to the eastward, was observed south of the 30th parallel, as had also been observed from the 9th to the 12th or 13th, while a previous hurricane was raging to the northward.

The Southerly winds advanced from about 25° E. on the 17th, to 65° E. on the 23rd; the winds, with the vessels in the Northerly current to the eastward, veering or shifting, by the N. and W., to S.W., S., and S.E.

By the time (the 23rd) that all the winds, observed to the south of the 30th parallel, were Southerly (chiefly from S.E.), and the N.W. Monsoon had, as already stated, extended to the Tropic amidst much lightning, the second hurricane was apparently setting in to the northward of Mauritius.

The barometer at Port Louis began to go down a little on the 21st; but we cannot determine the centre of the hurricane (supposing it existed) till the 25th or 26th. The following Table gives its course, rate, extent, &c. :—

Date.	Centre at Noon.		Course.	Distance travelled in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S.	E.				
Jan. 25	16 40	57 00		...	...	...
" 26	18 30	55 54	S. 29° 39' W.	126.0	5.2	400
" 27	20 00	55 30	S. 14° 11' W.	93.0	3.8	600
" 28	24 15	57 18	S. 19° 59' E.	271.0	11.3	450

It appears, therefore, that the storm travelled a distance of at least 400 miles.

At Port Louis, the barometer fell from 30.038 at 9½ A.M. on the 21st, to 29.784 at

3½ A.M. on the 27th; the total fall of rain, from 9½ A.M. on the 24th to 9½ A.M. on the 28th was 8·277 inches; and the anemometer indicated a maximum pressure of 12 lbs. per square foot.

This storm, also, was characterized by a central calm in which the *Atieth Rahaman* remained about three hours. The wind seems to have ceased at N.E. to E., and to have recommenced at N.W. It is probable, therefore, that the central calm had a diameter of about 20 miles.

In the centre, the barometer with the *Atieth Rahaman* fell only to 29·25 inches, which is nearly an inch higher than it was with the *Yarra* and *Cossipore* in the centre of their hurricane.

On the 26th and 27th, the storm was circular, but on the 28th it was flattened—at least on its eastern side.

There was much rain in the body of the storm, especially near the centre.

Frequent lightning was observed at Port Louis, and in other places, with the Northerly winds.

Whenever signs of the hurricane appeared to the northward of Mauritius, a N.E.-ly wind set in beyond the S.E.-ly winds which prevailed as far as 36° S., and speedily occupied, so far as our observations show, the whole space from 30° to 40° S. and from 15° to 70° E. On the 27th, however, a Southerly wind made its appearance to the westward of the Northerly wind, and it seems to have advanced rapidly to the eastward, till at noon on the 30th all the vessels from 30° to 40° S. and from 50° to 70° E. had again the wind from S. and S.S.W.-ward in fresh breezes.

With most of the vessels which had the Northerly winds, the veering or shifting took place through the N. and W.; but with one or two of those farthest north, and next the storm, it took place from W.N.W. to E.N.E., E. and E.S.E.

On the 28th and 29th, the S.E. Trade, east of the 60th meridian, and from 18° or 17° S. to 20° S., curved away to the S.W.-ward, towards the storm, forming a S.E. E.S.E., East, N.E., and N. wind.

The Northerly winds advanced to the Tropic, as was the case in the *Yarra's* hurricane.

After the hurricane of the 24th to the 29th January, the S.E. Trade resumed its ordinary state, and prevailed from nearly 30° to 5° S. in about 80° E.,—and to 14° S. on the western side of the Ocean.

At noon, on Feb. 6th, it was prevalent, as observed by several vessels, from 21° 45' S. and 104° 2' E. to 4° S. and 78° 3' E.,—and from 29° 7' S. and 39° 4' E. to 13° 21' S. and 58° 45' E.,—blowing in hard gales, with rain, in about 25° S. and 49° E.

South of the 30th parallel, between 18° and 42° E., the wind was from N.N.E. and the N. W.-ward, in strong breezes.

The N.E. Trade extended from 13° 45' N. and 93° 20' E. to the Equator.

TUESDAY, THE 7TH OF FEBRUARY.—There was scarcely any change in the winds and weather on this day; but a N.E.-ly wind had made its appearance to the

northward of Mauritius. The positions of the vessels which experienced it were as follows :—

Launceston :— $4^{\circ} 50' S.$; $64^{\circ} 35' E.$; wind N.N.E. (1); cloudy, squally.

Allies :— $13^{\circ} 6' S.$; $60^{\circ} 8' E.$; wind N.E. by N. (4); bar. 30.093; ther. 89° .

Vanguard :— $14^{\circ} 36' S.$; $58^{\circ} 14' E.$; wind N.N.E. (4); bar. 29.958; ther. 89° ; squally with rain; threatening appearance.

These vessels had a higher temperature than was observed in any other part of the Ocean.

With the *Vanguard*, the wind at 10 P.M. on the 6th "passed from E.S.E. to N.W. with squalls, rain, and a threatening appearance."

The *Allies*, farther north, lost the Trade on the morning of the 6th; she had then for a few hours light airs from W.N.W., and, in the latter part of the day, a light breeze from N.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
$3\frac{1}{2}$ A.M.	30.000	82.0	80.0	74.0	E.-ward	1.00	Clear and fine
$9\frac{1}{2}$ "	30.036	82.0	81.0	75.5	"	1.50	c. p. q.
$3\frac{1}{2}$ P.M.	29.974	81.0	79.0	74.0	East	4.00	o. p. q.
$9\frac{1}{2}$ "	30.040	80.0	78.0	73.5	"	3.00	o. q. r.

To the S.W.-ward of the island, the Trade was squally, with rainy weather; and, in $24^{\circ} 26' S.$ and $49^{\circ} E.$, the *Swallow* was lying to with a strong gale from S.E., and heavy rain.

From 36° to $39^{\circ} S.$, and nearly in $44^{\circ} E.$, two vessels had strong breezes from N.E.; and from 36° to $40^{\circ} S.$ and 23° to $32^{\circ} E.$ three other vessels had strong to moderate breezes from N.W.

We thus see, that while the S.E. Trade reigned at Mauritius and to the southward of it, a Northerly wind was observed to the northward of the island, and also a Northerly wind beyond the polar limits of the Trade.

The N.E. Trade prevailed north of the Equator.

WEDNESDAY, THE 8TH OF FEBRUARY.—East of $68^{\circ} E.$, the S.E. Trade extended to $10^{\circ} S.$: it prevailed also at Mauritius and to the southward of it; but, to the N.W.-ward and northward of the island, the wind was from W.S.W.-ward and N.N.W.-ward, as if a cyclone existed, or was being formed, between the S.E. Trade and the N.W. Monsoon. The following are the observations which have led to that inference :—

Swallow :— $25^{\circ} S.$; $48^{\circ} 50' E.$; wind E.S.E. (9); lying to.

Tyrian :— $22^{\circ} S.$; $56^{\circ} E.$; wind E.S.E. (6, 7); cloudy, squally.

Jules and Aglaé :— $19^{\circ} 57' S.$; $58^{\circ} 13' E.$; wind Eastward (5); cloudy, squally with rain.

Marie Sarah :— $17^{\circ} 51' S.$; $52^{\circ} 1' E.$; wind W.S.W. (4); bar. 30.010.

Vanguard :—14° S.; 57° 29' E.; wind N.N.W. (4); bar. 29·978; ther. 85°; gloomy and squally.

Launceston :—5° 27' S.; 65° 54' E.; wind N.W. (5); cloudy.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·978	81·5	80·0	75·0	E.N.E.	3·50	c.; fine
9½ „	30·050	78·0	76·0	73·0	E.-ward	2·00	c. r.
3½ P.M.	29·990	82·0	81·0	75·5	E.N.E.	0·30	c.; fine
9½ „	30·050	80·0	78·0	73·5	Var.	0·04	c. r.

In 29° 23' S. and 35° 34' E., the *Royal Arthur* had a fresh breeze from S.S.W., with a rising sea; barometer 30·10; thermometer 79°.

South of the 30th parallel, the winds were still from the Northward, except with the *Good Hope*, in 36° 42' S. and 47° 12' E., where it was blowing a heavy gale from the S.W. This vessel, on the whole of the 7th, had the wind from N.E.-ward, with the barometer at noon at 29·80. Towards midnight the breeze fell light, and it remained so till about 8 A.M. on the 8th, when it passed from N.E. to S.W., the barometer at noon standing at 29·75, but soon afterwards rising.

About 150 miles S.S.E. of the *Good Hope*, the *Marquise*, in 38° 43' S. and 47° 43' E., had the wind from N.E., with heavy rain, but an hour or two afterwards it passed to W.S.W.

Farther east, in 37° 44' S. and 59° 14' E., the *Tullochgorum* had the wind fresh and strong from N.E.-ward throughout, with cloudy, but fine weather.

West of 33° E. the wind, as observed by five vessels, was from N.W.-ward, with fine weather.

The N.E. Trade was blowing in light to fresh breezes, from Calcutta to the Equator.

THURSDAY, THE 9TH OF FEBRUARY.—On this day we have, generally, the same winds and weather as yesterday.

The S.E. Trade east of 66° E. extended to 10° or 8° S.

West of that meridian, however, the Northerly Monsoon prevailed, to at least 14° S.; and there were still signs of the formation of a rotative wind to the northward of Mauritius, as will appear from the following observations :—

Tyrian :—21° 10' S.; 57° 20' E.; wind E.S.E. (8); squally with rain.

Marie Sarah :—16° 49' S.; 50° 34' E.; wind W.S.W. (5); bar. 29·930; squally with rain; heavy cross sea; midnight, lightning.

Vanguard :—13° 33' S.; 57° 49' E.; wind N. (2); bar. 29·928; ther. 86°; fine; at 6 P.M. squally.

Launceston :—3° 59' S.; 64° 45' E.; wind N.N.E. (4); bar. 29·86; ther. 84°; cloudy, fine.

Black Friar :—4° 34' S.; 67° 8' E.; wind N. (5); cloudy.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29.950	79.0	78.0	73.5	E.-ward	0.20	o.; fine
9½ "	29.999	81.0	80.0	74.5	"	0.30	o. g. r.
3½ P.M.	29.950	81.0	79.0	75.0	Calm	0.00	o. g. r.
9½ "	29.982	79.0	78.0	73.5	E.-ward	0.50	c.; fine

It appears from these observations that the barometer was going down at Mauritius as well as with the *Marie Sarah* and *Vanguard*.

The *Swallow*, in 26° 28' S. and 48° 49' E., had now calms and fine weather; and the *Royal Arthur*, in 29° 40' S. and 33° 4' E., a light breeze from S.E., with hazy weather; barometer 30.19; thermometer 76°.

In 35° to 39° S. and 49° to 52° E., the *Good Hope* and *Marquise* had light winds, the former from S., and the latter from W.S.W. The barometer of the *Good Hope* at noon stood at 29.90, or 0.15 higher than yesterday.

West of those two vessels, the *Tullochgorum*, in 37° 25' S. and 61° 19' E., had at noon a fresh breeze from the W., with misty weather. The N.E. wind, which she had on the previous day, increased, in heavy squalls, to a double-reefed topsail breeze, and veered to N. and W.; and at 2 P.M. on this day (the 9th), she had a moderate breeze from S.

It is clear, therefore, that the *Good Hope*, *Marquise*, and *Tullochgorum*, experienced the same changes of wind and weather, and that the Southerly current of air, which they got in succession, was travelling to the eastward at the rate of 15° a day, or of about 29 miles per hour.

From 19° to 35° E. and from 36° to 40° S., the wind was from Northward and N.W.-ward; and in 40° 47' S. and 14° 13' E., the *Robert* and *Alexander* had a moderate breeze from W.S.W. and misty weather.

The N.E. Trade still prevailed in the Bay of Bengal; and between it and the S.E. Trade, in 82° E. and south of the Equator, two vessels had light airs and calms.

FRIDAY, THE 10TH OF FEBRUARY.—At noon on this day, the N.E. Trade apparently extended from 11° N. to 14° S., as will be seen from the following vessels :—

Bentinck :—11° N.; 84° 55' E.; wind E.N.E. (2); fine.

Meteor :—6° 6' N.; 82° 8' E.; wind N.N.E. (4); clear.

Martha :—4° 9' S.; 81° 27' E.; wind Northerly (2); fine.

Launceston :—4° 22' S.; 68° 41' E.; wind N.N.E. (2, 5); squally.

Black Friar :—4° 29' S.; 65° 32' E.; wind N. (2); bar. 29.942; ther. 85°; fine.

Rosalie :—6° 23' S.; 78° 50' E.; wind Northerly (2); cloudy.

Narvahal :—7° 44' S.; 78° 53' E.; wind N.N.E. (2); fine.

St. Bernard :—12° 57' S.; 71° 37' E.; wind E.N.E. (6); bar. 30.040; squally with rain.

Vanguard :— $13^{\circ} 9' \text{ S.}$; $57^{\circ} 12' \text{ E.}$; wind N.N.E. (5); bar. 29.978; ther. 85° ; squally.

In 17° S. and $50^{\circ} 57' \text{ E.}$, the *Marie Sarah* had fresh breezes from W.S.W. to W., with heavy rain, and the barometer at 29.78. At midnight she had heavy rain, lightning, and light airs from W.S.W.

The *Chillingham*, in $19^{\circ} 17' \text{ S.}$ and $56^{\circ} 6' \text{ E.}$, had a strong gale from E. to N.E., with a wild appearance, and rainy weather.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
$3\frac{1}{2}$ A.M.	29.928	79.0	77.5	74.0	N.E.	2.00	o. q. r.
$9\frac{1}{2}$ „	29.982	79.5	79.0	73.5	E.-wrd.	2.00	o. r.
$3\frac{1}{2}$ P.M.	29.950	78.0	76.0	73.0	N.E.-wrd.	0.30	o. r.
$9\frac{1}{2}$ „	29.992	77.0	76.0	72.5	E.N.E.	2.00	c.; fine

The S.E. Trade extended towards 10° S. in 95° E. It prevailed also to the eastward and southward of Mauritius, as shown by the following vessels :—

Flatworth :— $17^{\circ} 50' \text{ S.}$; $64^{\circ} 30' \text{ E.}$; wind S.E. (4); fine.

Radnagore :— $18^{\circ} 17' \text{ S.}$; $65^{\circ} 6' \text{ E.}$; wind E. by S.; bar. 30.010; ther. 84° .

Mona :— $19^{\circ} 23' \text{ S.}$; $63^{\circ} 54' \text{ E.}$; wind E. by S. (5); clear.

Lord of the Isles :— $22^{\circ} 51' \text{ S.}$; $55^{\circ} 22' \text{ E.}$; wind S.E. (6); squally with rain.

In $26^{\circ} 10' \text{ S.}$ and $49^{\circ} 7' \text{ E.}$, the *Swallow* had calm and fine weather; but in the afternoon a strong breeze sprang up from S.E.

These observations would lead us to infer that there was a locality of *minimum* atmospheric pressure to the north-westward of Mauritius, and that the adjacent air was flowing either towards it or around it.

From 35° to 38° S. and from 49° to 62° E. , the *Good Hope*, *Marquise*, and *Tullockgorum*, had still Southerly winds.

Further west, the winds and weather were as follows :—

Royal Arthur :— $30^{\circ} 15' \text{ S.}$; $30^{\circ} 33' \text{ E.}$; wind E. by S. (4); bar. 30.201; ther. 82° ; fine.

Prince :— $36^{\circ} 50' \text{ S.}$; $36 19' \text{ E.}$; wind N.N.E. (5); clear.

Jalawar :— $37^{\circ} 39' \text{ S.}$; 33° E. ; wind E.N.E. (3); clear.

Isis :— $39^{\circ} 45' \text{ S.}$; $29^{\circ} 28' \text{ E.}$; wind E.N.E. (5); clear.

Jeanne de Montfort :— $40^{\circ} 5' \text{ S.}$; $20^{\circ} 59' \text{ E.}$; wind N.N.E. (5); fine.

Centaur :— $37^{\circ} 28' \text{ S.}$; $18^{\circ} 12' \text{ E.}$; wind S. (2); bar. 30.314; ther. 68° ; clear.

Robert and Alexander :— $40^{\circ} 44' \text{ S.}$; $15^{\circ} 26' \text{ E.}$; wind S. by W. (3); cloudy, fine.

Louis Gaveaux :— $37^{\circ} 26' \text{ S.}$; $14^{\circ} 37' \text{ E.}$; wind N.W. (2); fine.

It would appear from these observations that a second system of Southerly winds was setting in to the westward of the Northerly winds in the above Table.

From 34° to 37° S. and from 104° to 117° E. , the following winds and weather were experienced by four vessels :—

Dominick Daly :—34° 26' S.; 104° 27' E.; wind S.W. (8); heavy sea.

Bon Accord :—36° 43' S.; 113° 4' E.; wind N.W. (9); bar. 29·80; cloudy.

Prince of the Seas :—36° 33' S.; 112° 59' E.; wind W.N.W. (6); cloudy, squally.

Zoe :—35° S.; 116° 47' E.; wind W.N.W. (8); cloudy, squally.

The wind with the *Dominick Daly* veered on the previous day from N.W. to W. and S.W., and it veered with the other vessels in the same way, but at a later period.

SATURDAY, THE 11TH OF FEBRUARY.—The N.E. Trade extended on this day to about 4° S. and 70° E., and, farther west, apparently to 13° S.

At the same time, the S.E. Trade prevailed from about 27° S. and 96° E. to 10° or 8° S. and 78° to 67° E.—and between it and the N.E. Trade there were light airs and calms.

Over all those parts of the Ocean the weather was fine, and the wind generally light.

But from 48° to 64° E. the weather had a different character; and there was evidently a rotatory movement of the atmosphere round a point to the W.N.W.-ward of Mauritius. The following Table shows the winds, positions, &c. of the vessels between those meridians :—

Marquise :—36° 52' S.; 53° 9' E.; wind variable (5); fine.

Good Hope :—34° 8' S.; 50° 47' E.; wind S.E. (6); bar. 30·27; clear.

Tullochgorum :—32° 23' S.; 61° 1' E.; wind S.E. (6); cloudy, huzy with rain,

Seallow :—25° 40' S.; 48° 57' E.; wind S.E. (5).

Lord of the Isles :—24° 45' S.; 52° 21' E.; wind S.E. (5); bar. 29·541; down topgallant yards.

(Str.) *Thunder* :—24° 6' S.; 57° 25' E.; wind E. (9); bar. 29·944; cloudy, hazy with drizzling rain.

Marie Sarah :—17° 30' S.; 51° 11' E.; wind S.W. (6); bar. 29·92; cloudy, squally; heavy cross sea.

Vanguard :—12° 39' S.; 57° 52' E.; wind N.N.E. to N. (2); bar. 29·978; ther. 85°; fine.

Chillingham :—19° 17' S.; 56° 30' E.; wind N.E. (9); cloudy, squally with rain.

Radnagore :—18° 51' S.; 63° 34' E.; wind E. by S. to E.; bar. 30·01; ther. 86°.

Flatworth :—19° 4' S.; 62° 34' E.; wind S.E. to E. by S. (4); cloudy.

Mona :—19° 39' S.; 62° 22' E.; wind E. (5); fine.

The following observations were taken at Port Louis :—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·914	78·0	77·0	73·5	E.N.E.	2·00	o.; fine.
9½ "	29·968	81·0	80·0	75·5	N.E.	2·50	o. g. p. q.
3¼ P.M.	29·910	82·0	79·5	75·5	N.E.-ward	1·50	o. p. q.
9½ "	29·942	80·0	79·0	76·0	N.E.	0·50	o. g.

We see that the barometer was still falling, though there was little difference in the direction and force of the wind.

It would appear that the wind blew with greatest force in a line drawn from the *Thunder* to the *Chillingham*.

With the former vessel, the gale, in the afternoon, increased to a hurricane from E. by S. "At 4 P.M., heavy gales with a tremendous confused sea making a complete sweep over the ship; in fore-staysail (bar. 29·97 Index Error,—0·86). At 6, blowing a complete hurricane, with thick drizzling rain at times, &c.; a fearful sea running and making a complete sweep over the decks. At 6·30, shipped two very heavy seas forward; stove in fore skylight, port bow life-boat, &c. Midnight, hurricane still blowing with terrific violence; barometer 29·95."

It is plain that the wind was not blowing in a circle, at least at some distance from the centre; for we have positive proof that the centre did not bear either N. or N. by E. of the *Thunder*, when that vessel had the wind from E.

The centre must have been between the *Chillingham* and the *Marie Sarah*, in about 19° S. and 53° 45' E.; and if the *Thunder* had run to the westward, she would have got into worse weather.

It is impossible, therefore, to avoid the conclusion, that the storm was a contest between a Northerly and a Southerly stream of air. The Northerly winds appear to press against the Trade, deflecting it to E.N.E., on the eastern side of the storm; and the Trade, farther west, as if meeting with less resistance there, sweeps round on the western side of the storm, forming Southerly and S.W.-ly winds.

The direction of the wind with the *Vanguard*, *Mona*, and *Tullochgorum*, beyond the outer circles of the storm, was towards the centre.

From 37° to 41° S. and from 16° to 38° E., we have the two counter-winds which were observed yesterday, as will be seen from the following statements:—

Prince:—37° 50' S.; 38° 52' E.; wind E. (6); clear.

Jalawar:—38° 45' S.; 36° 7' E.; wind N. by E. (5); clear.

Isis:—40° 17' S.; 33° 7' E.; wind E.N.E. (3); clear.

Jeanne de Montfort:—39° 55' S.; 21° 39' E.; wind N.N.E. (2); fine.

Robert and Alexander:—40° 9' S.; 19° 20' E.; wind S.E. (2); fine.

Centaur:—37° 9' S.; 19° 31' E.; wind S. (2); bar. 30·214; ther. 68°; clear.

Louis Gaveaux:—37° 44' S.; 16° 29' E.; wind N. (2); fine.

As a general rule, these N.E.-ly winds always appear when a S.E.-ly wind prevails to the N.E.-ward, as on the present occasion.

The *Louis Gaveaux* had the wind at noon from N., but it veered to N.W., and at 4 P.M. was from S.W.

Between 34° and 37° S., and between 104° and 115° E., the *Dominick Daly*, *Bon Accord*, and *Zoe*, had the wind from W. by N. to N.W.

SUNDAY, THE 12TH OF FEBRUARY.—In the northern part of the Ocean we find the N.E. Trade stretching to 10° S., as observed by the following vessels:—

Adelaide:—13° 32' N.; 87° 10' E.; wind Northerly (2); bar. 30·012; ther. 82°; clear.

Bentinck:—12° 56' N.; 83° 29' E.; wind E.N.E. (2); sultry.

Lafayette:—4° 11' N.; 80° 38' E.; wind N.E. (2); fine.

Grassmere:—3° 10' S.; 80° 9' E.; wind N. by E. (2); cloudy, with passing showers.

Launceston :—4° 15' S.; 69° 56' E.; wind N.W. (5); squally with rain.

Martha :—4° 35' S.; 81° 27' E.; wind N.W. (1); fine.

Black Friar :—6° 21' S.; 67° 50' E.; wind N.N.W. to N. (2); bar. 29·942; ther. 83°; fine.

Rosalie :—7° 25' S.; 80° 20' E.; wind N.E.; cloudy.

Narwhal :—9° 28' S.; 77° 54' E.; wind N. by E. (2); bar. 30·026; ther. 82°; fine.

To the southward and eastward of these vessels the S.E. Trade prevailed.

From 10° S. to beyond 30° S., and from 48° to 63° E., there was at noon a vast whirlwind, as the following observations show:—

Marquise :—34° 42' S.; 53° 23' E.; wind E.S.E. (5); cloudy; a swell on.

Good Hope :—32° 14' S.; 51° 21' E.; wind E.S.E. (4); bar. 30·22; clear; at 5 P.M. double-reefed fore-topsail.

Tullochgorum :—29° 52' S.; 60° 6' E.; wind E. (5); cloudy.

Swallow :—25° S.; 51° 30' E.; wind S.E. (9); cloudy.

Lord of the Isles :—24° 22' S.; 51° 27' E.; wind S.E. (9); bar. 29·621; squally, rain.

Marie Sarah :—17° 16' S.; 50° 19' E.; wind S.W. (7); bar. 30·00; heavy cross sea; midnight, lightning.

(Str.) *Emeu* :—9° 45' S.; 55° 38' E.; wind W. to W.S.W. (2); bar. 30·03; fine; at 4 A.M. ther. 85°.

Radnagore :—19° 32' S.; 61° 24' E.; wind E.N.E. (4); bar. 29·93; ther. 82°; gloomy; a short sea from westward.

Flatworth :—19° 47' S.; 60° 23' E.; wind E.N.E. (4); squally, rainy.

Mona :—19° 40' S.; 60° 15' E.; wind N.E. (5); squally, rainy.

Mallard :—19° 59' S.; 59° 18' E.; wind N.N.E. (2); bar. 29·946; squally, rain; windy appearance.

Chillingham :—21° 28' S.; 56° 6' E.; wind N.N.E. (8); squally, rain.

(Str.) *Thunder* :—23° 44' S.; 57° 35' E.; wind E. (10); bar. 29·874; drizzling rain, squally.

Observations taken at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·894	79·5	78·0	75·5	N.N.E.	0·30	o. r.
9½ "	29·948	81·5	80·0	76·0	N.-ward	0·40	o.; fine
3½ P.M.	29·900	84·0	82·5	77·0	N.W.	0·40	o.; fine
9½ "	29·942	81·5	80·0	76·0	Calm	0·00	fine; light haze

The gale blew with greatest violence from N.N.E., E., and S.E., to the southward of the island. But though the wind had decreased at Port Louis, the barometer stood somewhat lower than on the previous day.

In the morning the *Thunder* had still a hurricane from E., with a fearful heavy sea. At 2 A.M. ship inclining to fall off; set close-reefed mizen, &c. At 4,

terrific squalls, with thick rain (bar. 29·91); ship labouring heavily and straining fearfully. At 8, still blowing a complete hurricane, with a cross confused mountainous sea; tacked ship to eastward, and took in the fore mizen topsail. Noon, less wind, but terrific squalls and thick drizzling rain; a tremendous sea running.

Lat. (D. R.) $23^{\circ} 44'$ S.; Long. (D. R.) $57^{\circ} 35'$ E.:—"P.M.—Gale still blowing with tremendous force; thick drizzling rain, with a high cross sea, and breaking heavily over the ship. At 4, a sea struck the ship on the port bow, starting bulwarks, &c.; wind N.E.; barometer 29·93. At 8, longer intervals between the squalls; a terrific sea. Midnight, gale abating; dense masses of cloud breaking away in patches; stars visible for a few moments, but terrific squalls—and rain at times."

The centre of the storm did not bear north of the *Thunder* at noon; and therefore the wind with her was not moving in a circle, if she had it from E.

From the winds and positions of the *Marie Sarah* and *Chillingham*, and the weather at Port Louis, we infer that the centre was in $20^{\circ} 30'$ S. and 53° E.

Hence the storm travelled, since the previous noon, S. $42^{\circ} 50'$ W. 122 miles, or at the rate of about 5 miles per hour.

The observations show that the western side of the cyclone was formed by the S.E. Trade, which curved from S.E. to S. and S.W., over a great extent in latitude, giving the storm, on that side of it, an elliptical form. It would appear, also, that the N.W. Monsoon formed the eastern side, nearly to the Tropic, where the S.E. Trade, deflected to E., blew with great violence. We should thus have the air moving spirally.

With regard to the extent of the cyclone, its diameter in latitude was about 1400 miles, and in longitude about 800 miles, the force of the wind ranging from light breezes to at least a whole gale.

It will be seen from the following logs that, south and west of the S.E.-ly wind of the cyclone, four vessels were experiencing N.E.-ly winds, while, at some distance to the west of them, the wind was southerly:—

Prince:— $38^{\circ} 29'$ S.; $41^{\circ} 58'$ E.; wind N.E. (5); cloudy.

Jalawar:— $38^{\circ} 41'$ S.; 39° E.; wind N.E. (4); fine.

Isis:— $40^{\circ} 28'$ S.; $35^{\circ} 31'$ E.; wind N.E. (4); squally, rain.

S. G. Glover:— $41^{\circ} 26'$ S.; $48^{\circ} 35'$ E.; wind N.E. (4); cloudy, hazy.

Jeanne de Montfort:— $38^{\circ} 52'$ S.; $25^{\circ} 30'$ E.; wind S.E. (2); fine.

Centaur:— $37^{\circ} 13'$ S.; $20^{\circ} 58'$ E.; wind Southerly (1); bar. 30·214; ther. 68° ; clear.

Robert and Alexander:— $39^{\circ} 49'$ S.; $19^{\circ} 14'$ E.; wind N.W. (5); cloudy; at 4 P.M. wind W.S.W.

Louis Gaveaux:— $37^{\circ} 4'$ S.; $19^{\circ} 8'$ E.; wind S.S.W. (2); fine.

Since noon on the 11th, the Southerly winds had travelled about six degrees to the eastward.

From 33° to 40° S., and from 102° to 119° E., the *Dominick Daly*, *Bon Accord*, *Zoe*, *Prince of the Seas*, and *Fidus*, had the wind from the S.S.W.-ward.

MONDAY, THE 13TH OF FEBRUARY.—At noon, on this day, the N.E. Trade extended to 11° or 12° S. in 78° E., appearing in the Southern Hemisphere as the N.W. Monsoon. This will be seen from the following Table:—

Bentinck:— $14^{\circ} 21'$ N.; $83^{\circ} 18'$ E.; wind N.E. (4); clear, sultry.

Adelaide:— $11^{\circ} 50'$ N.; 86° E.; wind N. (4); bar. 29·962; ther. 82° ; fine.

Lafayette:—1° 39' N.; 79° 10' E.; wind N.E. (5); clear, but at times passing clouds.

Meteor:—1° 26' N.; 79° 25' E.; wind N. by E. (4); bar. 29·962; cloudy, squally.

Lawnceton:—3° 36' S.; 71° 46' E.; wind N.N.W. (5); squally.

Grassmere:—5° 5' S.; 80° 25' E.; wind N. by E.; cloudy, rain.

Martha:—5° 24' S.; 81° 16' E.; wind Northerly (1); squally; midnight squally, rain with thunder and lightning.

Rosalie:—8° 37' S.; 78° 5' E.; wind N.W.-ly (2); squally.

Black Friar:—8° 42' S.; 68° 37' E.; wind N.W. (4); bar. 29·952; ther. 83°; squally, rain.

Narwhal:—11° 19' S.; 77° 38' E.; wind N.W. (6); bar. 29·976; ther. 83°; squally, rain.

From 26° to 16° S. and from 91° to 87° E., three vessels had the S.E. Trade and fine weather.

The winds and weather from 10° to 37° S. and from 49° to 60° E., given below, show that the cyclone still existed in that quarter:—

Marquise:—36° 22' S.; 54° 35' E.; wind E.S.E. (5); fine.

Good Hope:—35° 55' S.; 51° 30' E.; wind E.S.E. (8); bar. 29·97; squally.

Swallow:—25° S.; 48 E.; wind S. (9); lying to.

Lord of the Isles:—24° 19' S.; 49° 58' E.; wind S. to S.W. (9); bar. 30·091; ther. 77°; clear.

Marie Sarah:—17° 16' S.; 50° 11' E.; wind W.S.W. (1); bar. 30·01; fine.

(Str.) *Emeu*:—13° 52' S.; 56° 24' E.; wind W.S.W. (4); bar. 29·98; ther. 82° at 4 A.M.; cloudy, passing showers.

Vanguard:—11° 26' S.; 59° 24' E.; wind W. (4); bar. 29·978; ther. 86°; fine.

Radnagore:—19° 32' S.; 60° 5' E.; wind Easterly (1); bar. 29·93; ther. 84°.

Mona:—19° 40' S.; 58° 45' E.; wind E.N.E. (5); cloudy, rain.

Mallard:—Off Round Island; wind E.N.E. (1); fine.

Chillingham:—21° 46' S.; 58° 4' E.; wind E.N.E. (8); finer.

(Str.) *Thunder*:—23° 7' S.; 57° 27' E.; wind E.N.E.; bar. 29·96; ther. 80°; cloudy,—a heavy sea on.

Tullochgorum:—26° 58' S.; 59° 38' E.; wind E. (5); bar. 29·874; clear.

The following observations were made at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·910	81·0	78·0	76·0	Calm	0·00	c.; fine
9½ " "	29·950	82·5	81·0	76·5	N.-ly	0·30	" "
3½ P.M.	29·920	85·0	83·0	77·5	N.W.	0·30	o.; fine
9½ " "	29·940	82·0	81·0	76·5	"	0·20	b. c.; fine

From these observations we infer that the centre at noon was in about 25° 15' S. and 52° E.,—to the eastward of the *Lord of the Isles* and *Swallow*.

During the preceding 24 hours, therefore, the storm travelled S. $10^{\circ} 57'$ W. 290 miles, or at the hourly rate of 11·25 miles.

The directions of the wind, as given in the log-books, do not show that the gale was circular at a distance from the centre. We have, as yesterday, the Southerly winds gently curving over many degrees of latitude, and, in about 11° S., apparently veering sharply to W., and meeting the N.W. Monsoon, which forms the eastern side of the storm, the N.E.-ly winds, as they advance to the southward, deflecting the S.E. Trade to east, as was observed yesterday in the case of the *Thunder*, and is on this day observed in that of the *Tullochgorum*.

In the space from 37° to 42° S. and from 22° to 42° E., the wind with four vessels was from N.E.-ward, and with three from Southward. The positions, &c., of those vessels were as follows:—

Samuel G. Glover:— $41^{\circ} 41'$ S.; $51^{\circ} 45'$ E.; wind N.E. (2); fine.

Prince:— $38^{\circ} 21'$ S.; $44^{\circ} 41'$ E.; wind N.E. (2); fine.

Jalawar:— $38^{\circ} 54'$ S.; $42^{\circ} 5'$ E.; wind N.E. (3); fine.

Isis:— $40^{\circ} 14'$ S.; $87^{\circ} 30'$ E.; wind N.E. by N. (3); fine.

Jeanne de Montfort:— $37^{\circ} 28'$ S.; $29^{\circ} 51'$ E.; wind S.S.W. (5); fine.

Robert and Alexander:— $39^{\circ} 17'$ S.; 26° E.; wind S.S.E. (4); clear,—a heavy sea on.

Centaur:— 38° S.; 22° E.; wind S.S.W. (5); bar. 30·164; ther. 66° ; cloudy, drizzling rain.

At some distance to the northward of the *Robert and Alexander* the wind was from N.W. at noon, and then from W.S.W.

The Southerly wind was still moving laterally to the eastward.

In 30° to 40° S. and from 101° to 118° E. the wind, as yesterday, was from the Southward, and appeared to be the S.E. Trade.

TUESDAY, THE 14TH OF FEBRUARY.—From noon on the 13th to noon on this day, the N.W. Monsoon advanced still farther to the southward, being now at, if not beyond, the Tropic, as will be seen from the following logs:—

Napoleon:— $16^{\circ} 3'$ N.; 89° E.; wind N.E. (2); bar. 29·95; fine.

Adelaide:— $9^{\circ} 50'$ N.; $85^{\circ} 53'$ E.; wind N. (6); bar. 29·912; ther. 83 ; clear.

Meteor:— $0^{\circ} 6'$ S.; $78^{\circ} 33'$ E.; wind N.E. (2); bar. 29·961; fine.

Lafayette: $0^{\circ} 16'$ S.; $81^{\circ} 11'$ E.; wind E.N.E. (5); A.M. thunder and lightning; noon, cloudy.

Launceston:— $3^{\circ} 27'$ S.; $73^{\circ} 28'$ E.; wind N.N.W. (5); squally, rain.

Martha:— $6^{\circ} 48'$ S.; $81^{\circ} 16'$ E.; wind N.W. (2); cloudy, squally with rain; noon, fine.

Black Friar:— $9^{\circ} 57'$ S.; $68^{\circ} 57'$ E.; wind N.W.-ly (1, 2); bar. 29·862; ther. 84° ; cloudy, squally appearance.

Rosalie:— $10^{\circ} 10'$ S.; $78^{\circ} 5'$ E.; wind W.; squally.

Narwhal:— $12^{\circ} 17'$ S.; $76^{\circ} 59'$ E.; wind N.W. (6); bar. 29·936; ther. 83° ; squally, with rain; noon, fine.

St. Bernard:— $14^{\circ} 47'$ S.; $69^{\circ} 49'$ E.; wind N.W. by W. (2); bar. 29·74; cloudy, squally appearance.

Joseph Bushby:— $16^{\circ} 42'$ S.; $86^{\circ} 27'$ E.; wind E. by N. (2); bar. 29·97; fine.

Mandarin:— $19^{\circ} 52'$ S.; $86^{\circ} 48'$ E.; wind N. by E. (5); squally, threatening appearance.

Emily Smith:— $19^{\circ} 56'$ S.; $77^{\circ} 18'$ E.; wind W.N.W. (2); cloudy.

Chillingham:— $22^{\circ} 47'$ S.; $59^{\circ} 9'$ E.; wind N.E. (5); fine.

Jemmy:— $24^{\circ} 43'$ S.; $88^{\circ} 6'$ E.; wind E.N.E.; cloudy.

Tullochgorum:— $24^{\circ} 56'$ S.; $59^{\circ} 10'$ E.; wind N.E. (4); cloudy, fine.

The Monsoon seems to have been a continuation of the N.E. Trade.

South of the Monsoon we have the S.E. Trade, or at all events a S.E.-ly wind; and the vessels next the Monsoon, as the *Jemmy*, *Tullochgorum*, and *Chillingham*, have the wind from N.E.-ward, as if the S.E. Trade were being deflected.

Several degrees to the S. W.-ward of the two last-named vessels, there were strong gales from the Southward, the S.E. Trade apparently still curving round on the western side of the storm. The winds and positions of those vessels were as follows:—

Good Hope:— $30^{\circ} 24'$ S.; $51^{\circ} 13'$ E.; wind E.S.E. (10); bar. 29.77; squally rain.

Lord of the Isles:— $25^{\circ} 44'$ S.; $50^{\circ} 32'$ E.; wind W.S.W. (9); squally, rain.

Swallow:— 25° S.; $48^{\circ} 50'$ E.; wind S. (9); squally, rain; lying to.

(Str.) *Emeu*:— $17^{\circ} 33'$ S.; $57^{\circ} 3'$ E.; wind S. (2); bar. 29.90; fine.

Vanguard:— $9^{\circ} 53'$ S.; $60^{\circ} 44'$ E.; wind S.W. (5); bar. 29.878; ther. 84° ; overcast; squally.

It would appear from these observations that the S.E. Trade extended from at least 31° S. to 10° S., becoming Southerly and S.W.-ly as it approached the Equator; and comparing the winds in the above Table with those of the *Black Friar*, *St. Bernard*, *Chillingham*, and *Tullochgorum*, we obtain a figure resembling an elongated ellipse, the centre of the storm being in front, where the Monsoon and Trade were in conflict.

The observations taken at Port Louis were as follows:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29.858	80.0	79.0	75.5	S.-ward	0.04	c. p.
9½ „	29.920	82.0	81.0	76.0	Calm	0.00	c.; fine
3¼ P.M.	29.880	86.0	84.0	77.5	W.N.W.	0.30	b. c.
9½ „	29.936	82.0	80.0	75.5	Calm	0.00	Clear

The barometer had now reached its minimum, although the weather had improved.

From the winds and positions of the *Good Hope* and *Lord of the Isles* (the vessels which were experiencing the strength of the storm) we infer that the centre at noon was in $27^{\circ} 48'$ S. and 52° E.

Hence the storm travelled, since the previous noon, S. 153 miles.

The following observations will show that the extra-tropical counter-winds still existed:—

Prince:— $38^{\circ} 29'$ S.; $46^{\circ} 16'$ E.; wind E. to N.E. (2, 4); fine.

Jalawar:— $38^{\circ} 26'$ S.; 44° E.; wind N.E. by N. (2); fine.

Isis:—39° 44' S.; 39° 56' E.; wind N. by E. (3); fine.

Jeanne de Montfort:—37° 40' S.; 31° 7' E.; wind S.W. (5); cloudy.

Robert and Alexander:—37° 25' S.; 25° 21' E.; wind S.E. (4); cloudy, fine.

Centaur:—37° 10' S.; 24° 42' E.; wind S.S.E. (5); bar. 30·314; cloudy, squally.

Louis Gaveaux:—37° S.; 24° 19' E.; wind S.W. to S. (5); cloudy, fine.

Juliet Erskine:—37° 44' S.; 15° 45' E.; wind S.S.E. (4); bar. 30·102; ther. 65°; fine.

The *Royal Arthur*, about eight miles S.W. by S. of Cape St. Francis, had a fresh breeze from W.N.W., with fine weather, the barometer standing at 29·97, and the thermometer at 74°.

Four vessels from 37° to 29° S. and from 114° to 99° E. had Southerly and S.E.-ly winds, with fine weather.

WEDNESDAY, THE 15TH OF FEBRUARY.—It would appear that at noon of this day the N.W. Monsoon still extended to the Tropic, and that it was, apparently, a continuation of the N.E. Trade; but for greater satisfaction the positions, &c., of the vessels are given below:—

Bentinck:—16° 55' N.; 84° E.; wind N.E. (2); fine.

Napoleon:—14° 31' N.; 88° 28' E.; wind E. (3); bar. 30·016; fine.

Vauban:—9° 29' N.; 85° 59' E.; wind E. (6); cloudy.

Adelaide:—8° 9' N.; 85° E.; wind N.N.E. (6); bar. 29·962; ther. 83°; cloudy, fine.

Meteor:—1° 23' S.; 78° 56' E.; wind N.W. (1); bar. 29·961; sultry.

Lafayette:—2° 7' S.; 81° 59' E.; wind Northerly (1); cloudy.

Launceston:—3° 11' S.; 74° 48' E.; wind N.E. to N. (5); cloudy.

Grassmere:—6° S.; 80° 30' E.; wind N. by E. (2); cloudy.

Martha:—8° 45' S.; 80° 53' E.; wind Westerly (3, 6); cloudy.

Rosalie:—11° 38' S.; 78° 6' E.; wind N.W.; squally.

Black Friar:—11° 21' S.; 69° 34' E.; wind N.W.; bar. 29·942; ther. 83°; fine.

Narwhal:—13° 12' S.; 76° 7' E.; wind N.N.W. (4); bar. 29·946; ther. 82°; cloudy.

St. Bernard:—15° 34' S.; 68° 47' E.; wind N.W. by W. (6); bar. 29·86; ther. 82°; squally, rain.

Emily Smith:—20° 47' S.; 76° 27' E.; wind W.N.W. (2).

Mandarin:—20° 22' S.; 83° 58' E.; wind N.W. (5); finer.

Chillingham:—23° 55' S.; 60° 22' E.; wind E.N.E. (4); fine.

Tullochgorum:—24° 26' S.; 59° 7' E.; wind N.N.E. (2); clear.

The following observations were made at Port Louis:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Dirac- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·876	79·0	77·0	72·5	Calm	0·00	b.; fine
9½ „	29·940	83·5	82·0	75·5	N.E.-ward	0·20	b. c.; fine
3½ P.M.	29·900	85·0	85·0	78·0	N.W.	0·30	„ fine
9½ „	29·970	81·0	79·0	74·0	Calm	0·00	b.; fine

The winds and weather experienced by the *Swallow*, *Lord of the Isles*, and *Good Hope*, at noon on this day, were as follows:—

Swallow:— $24^{\circ} 40'$ S.; $48^{\circ} 20'$ E.; wind S.W. (5); squally.

Lord of the Isles:— $26^{\circ} 32'$ S.; $50^{\circ} 31'$ E.; wind W. (5); cloudy, squally.

Good Hope:— $28^{\circ} 5'$ S.; $52^{\circ} 19'$ E.; wind W.N.W. (9); bar. 29.57; cloudy, squally.

Since noon on the 14th the wind with the *Swallow* veered from S. to S.W.; with the *Lord of the Isles* from W.S.W. to W.; and with the *Good Hope* from S.E. to W.N.W., through the S.

The log of the *Good Hope* states that at 4 P.M. on the 14th the wind (then at S.) began to veer to the Westward at the rate of one point per hour. "At 6, steady gale; barometer 29.53. At sunset, observed all the sky of a brick-red appearance. Midnight, heavy gales and hard squalls." On this day (the 15th) the gale continued with her till 4 P.M., when it began to moderate.

The centre of the storm was probably in $28^{\circ} 50'$ S. and 52° E., which gives for the course and rate, since the previous noon, S. 62 miles.

It does not appear that the greater diameter of the cyclone exceeded 1000 miles.

From 37° to 27° S., and from 93° to 116° E., five vessels had the wind still from the S.E.-ward, with fine weather. These S.E.-ly winds were, apparently, the Trade-wind which had been driven back by the N.W. Monsoon, the line or belt of variables being south of the Tropic.

The rotatory gale on the western side of the ocean seems to have been still between the Trade and Monsoon; for the *Marquise*, in 36° S. and $55^{\circ} 48'$ E., had a light breeze from S.E., while to the N.E.-ward of the storm the winds were Northerly.

There is reason to think also that the wind forming the western side of the gale extended as a S.W.-ly current to 8° S. and $62^{\circ} 13'$ E., where the *Vanguard* had a fresh breeze from S.W.

An inspection of the following logs will show that the extra-tropical counter-winds still prevailed, and that they had, since noon on the 14th, travelled 6 or 7 degrees to the eastward:—

Prince:— 38° S.; $47^{\circ} 35'$ E.; wind N.E. (2); fine.

Jalawar:— $38^{\circ} 15'$ S.; $46^{\circ} 15'$ E.; wind N.W. (4); cloudy, misty.

Isis:— $38^{\circ} 50'$ S.; $42^{\circ} 47'$ E.; wind S. by W. (4); cloudy, passing showers.

Jeanne de Montfort:— $36^{\circ} 55'$ S.; $33^{\circ} 27'$ E.; wind S.S.E. (5); cloudy, rain.

Centaur:— $36^{\circ} 15'$ S.; $26^{\circ} 39'$ E.; wind S.S.E. (5); bar. 30.264; ther. 78° ; cloudy.

Louis Gaveaux:— $35^{\circ} 39'$ S.; $26^{\circ} 14'$ S.; wind S.S.E. (5); fine.

Juliet Erskine:— $36^{\circ} 25'$ S.; $18^{\circ} 11'$ E.; wind S.S.E. (6); bar. 29.952; ther. 70° ; heavy sea.

In the night of the 14th to the 15th, the wind with the *Isis* passed from N. by E. to S. by W., but whether it veered or shifted is not stated.

The *Robert* and *Alexander*, in $89^{\circ} 18'$ S., and $26^{\circ} 53'$ E., had a fresh breeze from the N.E. by E., with fine weather; so that, if no error has been committed in recording the direction of the wind, it is evident that the S.E.-ly winds did not prevail farther south than the 38th or 39th parallel, at least in 27° E.; and this would lead us to suppose that the Southerly winds were the polar winds making their appearance at the surface, while the N.E.-ly wind was the equatorial current.

THURSDAY, THE 16TH OF FEBRUARY.—The N.W. Monsoon was still extending as far south as the Tropic, but becoming light and unsteady, as will be seen from the following observations:—

Bentinck:— $17^{\circ} 32'$ N.; $85^{\circ} 5'$ E.; wind E.N.E. (4); clear and fine.

Eurine:— $13^{\circ} 32'$ N.; 70° E.; wind N. (2); bar. 30.00; fine.

Napoleon:— $12^{\circ} 38'$ N.; $88^{\circ} 3'$ E.; wind E. by S. (3); bar. 30.106; fine.

Vauban:— $6^{\circ} 49'$ N.; $87^{\circ} 4'$ E.; wind E. (6); cloudy and squally.

Adelaide:— $5^{\circ} 58'$ N.; $85^{\circ} 12'$ E.; wind N. (6); bar. 29.962; ther. 83° ; cloudy and squally.

Meteor:— $2^{\circ} 44'$ S.; $79^{\circ} 19'$ E.; wind N.E. (1); bar. 29.961; sultry.

Launceston:— $3^{\circ} 5'$ S.; $76^{\circ} 12'$ E.; wind N.E. (5); squally, with passing showers.

Grassmere:— $6^{\circ} 27'$ S.; $80^{\circ} 35'$ E.; wind S.W. and variable (1 to calm).

Vanguard:— $6^{\circ} 45'$ S.; $64^{\circ} 16'$ E.; wind W. (5); bar. 29.978; ther. 85° ; fine.

Martha:— $9^{\circ} 48'$ S.; $80^{\circ} 41'$ E.; wind S.W. (1); fine.

Rosalie:— $12^{\circ} 22'$ S.; $75^{\circ} 30'$ E.; wind variable; cloudy.

Black Friar:— $13^{\circ} 8'$ S.; $70^{\circ} 14'$ E.; wind variable (2); bar. 29.882; ther. 87° ; cloudy; showers.

Narwhal:— $14^{\circ} 2'$ S.; $74^{\circ} 46'$ E.; wind N.W. (4); bar. 29.964; ther. 83° ; cloudy, but fine.

St. Bernard:— $16^{\circ} 10'$ S.; $68^{\circ} 45'$ E.; wind N.N.W. (2); bar. 29.76; ther. 83° ; sultry.

Joseph Bushby:— $16^{\circ} 59'$ S.; $83^{\circ} 20'$ E.; wind N. by W.; bar. 29.97; fine.

Mandarin:— $21^{\circ} 3'$ S.; 83° E.; wind W.N.W. (1); clear and sultry.

Jemmy:— $24^{\circ} 40'$ S.; 82° E.; wind W.N.W. (2, 1); fine.

Emily Smith:— $20^{\circ} 49'$ S.; $75^{\circ} 5'$ E.; wind S.E. (2); cloudy.

Tullochgorum:— $24^{\circ} 5'$ S.; $59^{\circ} 29'$ E.; wind N.W. and variable (1 to calm); cloudy.

The *Emily Smith* had now the S.E. Trade. The wind veered with her from W.N.W. to W., S.W., S., and S.E.

The observations taken at Port Louis were as follows:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29.926	80.0	79.0	74.0	Calm	0.00	b.; fine
9½ „	29.964	83.0	82.0	75.5	N.-ward	0.30	c.; fine
3½ P.M.	29.968	82.5	79.5	73.5	E.S.E.	1.00	o. p.
9½ „	30.084	80.0	79.0	71.8	Calm	0.00	b.; fine

We perceive from these observations that the barometer was now rising so rapidly that its usual oscillations were masked.

From 26° to 30° S. and from 95° to 101° E., three vessels had S.E. Trade and fine weather.

Between the Tropic and 38° S., and from 45° and 56° E., the winds and weather, as shown by the following logs, were still indicative of a revolving gale :—

Marquise :— $33^{\circ} 58'$ S. ; $55^{\circ} 20'$ E. ; wind S.S.E. (6, 7) ; cloudy with rain ; heavy sea.

Prince :— $35^{\circ} 30'$ S. ; $49^{\circ} 55'$ E. ; wind S. and S.S.E. (7) ; cloudy ; fine.

Jalawar :— $36^{\circ} 33'$ S. ; $49^{\circ} 44'$ E. ; wind S. (6) ; cloudy ; fine.

Isis :— $37^{\circ} 20'$ S. ; $45^{\circ} 20'$ E. ; wind S.E. by E. ; fine.

Lord of the Isles :— $27^{\circ} 22'$ S. ; $50^{\circ} 7'$ E. ; wind S.W. (5) ; squally, with rain.

Swallow :— $24^{\circ} 28'$ S. ; $48^{\circ} 53'$ E. ; wind S.W. (4) ; fine.

Good Hope :— $27^{\circ} 18'$ S. ; $55^{\circ} 46'$ E. ; wind W.N.W. (8) ; bar. 29.79 ; cloudy and squally.

It is probable that the centre at noon was in 30° S. and $53^{\circ} 30'$ E. If that was its position, it travelled, since the previous noon, S. $33^{\circ} 7'$ E. 83.5 miles.

We have not, however, a sufficient number of observations to determine the centre with precision.

Comparing the observations of this day with those of the 15th, we see that the wind with the *Marquise* was still from S.E., and much stronger ; but that with the *Prince* and *Jalawar*, instead of being from the northward, as on the 15th, it was now from the southward.

The change of wind with those two vessels took place through the west, as had previously been the case with the *Isis*, the wind, apparently, shifting to S., when it came to N.W. or W.

Beyond this day, then, we cannot trace the extra-tropical counter-winds, the Northerly winds having disappeared, while the Southerly were now forming the south-western side of the cyclone, as if advancing from the westward, whilst the cyclone was travelling to the southward, they had come up with its southerly winds, and coalesced with them.

West of the Southerly winds (as generally, if not always, happens on such occasions) we find the wind becoming Easterly and then Northerly. Thus, the *Jeanne de Montfort*, in $37^{\circ} 50'$ S. and $35^{\circ} 44'$ E., had a fresh breeze from E.N.E.-ward, with fine weather ; and the *Robert and Alexander*, in $40^{\circ} 3'$ S. and $29^{\circ} 51'$ E., had a fresh breeze from N.

To the westward of those vessels, again, there was a Southerly wind.

FRIDAY, THE 17TH OF FEBRUARY.—At noon on this day the N.W. Monsoon still extended far south ; but the S.E. Trade was encroaching upon it. The following are the observations at that hour :—

Chowringhee :— $20^{\circ} 28'$ N. ; $88^{\circ} 21'$ E. ; wind N.W. (4) ; fine.

Bentinck :— $17^{\circ} 46'$ N. ; $85^{\circ} 17'$ E. ; wind N.E. (2) ; fine.

Eurine :— $12^{\circ} 10'$ N. ; $70^{\circ} 6'$ E. ; wind N. (2) ; bar. 30.00 ; fine.

Napoleon :— $10^{\circ} 42'$ N. ; $87^{\circ} 9'$ E. ; wind E. (5) ; bar. 30.106 ; fine.

Fauban :— $5^{\circ} 14'$ N. ; $85^{\circ} 15'$ E. ; wind E. (1) ; cloudy, rain.

Adelaide :— $4^{\circ} 38'$ N. ; $83^{\circ} 20'$ E. ; wind S.E. (1) ; bar. 29.962 ; ther. 82° ; cloudy, fine.

Launceston :— $2^{\circ} 49'$ S. ; $77^{\circ} 30'$ E. ; wind N. by E. (2) ; cloudy, squally.

Meteor :— $3^{\circ} 9'$ S. ; $79^{\circ} 37'$ E. ; wind W.N.W. (2) ; sultry.

Lafayette :— $3^{\circ} 54'$ S. ; $80^{\circ} 42'$ E. ; wind W. (1) ; cloudy.

Vanguard:— $6^{\circ} 4' S.$; $66^{\circ} 8' E.$; wind N.N.E. (2); bar. 30·078; ther. 84° ; fine.

Grassmere:— $7^{\circ} 11' S.$; $80^{\circ} 3' E.$; wind variable; cloudy, with passing showers and squalls.

Martha:— $11^{\circ} 7' S.$; $80^{\circ} 41' E.$; wind N.W. (3); cloudy, fine.

Rosalie:— $13^{\circ} 6' S.$; $77^{\circ} 50' E.$; wind N.W. and variable; squally.

Narwhal:— $15^{\circ} 29' S.$; $73^{\circ} 45' E.$; wind W.N.W. (5); bar. 30·016; ther. 83° ; fine.

St. Bernard:— $16^{\circ} 24' S.$; $68^{\circ} 13' E.$; wind N. by W.; bar. 30·03; ther. 86° ; fine; sultry.

Joseph Bushby:— $16^{\circ} 56' S.$; $82^{\circ} 50' E.$; wind N. by W. and W. to S.W.; bar. 30·03; fine.

Good Hope:— $25^{\circ} 6' S.$; $57^{\circ} 45' E.$; wind N. (4); bar. 29·97; cloudy, with passing showers.

In $20^{\circ} 56' S.$ and $81^{\circ} 56' E.$, the *Mandarin* had a fresh breeze from S., which was the Trade-wind. At noon, on the 16th, she had light airs from W.N.W.; and in the afternoon she got a light breeze from S., after calms, there having apparently been no veering of the wind.

West of the *Mandarin*, the *Emily Smith*, in $21^{\circ} 5' S.$ and $74^{\circ} 44' E.$, had the Trade moderate from S.E.

The observations taken at Port Louis were as follows:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·988	79·0	78·0	73·5	Calm	0·00	b.; fine
9½ „	30·030	82·0	81·0	74·5	W.-ward	0·20	b. c.; fine
3½ P.M.	30·030	86·5	85·0	76·0	W.N.W.	0·30	b.; fine
9½ „	30·050	80·5	79·5	74·0	S.E.-ward	0·20	„

To the southward and S.W.-ward of the *Good Hope* the wind was from the S.E.-ward as observed by five vessels; so that the wind with the *Good Hope*, several degrees to the eastward of those vessels, being from the N., we have signs of two contrary streams of air (the Trade and Monsoon), but no evidence that they formed a revolving gale.

From 36° to $38^{\circ} S.$, and from 30° to $47^{\circ} E.$, the wind was from the N.E.-ward; and west of $30^{\circ} E.$ from the S.-ward. We have, therefore, a third system of extra-tropical counter-winds.

The following were the positions, &c., at noon, of the vessels which experienced those different winds:—

Swallow:— $25^{\circ} S.$; $48^{\circ} E.$; wind S.E. (2); fine.

Lord of the Isles:— $27^{\circ} 48' S.$; $47^{\circ} 16' E.$; wind S.E. (5); fine.

Prince:— $33^{\circ} 26' S.$; $51^{\circ} 29' E.$; wind S.E. (7); cloudy.

Marquise:— $34^{\circ} 16' S.$; $56^{\circ} 39' E.$; wind S.E. (5); cloudy; heavy sea on.

Jalawar:— $34^{\circ} 30' S.$; $51^{\circ} 23' E.$; wind S.E. by E. (4); cloudy; fine.

Iris:—36° 56' S.; 46° 17' E.; wind E.N.E. (2); fine.

Jeanne de Montfort:—38° 27' S.; 38° 53' E.; wind N.E. (5); cloudy; fine.

Louis Gaveaux:—37° 13' S.; 29° 44' E.; wind E.N.E. (4); cloudy; rain.

Centaur:—37° 4' S.; 30° 21' E.; wind S.S.W. (5); bar. 30·194; ther. 78°; cloudy; rain.

Robert and Alexander:—39° 39' S.; 31° 44' E.; wind S.E. (4); cloudy; rain.

Juliet Erskine:—37° 5' S.; 21° 14' E.; wind S.S.W.; bar. 30·042; ther. 67°; cloudy; fine.

Royal Arthur:—34° 30' S.; 19° E.; wind S.E. (5); bar. 30·061; ther. 68°; fine.

In the afternoon, the wind with the *Louis Gaveaux* veered to E., and at 4 P.M. was strong from S.E.

At noon on the 16th, the *Centaur*, in 36° 19' S. and 28° 4' E., had a strong breeze from E.N.E., and shortly afterwards a strong breeze from S.S.W.

It is not stated whether the wind veered or shifted with these vessels; but it is plain that the third system of Southerly and Northerly winds was travelling to the eastward.

SATURDAY, THE 18TH OF FEBRUARY.—By noon on this day the S.E. Trade had advanced nearly as far as 10° S. and 80 E.; the *Martha*, *Narwhal*, *St. Bernard*, and other vessels, having now the wind from the Southward, generally in light airs and breezes, and the Trade blowing fresh to the southward of them.

The wind passed from W.N.W. to W.S.W., &c.

From the Equator to 8° S., and from 68° to 84° E., the N.W. Monsoon, as observed by five vessels, was blowing in fresh breezes to moderate gales, with cloudy, squally, rainy weather, and occasional lightning. These vessels had the following winds and weather at noon:—

Launceston:—2° 3' S.; 79° 53' E.; wind Westerly (6); squally; rainy.

Vanguard:—5° 4' S.; 68° 14' E.; wind N. (5); bar. 29·978; ther. 84°; squally.

Meleor:—4° 17' S.; 84° 4' E.; wind W.N.W. (8); bar. 30·051; cloudy; lightning and rain.

Lafayette:—5° 31' S.; 82° 21' E.; wind S.W. to W. by N. (6 to 4); cloudy.

Grasmere:—7° 44' S.; 80° 33' E.; wind N. by E.; squally with rain.

The weather with those vessels was such as is generally found in that locality at the commencement of a hurricane, except that the Trade was very light.

The observations taken at Port Louis were as follows:—

Hour.	Barom. Uncor- rected.	Att. Ther.	Dry Bulb Ther.	Wet Bulb Ther.	WIND.		Weather.
					Direc- tion.	Force in lbs. per sq. foot.	
3½ A.M.	29·888	80·5	79·5	74·5	Calm	0·00	b.; fine
9½ "	30·050	84·0	83·0	75·0	E.N.E.	0·30	b. c.; fine
3½ P.M.	30·000	85·0	82·5	75·0	S.E.	0·20	c.; fine
9½ "	30·034	84·0	82·0	75·0	Calm	0·00	b.; fine

The following observations will show that the system of Northerly and Southerly extra-tropical winds had travelled several degrees to the eastward :—

Isis :— 37° S.; $47^{\circ} 27'$ E.; wind N.E. by N. (2); fine.

Jeanne de Montfort :— $38^{\circ} 21'$ S.; $40^{\circ} 26'$ E.; wind N.E. (2); cloudy; rain.

Robert and Alexander :— $40^{\circ} 50'$ S.; $31^{\circ} 47'$ E.; wind S.E. (2); cloudy; rain.

Louis Gaveaur :— $37^{\circ} 33'$ S.; $31^{\circ} 2'$ E.; wind S.S.E. (6); finer.

Centaur :— $37^{\circ} 18'$ S.; $30^{\circ} 54'$ E.; wind S.E. by S. (6); bar. 30.214; clear; cross sea on.

SUMMARY OF RESULTS.—From the 6th to the 15th of February, the N.W. Monsoon advanced to the Tropic; and it was, apparently, an extension of the N.E. Trade.

The Monsoon then receded, the S.E. Trade taking its place, and on the 18th extending nearly to 10° S.

In passing from S.E. to N.W. the wind veered or shifted by the N.; and in passing from N.W. to S.E., it veered or shifted by the S.; so that it made a complete circuit. But from the time that it was at W. till it came to S. or S.E., there were generally, calms and variables.

The N.W.-ly winds were attended with rainy, squally weather and occasional lightning; and with some vessels the barometer fell about 0.300 of an inch.

At Port Louis the wind veered from E. to N.W. (by the N.), its maximum force being 4 lbs. per square foot; the barometer fell 0.130 of an inch; and the total amount of rain from the 7th to the 12th was 9.425 inches.

The cyclone originated between the Trade and Monsoon, from the 6th to the 10th of the month, a few degrees to the northward of Mauritius. Its course, rate, &c., from the 10th to the 16th, were as follows :—

Date.	Position of Centre at Noon.		Course.	Distance travelled in Miles.	Rate per Hour.	Diameter in Miles.
	Lat.	Long.				
	S.	E.				
	° ,	° ,				
Feb. 11	19 00	53 45		...	...	660 to 900
" 12	20 30	53 00	S. $42^{\circ} 50'$ W.	122.0	5.0	800 to 1400
" 13	25 15	52 00	S. $10^{\circ} 57'$ W.	290.0	11.2	" "
" 14	27 48	52 00	South	153.0	6.4	" "
" 15	28 50	52 00		62.0	2.6	700 to 1000
" 16	30 00	53 00	S. $33^{\circ} 7'$ E.	83.0	3.5	" "

In giving approximate values of the diameter, it is not meant that the wind blew over all the extent indicated, with hurricane violence, or even in strong gales; but that, over that space, it was moving round a central point.

The storm was a contest between the Monsoon and Trade-wind; the Monsoon forming its eastern, and the Trade its western side,—and the two winds moving spirally round the centre.

The Southerly and Northerly winds extended many degrees south and north of the centre, giving the storm an elliptical appearance; and on at least the 11th, 12th, and 13th, the Trade at some distance to the eastward was directed *towards* the centre.

Hence, the bearing of the centre from most of the vessels was not at right angles to the wind's direction.

None of the vessels experienced a central calm.

The barometer of the *Lord of the Isles* fell to 29·541 with the wind at S.E., and rose to 30·091 when the wind had veered, by the S., to S.W. That of the *Good Hope* fell from 30·270 on the 11th, in $34^{\circ} 8' S.$ and $50^{\circ} 47' E.$, with the wind at S.E., to 29·570 on the 15th, in $28^{\circ} 5' S.$ and $52^{\circ} 19' E.$, with a strong gale from W.N.W.

A considerable amount of rain seems to have fallen in the body of the storm; and lightning was sometimes observed in its northern half.

The storm was probably stationary on the 9th and 10th; it afterwards travelled to the southward as the N.W. Monsoon advanced.

South of the 30th parallel, three systems of Southerly and Northerly counter-winds appeared in succession.

The first of these was observed on the 8th, from 46° to $60^{\circ} E.$, the *Good Hope* at noon on that day having a strong gale from S.W., and the *Marquise* and *Tullochgorum*, to the eastward of her, strong and fresh breezes from the N.E.-ward. In the course of the next twenty-four hours the two other vessels also got the wind from S.-ward, after it had veered or shifted by the W.

On the 10th, the second system made its appearance between 14° and $38^{\circ} E.$, and, advancing to the eastward, its Southerly winds, on the 16th, formed the south-western side of the cyclone which had been travelling to the southward.

Up to this time, the S.E.-ly wind of the storm lay between the N.E.-ly counter-wind (south of the 30th parallel) and the N.E.-ly wind forming the eastern side of the storm.

It would seem, therefore, that the N.E.-ly wind south of the 30th parallel, was the N.E.-ly wind of the cyclone, which, after passing above the S.E. wind, had reappeared on the surface.

The third system of counter-winds, which was observed on the 16th, from 18° to $33^{\circ} E.$, also travelled to the eastward.

On the 10th of the month a counter-gale (Northerly and Southerly) occurred in 34° to $37^{\circ} S.$, and from 104° to $117^{\circ} E.$ It, likewise, advanced to the eastward.

There seems to be a constant succession of counter-gales south of the polar limits of the Trade, formed by the polar and equatorial currents of air coming down to the surface and running nearly parallel to each other. But they are (at least at this season of the year), most remarkable when the N.W. Monsoon advances towards the Tropic and a cyclone occurs.

123. The foregoing observations (pp. 152 to 187) by MR. MELDRUM, and especially his *summaries* (pp. 166 to 186), illustrate the fact now generally recognised—that *cyclonic gales* are not (at all times) continuous in their progression, but that these storms frequently travel a considerable distance for two, three, or four days, and a succession of them—occurring in different parts of the ocean—may be linked together to form one HURRICANE TRACK.

124. Hurricane Seasons in the Different Oceans.—It remains now to draw the attention of the navigator to the period of the year at which he may most probably expect a Cyclone or Hurricane in the different parts of the ocean; this is shown in the following tabular form, where the number of recorded cyclones (to 1859) for each locality is ranged under each month:—

HURRICANES OR CYCLONES.

Locality.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
North Atlantic and West Indies	5	7	11	6	5	10	42	96	80	69	17	7
Southern Indian Ocean and Mauritius . .	9	15	15	8	4	...	...	...	1	1	4	6
Northern Indian Ocean:—												
Bay of Bengal { during N.E. Monsoon	1	...	3	...	...	...	...	...	...	12	7	6
{ during S.W. Monsoon	...	...	...	6	16	4	1	2	1	...	...	...
Arabian Sea { during N.E. Monsoon	1	1	1	...	...	...	...	...	8	12	9	5
{ during S.W. Monsoon	...	...	...	5	9	2	4	5	...	...	...	...
China Sea and North Pacific (Western part)	...	1	...	...	2	2	12	5	18	14	12	1
Java Sea and N.W. Coast of Australia . .	3	5	1	1	2	...	...	...	...	...	...	2

In the foregoing Table the figures are expressed in stronger type under the months when rotatory gales may *especially* be expected in each locality.

125. The Tracks of these Storms are of such a varied character that a delineation of a few of them on the CHART DIAGRAMS will probably convey more information than a long description.

PIDDINGTON's "Horn Book" is a favourite work with navigators on the subject here briefly noticed, but another of considerable merit should be found in every seaman's library—BIR's "Hand-book of the Law of Storms." With respect to the cyclones of the North Pacific, an excellent article by REDFIELD will be found in the "Mercantile Marine Magazine," vol. iv.

126. In the Southern Indian Ocean, south of the Cape of Good Hope and thence towards Australia and New Zealand, rotatory gales are most commonly experienced towards the end of autumn and during the winter season of that hemisphere—as is the case in the higher latitudes of the North Atlantic.

127. Cyclones in the Hoogli.—With the great Calcutta cyclone (October, 1864), fresh in the recollection of our readers—and in consideration of the enormous loss of life and waste of property resulting therefrom—we may aptly close these remarks with PIDDINGTON's "Notes for Ships and Steamers lying in the Stream, or at Moorings at Calcutta, or near it; and for River Boats on the approach of a Cyclone :"—

"A glance at the chart of the river will show us that the Calcutta Reach of it lies about N.N.E. and S.S.W., while Garden Reach runs to the W. by N.; the next Reach, to Akra, about S., and the next S.W. to Oolabariah. This must be borne in mind.

"A cyclone at Calcutta usually commences somewhere between N. and E., say N.E. If, as in 1842, the centre passes over the city, then the north-easterly gale continues to increase in strength till it is a hurricane, the barometer always falling, of course, till the wind abates quickly to a calm more or less perfect and suddenly, which calm may continue for half-an-hour to two or three hours; and then comes another tremendous burst of the hurricane from the south-westward, even more violent and terrific than before, lasting till the rearward portion of the cyclone has passed over; and it is in this second part of the cyclone that the mischief of them is mostly done. If, as in the cyclone of 1852, the centre passes up to the eastward of Calcutta, then the wind veers to the northward, and is heaviest from that quarter; and it ends at N.N.W. or W. If it passed up to the westward of Calcutta, of which we have no instance on record, then the wind, beginning about E. or E.S.E., veers to S.E. and S., where it would be heaviest; and ends at S.W. The dangerous cyclones for us, then, are those of which the centre passes over or close to us, so as to bring a sudden shift.

"For, in the first part, where the centre passes over us, as the wind is generally to the eastward of N.N.E., the ships at the moorings are lying more or less under the lee of a weather shore, and no *great* sea gets up for those in the stream, though often a very disagreeable one. But in the second part the whole sea from the lower reaches rolls up, and adds greatly to the strain on the cables; the ships being also

less sheltered than before. In the cyclone of 1842, ships were blown from their anchors, and drifted and sunk as high as Cossipore; and in the mooring tiers the inner ships were on shore, and the others heaped up on the top of them. In a word, every man who has not seen a real tropical cyclone may be well assured that his imagination cannot picture to him half of its tremendous power of mischief, even in a river-port like this, where ships are apparently so safe from the effects of wind.

"And every sailor of the old school knows also that this power of mischief is increased by one-half when the wind's force exceeds a high figure (say nine on the Admiralty scale), and for all ships except men-of-war, by the infatuation of our ship and steamer owners in *under-anchoring* their vessels!—i.e., giving to 1200-ton ships the anchors which an 800-ton vessel formerly carried; and so on. In steamers this has been carried to a preposterous extent—no doubt to ease them forward when driving through a sea. The steam being got up will, it is always supposed, ease the strain on the cable sufficiently. But this is often a dismal mistake, even with paddle-wheel steamers, as witness the stranding of the P. and O. C.'s steamer *Precursor* at Kedgerie in the cyclone of October, 1851, in spite of her steam; the disasters at Balaclava, where not a single captain appears to have thought of *backing* his sheet anchor! and at the Havana, a land-locked basin, where 80 vessels—steamers and sailing vessels—were driven on shore in the Cuba cyclone of 1844.

"We come now to the precautions to be taken in a river-port like Calcutta, and especially for the ships in the stream. Those at the moorings can do little else beyond looking to and doubling their bridles, and getting down as much top-hamper as they can—their topmasts even, if they can manage it, and this they may do by lending each other their scant crews; and if too late at first, doing it in the calm.

"Ships in the stream in Calcutta should first look to their *hawse*, which I regret to say is rarely kept clear. Then to getting down topgallant and even topmasts and lower yards, before the gale becomes too heavy.*

"The ground tackle has next to be thought of; and here we must bear in mind that in the first part of the cyclone the ship will probably be riding to her ebb anchor, and that if she drags that, even after veering away all she can, she has still to bring both anchors ahead with the longer scope on the northernmost anchor before she is adrift in that part of the gale; but the utmost care must be taken in the calm, and before the shift, to avoid her fouling her anchors, and then to be ready to veer away all the chain that can be afforded on the southernmost anchor, which, foul or clear, will now be the riding anchor till both, perhaps, are again brought ahead. I do not allude to the tides, as it is quite uncertain how they may be running, and indeed both tides are usually blown back at the surface by the force of the wind in the height of the cyclone, if it is against them.

"But in either half of the cyclone, the light anchors we have now-a-days may be insufficient to hold the ship; and as no sailor would, if he could help it, I suppose, go on shore with his sheet anchor at his bows, even in a river-port, I will assume that our ship or steamer has hers ready, with a good scope of chain to it, and the inner end properly clinched to the mainmast, so as to be ready for letting go under foot, or on parting.

* Nothing so common in our cyclones in the Eastern Seas as for them to rise to such strength in a few hours, that even in men-of-war the top-gallant masts cannot be got down, nor can a man go aloft!

"But in weather such as I have described above, the sheet anchor alone, nor, if the chains have not ere this parted, the sheet and the two dragged bowers may be unable to hold the vessel, *unless the sheet anchor before it is let go is backed*, which should always be done by clinching, say twenty fathoms of hawser or chain to the crown of the sheet anchor and bending them to a kedge which should be ready for letting go from the cathead before the sheet is cut away from the chains. An anchor so reinforced will often hold when nothing else will, because the backer is not subject to the jerks of the lifts from the bight of the chain.

"When the sailor has done all he can with his ground tackle, if he finds himself still drifting, and above or below the shipping, he should cut away or be ready to cut away his masts; for both above and below the Calcutta Reach there are steep and dangerously hard banks; and grounding upon them in any weather is bad, and in a cyclone may prove fatal, especially to a loaded or an iron ship; and this should be borne in mind, because the soft muddy banks give a stranger to our river the idea that its shoals are also mud banks—than which, for the most of them, nothing can be more erroneous.

"*Postscript for Boats, or River Steamers and Flats.*—In cyclones, it may often become with steamers, boats, and small craft, of great importance to know that the shift or veerings of wind will take place in such or such a direction rather than in another; for by this knowledge they can often run at the commencement of a cyclone for an anchorage, at which they can lie sheltered through the whole of it; or they can, if anchored on a weather shore, profit by the lull to get over to the other, before the shift of wind comes on, which would convert their former shelter into a dangerous lee-shore. Let us, as an example, take the Hoogly or Canton River, both much frequented, and running about north and south towards their mouths, and suppose ourselves in them exposed to a cyclone crossing them from east to west, in a launch with treasure on board, or in a steamer. It is clear that for the first half of the tempest, if the wind is to the eastward of N., the centre will pass to the south of the boat, and as the wind will be N.E. and E., and S.E.-ly, the eastern shore or any bank sheltering from these quarters is safe; but that if obliged to anchor to the south of a bank or island, when the centre is passing exactly over the boat's position, the latter part of the cyclone may drive her on shore, or sink her at her anchors. The Storm Card also shows how, if the wind is to the W.-ward of N., it will veer to the W. and S.W., and thus perhaps render an apparently safe berth really dangerous, if due precaution be not taken.

"In a word, the Law of Storms will here, as in many other cases, *forewarn* the mariner of what is to come; and 'forewarned is forearmed.' The tales which we have all read of the wind's '*unfortunately shifting to the opposite quarter*,' when 'the boat (or ship) was driven on shore and all hands perished,' will be changed into—'During the lull (or when the wind had veered to —) the boat (or ship), in due anticipation of the latter part of the cyclone, changed her berth to the — shore, where she safely rode out the remainder of it without damage.' And let me add, that every officer and commander of whom this shall be said or written, will be held in that degree of professional esteem which is the rightful meed of such careful and scientific management of the lives and property entrusted to his charge, as contrasted with the fatalism, the fool-hardiness, or the helplessness of ignorance."

CHAPTER VII.

TIDES OF THE INDIAN OCEAN, CHINA SEA, AND WESTERN PACIFIC.

128. The progress of the Tide-wave in the Indian Ocean and China Sea is so broken and uncertain, that too much space would be occupied in following out the investigation; we proceed therefore to show the application of the Table, p. 193 to 205.

Rule.—To find the Time of High Water on a given day at any place where the time of High Water at Full and Change of the Moon is known:—Find the time of the moon's meridian passage at the place; and to this time apply the correction from the following Table according to the proper sign—entering the Table with the γ 's Mer. Pass. in the side column and the γ 's Semidiameter at the top; to the result add the time of High Water at Full and Change at the given place, taken from the following list of places; the sum will be the time of high water on the afternoon of the given day. Should, however, this sum exceed 12h. 24m., or 24h. 49m., subtract one or other of those times, as necessary, from it, and the remainder will be the *approximate* time of high water on the afternoon of the given day.

Corrections to be applied to the time of the Moon's meridian passage in finding the Time of High Water.

γ 's Mer. Pass.	γ 's Semidiameter.			γ 's Mer. Pass.	γ 's Mer. Pass.	γ 's Semidiameter.			γ 's Mer. Pass.
	14' 30"	15' 30"	16' 30"			14' 30"	15' 30"	16' 30"	
H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
0 0	-0 4	0 0	+0 5	12 0	6 0	-0 55	-1 2	-1 12	18 0
0 30	-0 10	-0 8	-0 5	12 30	6 30	-0 46	-0 51	-0 58	18 30
1 0	-0 17	-0 16	-0 15	13 0	7 0	-0 32	-0 34	-0 37	19 0
1 30	-0 24	-0 25	-0 25	13 30	7 30	-0 17	-0 16	-0 14	19 30
2 0	-0 31	-0 34	-0 36	14 0	8 0	-0 1	+0 3	+0 9	20 0
2 30	-0 38	-0 41	-0 46	14 30	8 30	+0 8	+0 15	+0 24	20 30
3 0	-0 44	-0 49	-0 55	15 0	9 0	+0 14	+0 21	+0 32	21 0
3 30	-0 50	-0 56	-1 4	15 30	9 30	+0 16	+0 24	+0 36	21 30
4 0	-0 55	-1 2	-1 12	16 0	10 0	+0 15	+0 23	+0 34	22 0
4 30	-0 58	-1 6	-1 16	16 30	10 30	+0 12	+0 19	+0 29	22 30
5 0	-1 0	-1 8	-1 19	17 0	11 0	+0 7	+0 14	+0 23	23 0
5 30	-0 59	-1 7	-1 18	17 30	11 30	+0 2	+0 7	+0 15	23 30
6 0	-0 56	-1 2	-1 12	18 0	12 0	-0 4	+0 0	+0 5	24 0

Ex.—Find the time of High Water at Port Philip Entrance, April 2nd, 1868.

γ 's Mer. Pass. at Greenwich	H. M.	8 19
Cor. for Long. 145° E.	-22	
γ 's Mer. Pass. at Port Philip	7 57	
Cor. for Table above for 8h. and	+ 9	
γ 's Semid. 16' 17"		
	8 6	

Brought forward	H. M.	8 6
H.W. at F. and C., p. 201	+1 30	
H.W. at Prt. Philip, Apr. 2nd.	9 36 P.M.	
	-24	
H.W. at Prt. Philip, Apr. 2nd	9 12 A.M.	

The following table (p. 193) explains itself:—It gives the Time of High Water on Full and Change Days at the various places in the Indian Ocean, China Seas, Australia, Tasmania, and New Zealand; together with the Rise of the Tide at Springs and Neaps:—



The lines show the progress
understood as showing

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Abd-ul Kuri, Ind. Ocean	8 30	6		Andaman Strait, Indian Ocean	10 24	9½	
Abū-shehr, Persian Gulf	7 30	7		Andrava Bay, Madagascar	3 30	7	
Acheen Head, Sumatra	8 45	8		Angoxa River, Africa, E.C.		13	
Adams Port (Mary Id.), Yellow Sea	2 0	10		Angra Bank, Hindostan, W. Coast	10 30	9	
Adelaide Port, Australia, S. Coast	5 44	6		Antongil Bay (Port Choiseul), Madagascar	4 0	5	
Aden and adjacent Bays, Arabia, S.E. Coast*	{ 7 30 to 9 30 }	{ 7 }	4½	Aor Pulo, Sumatra, N.E. Coast		5	
Adenara, Flores, Malay Archipelago		8		Aotea Harb., New Zealand	10 0	12	9½
Admiralty G., Australia, N.W. Coast	12 0			Aracan R. (Bar), Bay of Bengal, E. Coast	9 45	9	6
Adolphus Island, Torres Strait	12 15	10		Arnhem Bay, Australia, N.C.	8 0	6-8	
Adou Atoll, Maldives	1 0	4		Arroa, Malacca Strait		10	
Adou Matte Atoll, Maldives	3 0	4		Arthur Port, Tasmania	7 52	4	
Adventure Port, New Zealand	12 20	8	6	Asaph St., B., Australia, N. Coast	5 45	14	
Agoada Pnt., Hindostan, W. Coast	10 30	9		Auckland Harbour, New Zealand, N. Island	7 5	11	9
Agulhas Cape, Africa, S. Coast	2 50	5		Augustine St., B., Madagascar, W. Coast	4 30	13	
Akaroa Harb., New Zealand	3 24	8	6	Avon Isles, Australia, E.C.	8 30	5	
Akasi, Japan Sea	6 36	6½		Awassima (Inland Sea), Japan	0 14	7	
Akyab, Aracan R., Bay of Bengal	9 45	9	6	Awanui R., New Zealand	7 44	7	
Al Bidá, Persian Gulf	8 30?	6½		Aylen Bay, Yellow Sea	2 30	6	4
Alabat Harbour, Luzon	10 0	9		Aymann, Persian Gulf	11 20	6	
Albany Ids. (Port Albany), Australia, E. Coast	12 15	10	7	Bab-el-Mandeb, G. of Aden	12 0	7	
Albert River (Kangaroo Point), Australia, N. Coast	7 30	10-13		Bacuit B., China Sea, E.C.	10 0	6	
Aldabra Ids., Mozambique	5 0	10		Badas Id., Linga Bay, Sumatra†	6 0 PM	12	
Algoa B., Africa, S. Cst.	4 0	4-5		Badong B. (S. Cst.), Baly	11 0	9½	
Alligator Rvr., Australia, N. Coast	8 40	19-20		Bahrain, Persian Gulf	5 30	7	
Amboyna, Moluccas	0 33	7		Balabac Id., China Sea, E. Coast	11 0	5	
Amiranté Isles (St. Joseph Id.), Indian Ocean	5 0	8½		Balade Harb., New Caledonia	6 30	4½	
Amoy (Inner Harbour), China, E. Coast	12 0	18½	14½	Balambangan Id., Borneo, N. Coast	10 0	6-8	
Ampanam B., Lomboek	8 0	6		Balasore R., B. of Bengal, W. Coast	10 0	15	
Amsterdam, Indian O.	11 0	3		Bancoot R. (entrance), Hindostan, W. Coast	2 0	12	
Amulgawein, Persian G.	11 40	6		Banda, Moluccas	4 0	6½	
Amur Strait, G. of Tartary	11 40	5-6		Bander Alkileh, G. of Aden	6 45	6	
Andaman Ids., Port Blair, Indian Ocean	10 0	9	6	— Gori, Gulf of Aden	8 45		
— Port Cornwallis	10 0	8½		— Shāab, Ind. Ocean	7 0	7	
				— Feikam, Arabia, S.E. Coast	10 0	8½	

* From a Survey of Aden Anchorage by COMMANDER DAYMAN, R.N., H.M.S. *Hornet*, 1863; but, according to the Surveyors of the Indian Navy, springs at Aden rise 8½ feet.

† From observations made in the month of September by W. STANTON, Master Commanding H.M. Surveying Brig *Saraceu*.

PLACE.	High Water, Full and Change.	Rise.		PLACE.	High Water, Full and Change.	Rise.	
		Spgs.	Nps.			Spgs.	Nps.
Bantam, Java	H. M.	ft.	ft.	Bluff Harb., New Zealand	1 18	8	6
Barbe St., Sumatra, N. E. Coast	6 0	6		Bombay Dockyard, Hindo- stan, W. Coast	11 40	12-17	
Barren Id., China Sea, E. Coast	9 30	5½		Booby Island, Australia, N. Coast	4 30	8	
Barren Ids., Madagascar	4 45	12		Botany Bay, Australia, E. Coast	8 15	7-8	
Barton Port (Bubon Pnt.), China Sea, E. C.	10 55	6		Boteler R., Madagascar .	4 30	15?	
Básidub, Persian Gulf . .	12 0	10		Bourbon Island, see Re- union Island.			
Basil Bay, Korea, W. C.	4 15	18	10	Bouro (Cajeli Bay) Mo- luccas	1 0	6	
Basrah (Bar), Persian Gulf	12 0			Bowen Port, Australia, E. Coast	9 35	16	
— Town	6 0	9?		Boyanna B., Madagascar, W. Coast	4 30	15	
Bassein R., Bay of Bengal	10 0	9	6	Bramble Cay, Torres Strt.	9 15	12	
Batanes, Bashee Islands, China Sea, E. Coast . .		4		Brava, Africa, E. Coast .	4 30	8	
Batavia, Java	10 0	2		Britannia Bay, Sumbawa	1 0	11-12	
Batchian, Gilolo, Moluccas	1 0	6		British Sound, Madagas- car, E. Coast	4 0	9½	
Bate (Gulf of Cutch), Hin- doetan, W. Coast	12 20	12	8	Broad Sound, Australia, E. Coast	11 0	20-30	
Batticalao River, Ceylon	5 0	2-3		Broadway R. (entrance), China, E. Coast	11 0	7½	
Bay of Islands (Motu Mea Islet), N. Zealand . . .	7 15	9	6	Broken Bay, Australia, E. Coast	8 0	6-9	
Bazaruto Cape, Africa, E. C.	4 15	10		Bruit River, Borneo . . .	3 0	11	
Belligam Bay, Ceylon . .	2 20	2½		Bruni R., China Sea, E. Coast	11 0	12	
Bellona Reefs (Middle), Australia, E. Coast . . .	8 30	6		Brunswick B., Australia, N. W. Coast	12 0	24	
Bembatooka Bay, Mada- gascar, W. Coast	4 30	16		Bubon Point, Port Barton, China Sea, E. Coast . .	10 55	6	
Bencoolen, Sumatra . . .	6 0	3-5		Buffalo R. (entrance), Africa, S. Coast	3 45	4½	
Berbereh or Burburra (Gulf of Aden), Africa, E. Coast	7 15	9		Bulsaur R., Hindostan, W. Coast	1 45	13	
Bersiap Point, Banka Strait	6 30	12		Buluagan O'sta Ana Port, Filipinas	12 0	5½	
Beypoor R. (entrance), Hindostan, W. Coast . .	0 15	5		Burong I., China Sea . .	4 45	7	
Bias Bay (Tooniang Id.), China, E. Coast	8 0			Bushire, see Abú-shehr.			
— (Tsangchow Id.)	8 30			Bussorah R. Bar, Persian Gulf	12 0		
Biddah R., B. of Bengal, W. Coast	10 0	14	12	Busuanga, Burins Island	12 30	6	
Bima Bay, Sumbawa . . .	Noon	6		Byron Bay, Australia, E. Coast	9 45	6	
Binkang B., China Sea, W. Coast	11 30	5		— Cape, Australia, E. Coast	9 45	6	
Bintula R., China Sea, E. Coast	5 45	6		Cajeli Bay, Bouro	1 0	6	
Bird Island, China Sea, E. Coast	9 30	6		Calcutta, Bengal	2 30		
— Ids., Africa, S. Cat. . .	4 0	4-5		Caledonia Harbour, New Granada	11 40	1½	1
Blair Harb., China Sea, W. Coast	8 50	9		Calicut Roads, Hindos- tan, W. Coast	0 15	5	
Blanche Port, Streaky Bay, Australia, S. Cat. .	1 0	5		Camaguin, Babuyan Ids.	6 0	6	
Bligh Sound, New Zea- land	10 45	8	6	Cambing, Banda Sea . .	noon	6	

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Camden Harb., Australia, N.W. Coast	12 0	37½		Ching-tau Bay, Yellow Sea	6 0	12	9
Campbell Cape, New Zealand	6 0	8	6	Chittagong (Bar), Bay of Bengal, E. Coast	1 15	15	10
Canton River (entrance), China	10 0	8		Chodo Id., Korea, W.C. Choiseul Port, Madagascar, E. Coast	6 20	12	
Canton River, (Kuper Id.) } In March	2 40	5½		Chosan Harbour or Tsauliang-hai, Japan Sea	4 0	5	
" } In May & June	1 40	5½		Christmas Island, Indian Ocean	7 45	7	5
Careening Bay, Australia, N.W. Coast	11 45	30		Christmas Harbour, Kerguelen Id.	10 0		
Caremapu, Patagonia, W. Coast	0 50	10		Chuen-pee Point, Canton River	2 0	2	
Cargados Garayos Shoals, Indian Ocean	2 0	4		Chusan Archipelago (Vernon Channel), China, E. Coast	2 0	7½	
Carteret Port, New Ireland		6		Chusan Tinghae, China, E. Coast	9 40	14	
Castries B., G. of Tartary	10 30	6		Circular Head, Tasmania	11 0	12	9
Casuarina Point, China Sea, E. Coast	9 30	6¾		Cleveland Bay, Australia, E. Coast	11 40	9	
Cato Bank, Australia, E. Coast	8 0	6		Cochin Harb. and Road, Hindostan, W. Coast	7 30	10-12	
Cavalli Islands, New Zealand	8 0	7		Cockburn Port, Africa, E. Coast	1 0	3½	
Cavern Island, China Sea, E. Coast	9 30	5½		Sound, Australia, W. Coast	4 15	12	
Centre Id. (Foveaux St.), New Zealand	12 15	8	6	Collier Bay, Australia, N.W. Coast	9 0	1-1½	
Ceram, Wahaay Harbour, Moluccas	6 0	3		Colombo, Ceylon	11 45	36	
Chalky Inlet, New Zealand	11 15	8	6	Colombo, Ceylon	1 0	2	
Champion Bay, Australia, W. Coast	9 10	1		Condore, Cochinchina	3 0	4	
Changchi Id., China, E.C. Chapu Road, Hang-chu Bay, China, E. Coast	9 30	17		Congoon Bay, Persian G. Conway Cape, Australia, E. Coast	7 45	9½	
Chauan Bay, China, E. Coast	11 0	6½		Cooper Port, New Zealand	11 0	18	
Cheduba, Bay of Bengal	11 30	8		Coringa or Cocanada Bay, Bay of Bengal, W. Coast	3 50	7½	5½
Chee-fow, see Chifu. Chentabun River, China Sea, W. Coast	10 0	5½		Coringa R. (Bar), Bay of Bengal, W. Coast	9 10	4-5	3
Cherbaniani Reef, Laccadives, Indian Ocean	10 0	7	4	Corner Inlet, S. Australia Crichton Harbour, Korea, S. Coast	9 0	5	
Chesterfield Islet, Australia, E. Coast	8 30	5		Crimon Ids., Java Sea	11 40	8	
Chifu, Yellow Sea	10 34	8	6½	Croisilles Harbour, New Zealand	9 50	11½	8½
Chimmo Bay, China, E. Coast	10 20	16		Crowdy Head, Australia, E. Coast	8 0	6	5
Chimney Id., Rees Pass, China, E. Coast	11 30	12		Cumsingmun Harbour, Canton River, China	9 0	12	8
Chincho Harbour, China, E. Coast	12 25	17		Cupchi Point, China, E.C. Curieuse, Seychelles, Indian Ocean	9 15	5	
Chin-hae, Yang R., China, E. Coast	11 20	12½		Curtis Port, Australia, E. Coast	12 6	6½	
					8 0		
					5 10	7	
					9 40	10-12	

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spga.	Nps.			Spga.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Daggs Sound, New Zealand	11 30	8	6	Elizabeth Bay, Africa, S.W. Coast		5-6	
Dalawan Bay, China Sea, E. Coast	11 0	5		Elliot Port, Australia, S. Coast		5-6	
Dalrymple B., Madagascar, W. Coast	5 0	15		Encounter Rock, Yellow Sea	10 44	11	8
Port, Tasmania	12 5	10	7½	Endeavour R., Australia, N. Coast	8 0	5-10	
Damaun Bar, Hindostan, W. Coast	1 30	17		Strait, Australia, N. Coast	1 0	9½	
Dampier Strait, Moluccas		11		Endermo Harbour, Japan	5 30	6	
Danno R., Hindostan, W. Coast	1 30	17		English R., Delagoa Bay, Africa, S. Coast	7 30	5	
Darnley Id., Torres Strait	9 30	12		Enora Bay, Japan Sea		4	
Darwin Port, Australia, N. Coast	5 30	17-24		Eran Bay (Palawan), China Sea, E. Coast	10 10	6½	
Dauphin Fort, Madagascar	4 30	7		Eslington Port, Australia, N. Coast	3 24	13	
Deep Point, Durian Strait	5 0	10		Eyre Port, Australia, S. Coast	10 30	6	
Delagoa Bay (Port Melville), Africa, S. Coast	4 30	15		Fairy Port, Australia, S.C. False Point, Bay of Bengal, W. Coast	8 0	8	
(Portuguese Factory), Africa, S. Coast	5 20	12		Fansiak Channel, Canton R., China, E. Coast	1 0	7½	5
Shefeen Id., Africa, S. Coast	4 40	12	11½	Farewell, Cape, New Zealand	9 20	14	10
Delgado C., Africa, E.C.	4 0	16		Fataizio, Japan Sea	6 0	5	
Delhi River, Sumatra	4 0	8		Fitz-Roy Id., Australia, E. Coast	9 15	7-12	
Denham Sound, Sharks Bay, Australia, N.W. Coast	12 5	5		Flesh Bay, or Bay St. Bras, Africa, S. Coast	3 30?	6?	
Denial Bay, Australia, S. Coast	12 15	6		Flinders Group, Australia, E. Coast	9 15	8-12	
Denison Port, Australia, E. Coast	9 30	6		Fog Ids., Hang-chu B., China, E. Coast	11 45	17	
Dewghur Harbour, Hindostan, W. Coast	11 25	9		Fongwhang Group (Bullock Harbour), China, W. Coast	8 30	17	
Diamond Island, Bay of Bengal	10 30	8		Formosa Mt., Malacca Strait	8 0	11	8½
Point, Malacca Strait	12 0	9½		Fowlers B., Australia, S. Coast	10 30	6	
Diego Garcia Island, Indian Ocean	1 30	6		France, Port de, New Caledonia	8 25	4	
Diu Island, Hindostan, W. Coast	2 0	6		Frederick Reef, Australia, E. Coast	8 0	6	
Divy Pt., Bay of Bengal		5		Freycinet Estuary	4 15	3½	
Dodandowe Bay, Ceylon	1 50	1½		Reach, Sharks Bay, Australia, N.W. Coast	3 0	5	
Douany, Comoro Ids.	4 0	11-12		Galang Bay, Hainan Id., China Sea		4-5	
Dunbar, Hindostan, W. Coast	10 10	8		Galle, Pointe de, Ceylon, S. Coast	2 0	2	
Dunk Island, Australia, E. Coast	9 28	6-10		Gambier Ids., Australia, S. Coast	1 50	3	
Durnford Port, Africa, E. Coast	4 45	12	8				
Dusky Bay, New Zealand	11 15	10					
Dyer Id., Africa, S. Cst.	2 50	5					
East Cape, New Zealand	8 55	7					
Eddystone Pt., Australia, E. Coast	9 39	7					

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Geby, Fohou Id., Gilolo Passage, Moluccas . . .		5		Hawke B., New Zealand	7 50	3	
Geelong Harbour, Australia, S. Coast . . .	2 50	2½		Heawandou Pholo Atoll, Maldives . . .	9 30	5	
George St., Basin, Australia, N.W. Coast . . .	12 15	25		Heda Bay, Japan Sea . . .		5½	
Georges Bay, Tasmania . . .	9 42	3	2	Heron Islet, Capricorn Group, Australia, E. Coast . . .	9 0	10	
Ghubbet Ne, Socotra, Indian Ocean . . .	7 0	7		Hie-chechin Bay, China, E. Coast . . .	7 0		
Hashish, Arabia, S.E. Coast . . .	10 0	10		Hicks Bay, New Zealand	9 0	7	
Gizree Bunder, Indus, Hindostan, W. Coast . . .	9 50	7		Hillsborough Island (New Port), Bonin Islands . . .	11 32	3½	
Glennie Ids., Bass Strait	12 20			Hobarton, Tasmania . . .	8 15	4½	3½
Goa, Hindostan, W. Cst.	11 30	6		Hoe-e-tow Bay, China, E. Coast . . .	12 15	16	
Gollonsir Socotra, Indian Ocean . . .	7 20	8		Hokianga R. (entrance), New Zealand . . .	9 45	10	
Good Hope, Cape of, China, E. Coast . . .	9 0			(Kokohu), New Zealand . . .	10 15	10	7
Gould Island, Australia, E. Coast . . .	6 45	6		Hon-cohe Bay, China Sea, W. Coast . . .	11 30	5	
Gooriya Creek (entrance), Hindostan, W. Coast . . .	11 0	9		Honghai B., China, E. Coast . . .	10 0	6½	
Gore Port, New Zealand	9 0	8	6	Hongkong, China, E. Cst.	10 15	4½	
Goulburn Ids., Australia, N. Coast . . .	6 0			Hoogly R. (W. entrance), Bay of Bengal, W. Cst.	10 0	10½	
Grand Port, Mauritius . . .	1 0	1½		Hooper Island, Korea, S. Coast . . .	9 10	11½	8½
Great Barrier Id., (Nagle Cove), New Zealand . . .	6 25	10	7	Hope Sound (Mia-u-tau Group), Yellow Sea . . .	10 24	6½	
Reef, Australia, E. Coast . . .	8 48	7		Hout B., Africa, W. Cst.	2 20	5	
Grey Port, Swan River, Australia, W. Coast . . .	9 0	1-1½		Houtman Rocks, Australia, N.W. Coast . . .	11 30	2½	
Guardafui Cape, Africa, E. Coast . . .	6 15	6		Howe, West Cape, Australia, S. Coast . . .	9 0	6	
Gundavee R. (entrance), Hindostan, W. Coast . . .	2 0	19		Hu-i-tau Bay, China, E. Coast . . .	12 15	16	
Gutzlaff Id., China, E.C.	11 30	15		Hukkar R. (entrance), Hindostan, W. Coast . . .	10 30	11	
Haimun Bay, China, E. Coast . . .	9 0			Hulu Shan B., Yellow Sea	2 30	8	6
Haiyun-tau (Thornton Haven), Yellow Sea . . .	9 30	12	8	Hunter Id., Bass Strait . . .	11 30	8	
Hakodadi Harbour, Yezo Island, Japan . . .	5 0	3		Port, Australia, E. Coast . . .	9 45	6-7	
Hamilton Port (Korea), Yellow Sea . . .	8 30	11		Iki, Japan Sea . . .		8	
Hammelin Pool, Sharks Bay, Australia, N.W. Coast . . .	5 0	3½		Iliolo Port, Filipinas . . .	12 0	5½	
Hang-chu Bay (Sesham Ids.), China, E. Coast . . .	11 45	14		Indus (Gizree Bunder), Hindostan, W. Coast . . .	9 50	7	
(Fog Ids.) . . .	11 45	17		Inhambane R., Africa, E. Coast . . .	4 15	10	
(Chapool Rd.) . . .	12 0	25		Investigator Road, Australia, N. Coast . . .	8 0	9	
off Can-pu . . .		32		Isolette Cape, Arabia, S.E. Coast . . .	9 0	10	
Hardy Port, New Zealand	9 55	8	6	Jacinto, Port San, Ticao Id., Filipinas . . .	6 30	6	
Hastings Harbour, Bay of Bengal, E. Coast . . .	10 40	13½		Jackson Port (N. Head), Australia . . .	8 15		

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Jaffrabat, Hindostan, W. Coast	11 35	9	7½	Keppel Bay, Australia, E. Coast	9 30	9-14	
Jashk Shoal, Persian Gulf	9 30	8		Kerguelen Island, Indian Ocean	2 0	2	
Jask Cape, Persian Gulf	6 0	6		Kesm, or Kishm, Persian Gulf	11 0	12	
Jervis Bay, Australia, E. Coast	6 20	6-9		Khór Jerámeh, Arabia, S.E. Coast	9 30	10	
Jezírat Arabí, Persian G.	6 30?			Kijouk Phyou Harbour, Bay of Bengal	10 0	9	6
— Hamar - al - nafur, Arabia, S.E. Coast	9 30	10		Kinsiang Point, China, E. Coast	7 0		
— Jún, Persian Gulf	11 30	10		Kirindi, Ceylon	3 30		
— Kabr „		8½		Kiswara Harb., Africa, E. Coast	4 30	12	
— Kais „	0 45	7½		Kitaapatnam, Bay of Bengal, W. Coast	11 0	1½	
— Kharg, or Káreg, Persian Gulf	8 0	6½		Koepang, Timor	11 0	9	6½
— Larek, Persian G.	10 15			Kokohu, New Zealand	10 15	10	7
— Tumb, „		8		Ko-kun-to Group, Korea, W. Coast	2 25	18	10
Jiddah, Red Sea		3		Kok-si-kon Prt. (Formosa) China Sea, E. Coast	11 30	3	
Johanna Id. (anchorage), — Pomony Harb., Comoro Ids.	3 40	11		Koombanah B., Australia, W. Coast	9 0	½-3	
John St., River, Africa, S. Coast	4 0	11	9	Koree R. (Monda Point), Hindoostan, W. Coast	11 40	11	
Jonquiere Bay, Gulf of Tartary	10 0	6		Koweit, Persian Gulf	0 15	9	
Jooria, Hindostan, W.C.	2 0	16	12½	Krakatoa, Strait of Sunda	7 0	4	
Juan de Nova, Madagascar		5		Kuper Harbour, Korea, S. Coast	9 28	11½	8½
Junk Fleet entrance, Canton River, China	11 50	6½		Kuriyán Muriyán Bay and Islands, Arabia, S.E. Coast	8 20	6½	
Junkseylon Id. (E. side), Malacca Strait	10 0	11½		Kurrachee, see Karachi.			
Kaikora Penin., New Zealand	5 30	8	6	Kweshan Ids., China, E. Coast	9 30	14	
Kaipara Harb. (entrance), New Zealand	10 55	10	8	Labuan Id., China Sea, E. Coast	9 45	6	
Kalian Point, Banka Strait	8 17*	12½		Lady Bay, Australia, S. Coast		4	
Kapiti Island, N. Zealand	9 0	6		Lady Elliot Islet, Australia, E. Coast	9 0	7-8	
Karachi Harb. (entrance), Hindostan, W. Coast	10 30	9½	6	Laguimanoc Port, Luzon	1 30	5½	
Kata, Japan Sea	6 4	6½		Lamo Harbour, Africa, E. Coast	4 6	11	
Kawau Id., New Zealand	6 30	10		Langahan Crossing, Yang-tse-Kiang†	1 40	12	8
Kawhia Harb., New Zealand	9 30	12		Lankeet Island, Canton River, China	11 20	6½	
Kedewarry, Hindostan	9 57	9		Lansew Bay, China, E.C.	10 0	13	
Keelacarry, Ceylon	11 0			Latham Id., Africa, E. Cst.	4 0	10	
Kedgerree, Bay of Bengal	11 30			Lau-mu-ho, Yellow Sea	1 30	5	
Keeling Islands (Port Refuge), Ind. Ocean	5 30	5					
Kelung Harb. (Formosa), China Sea, E. Coast	10 30	3					
Kenn Reef, Australia, E. Coast	8 0	5½					
Kent Island, Bass Strait	11 10						

* In N.W. Monsoon.

† At the Langahan Crossing the tide rises for 3 hours only, and falls for 9 hours.—H.M.S. *Acton*, 1861.

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Leven Port, Madagascar	3 30	7½		Makalleh, Arabia, S.E.			
Liant Cape (G. of Siam),				Coast	8 30	7	
China Sea, W. Coast	5 7	6½		Makumba R., Madagascar	4 45	17	
Liau Ho (Bar), Yellow				Makung Harbour, Pesca-			
Sea	4 0	11½	7½	dores, China Sea	10 30	9½	7
(entrance)	5 0	12		Malacca Strait (light ves-			
Lian-tung, Chingho, Yel-				sel one fathom bank)	6 0	15	12
low Sea	1 20	6½		(off Mount			
Gulf (Sand				Formosa)	8 0	11	8½
Point), Yellow Sea	4 50	7	5½	— Road, Malacca			
N.W. Head				Strait	7 30	11	8½
of Gulf	5 30	10	8½	Malcolm Atoll, Maldives	10 30	3	
Lindy River (entrance),				Male, Maldives	12 30	3	
Africa, E. Coast	4 15	12		Malludu Bay, Borneo	10 30	6-8	
Lingeh, Persian Gulf	12 0?			Mana Island, New Zea-			
Lintin Island, Canton R.,				land	7 0	8	6
China, E. Coast	12 0	7½		Manama, Persian Gulf	5 20	7	
Lishan Bay, China, E.C.	10 15	16		Manawatu River, New			
Litan Bay, Yellow Sea	3 0	6	4	Zealand	10 0	8	6
Lizard Id., Australia, E.				Mandavee Roads, Hin-			
Coast	9 15	7-10		dostan, W. Coast	11 50	15	11
Lloyd Port, Bonin Ida.	6 8	3		Manila (Luzon Island),			
Lobah Point, Banks Str.*	11 0*	10		China Sea, E. Coast	10 40	2½	
Lobeia, Red Sea	1 30	3		Manning River, Australia,			
Lombok (Ampanam B.),				E. Coast	9 15	4	
Java Sea	8 0	6		Manora P., Karachi, Hin-			
Lord Howe Island, S.				dostan, W. Coast	10 30	9½	6
Pacific	8 30	6		Manorah R., Hindostan,			
Lo-shan-kan, Yellow Sea	4 30	11	9	W. Coast	1 30	16	
Louis Port, Mauritius	12 30	3	2½	Manukau Harbour (en-			
Luabo River (entrance),				trance), New Zealand	9 30	13	10
Africa, E. Coast		22		Maria Van Diemen Cape,			
Lucipara Pass, Banks				New Zealand	8 0	7	
Strait	irr.	10	7½	Marka, or Muerka, Africa,			
Lung-mun Harbour, Yel-				E. Coast	4 30	8	
low Sea	10 0	7		Maroni Bay, Comoro Ida.	4 53	10	
Macao, China, E. Coast	10 0	6½		Martaban, Bay of Bengal	2 20	21	
Macassar, Celebes	4 40	5½		Mary, St., Harb., Mada-			
McDougall Harb., Africa,				gascar, E. Coast	4 0	5	
S.W. Coast	2 30	5½		Mascot, Persian Gulf	11 15	6	
Macowa, Red Sea	0 30	2		Mason B., New Zealand	11 10	8	6
Macquarie Harbour, Tas-				Massacre Bay (Tasman			
mania	7 30	3		corner), New Zealand	8 45	13	9
Port, Australia,				Motu Pipi			
E. Coast	8 56	4-5		River, New Zealand	9 50	14	10
Madame Island, Mada-				Massowah, Red Sea	1 0	3	
gascar	4 0	5		Maule River, Chile	10 0		
Madras Road, Coroman-				Maulmain, Bay of Bengal	2 0	22	17
del Coast	7 34	3½		Mauritius (Port Louis)	12 30	3	2½
Madoxoa, Africa, E. Cst.	4 30	8		(Grand Port)	1 0	1½	
Mahato Id., Africa, E.				Mayday Bay, Palawan	9 55	3½	
Coast	4 30	7		Mayhé Id., Indian Ocean	4 0	6½	
Majambo B., Madagascar	4 30	16		Mayotte Id., Mozambique	4 10	1½	
Makatein, Arabia, S.E.				Mazambo Port, Mada-			
Coast	9 0	6		gascar	4 30	15	

* In S.E. Monsoon.

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Meichen Sound, China, E. Coast	12 30	17		Murray Pass, Bass Strait	11 10	8	
Melbourne, Australia, S. Coast	1 20	3		Musa Port, Babuyan Ids.		5	
Melinda P., Africa, E.C.	4 15	11		Mutlah River (entrance to Biddah River), Bay of Bengal, W. Coast .	10 0	14	
Mellish Reef (Sand Cay), Australia, E. Coast .	7 55	5-6		— (Muda Kali), Bay of Bengal, W. Coast .	11 45	15	
Menam River (Paknam), China Sea, W. Coast .	5 7	9½		Naafe R., Bay of Bengal, E. Coast	10 0		
Mensular Id., S.E. end, Sumatra	6 0	4		Nafa-Kiang, Loo Choo Islands	6 28	7	
Merbát, Arabia, S.E. Cst.	9 0	6¾		Nagasaki Bay, Japan Sea	7 15	9	7½
Mercury Bay, New Zea- land	7 21	7	5	Nagore, Bay of Bengal, W. Coast	8 15		
Mergui, Bay of Bengal, E. Coast	10 30	18		Namki Ids., China, E. Cst.	8 30	17	
Merjee R., Hindostan, W. Coast	11 0	7		Namoa Island (Clipper Road), China, E. Cst.	11 15	7	
Miau-tau (Depôt Bay), Yellow Sea	10 35	6		Namquan Harb., China, E. Coast	10 0	17	
Michael Seymour Port, Gulf of Tartary . . .	5 30	3		Nancowry Harb., Nico- bar Islands	9 15	8½	
Milford Sound, New Zea- land, Mid. Island . .	9 15	8	6	Nangamessie Harbour, Sumba	11 30	17	13½
Millman Island, Palawan, W. Coast	10 27	2¾		Nangka Id., Banka Strait		12	
Min R. (Temple Point), China, E. Coast . . .	10 45	19	14½	Nansaree River (Bar), Hindostan, W. Coast	3 0	18	
— (Losing Island), China, E. Coast . . .	12 0			Napoleon Road, Gulf of Tartary	2 30	2½	
Mindanao, Filipinas . .	7 0	6		Narrinda Bay, Madagas- car, W. Coast	4 30	15	
Minow Islands, Madagas- car, W. Coast	5 0	15		Naruto (Fukura), Japan Sea	6 17	7	
Mirs Bay (Tide Cove), China, E. Coast . . .	10 0	6½		Natal Port, Africa, S. Cst.	4 30	6	
Mocha Road, Red Sea, E. Coast	12 0	4½		Naturaliste Channel, Sharks Bay, Australia, N.W. Coast	11 45	6	
Molynoux Bay, N. Zeald.	3 0	8	6	Negapatam, B. of Bengal	5 0	3	
Mombaza Port, Africa, E. Coast	4 0	11		Newcastle, Australia, E. Coast	9 45	6-7	
Monganui Harbour, New Zealand	8 15	9	7	Nhatrang Bay, China, W. Coast	8 30	5½	
Moreton Bay, Australia, E. Coast	9 30	3-7		Nicholson Port (Lambton Harbour), New Zea- land	4 30	5	3
Mossel B., Africa, S. Cst.	3 30	6		Nicobar Id. (Nancowry Harb.), Indian Ocean	9 15	8½	
Mourondava, Madagascar, W. Coast	4 45	12		Nimrod Sound, China, E. Coast	10 30	20	
Mozambique Har., Africa, E. Coast	4 15	12		Ninepin Group, China, E. Coast	10 0	5	
Mungalaum Id., China Sea, E. Coast	11 0	5		Ning-hai, Yellow Sea .	12 0	6	
Mungullo or Mongallo R., Africa, E. Coast .	4 45	12		Nin-po-fu, Yung River, China, E. Coast . .	1 0	9	
Murdounah Id. (E. Cst.), Red Sea	6 0	3		North Sands, Malacca Strait	5 30	15	12
Murray Islands, Torres Strait	9 30	10		Noss Island, Madagascar	5 0	15	
				Numa-choa, Comoro Ids.	3 0	14	

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Nysna Harbour, Africa,				Pemba Id., Mozambique	4 15	12	
S. Coast	3 45	5		Penang, Malacca Strait .	12 0	9	7½
Observatory Id., China				Percy Isles, Middle or			
Sea, E. Coast	11 0	5½		No. 1 Island	10 30	16	13
Oelar Cape, Banka Strait	6 30	12		— South or			
Oho Sima, Loo Choo Ids.	7 30	5½		No. 2 Islet, Australia,			
Oibo Harb., Africa, E.C.	4 15	6		E. Coast	10 30	14	
Omaider Island (Gulf of				Perim Id., Gulf of Aden .	12 0	7	
Akabah), Red Sea . . .	6 0	4		Peros Banhos, Indian			
Omersary R., Hindostan,				Ocean	1 30	5	
W. Coast	1 45	18		Perouse, La, Strait, Japan			
'Om-rasas-Masirah, Ara-				Sea	10 30	6	
bia, S.E. Coast	10 0	10		Perron Cape, Sharks Bay,			
One Fathom Bank Light,				Australia, N.W. Coast	12 45	5½	
Malacca Strait	6 0	15	12	Pescadore Ids. (Makung			
Oolooan Bay, China Sea,				Harbour), China Sea .	10 30	9½	7
E. Coast	9 30	5½		Petrel Bay, St. Francis			
Oonting Port, Loo Choo				Isle, Australia, S. Cst.	12 0	6	
Islands	6 35	8		Pheasant Point, Wusung			
Oosima, Japan Sea . . .	6 50	5		River, China, E. Cst.	0 35	13	8
Osaki, "	5 55	6½		Philip Port, Capel Bay,			
Osprey Reef, Australia,				Australia, S. Coast .	2 30	3-4	
E. Coast	8 36	6		— (entrance),			
Otago Har., New Zealand	2 50	7	5	Australia, S. Coast .	1 30	3-4	
Palliser Cape, "	6 0	6		— Queenscliff	1 30	3	
Palmedo Road, Sumba Id.		15		Philip B., Hobson Bay,			
Palmeira Point, Ceylon .	9 30	7-11		Australia, S. Coast .	3 0	3-4	
Paloan Bay, Mindoro . .		5		Pidloe Bay, Lomboek .		10-12	
Pamarung Ids., Borneo,				Pierre Island, China Sea,			
E. Coast		8-10		E. Coast		4	
Pampang Bay, Java . . .		7-8		Pigeon Bay, Yellow Sea	11 45	8	
Pancol, China Sea, E.C.	9 40	6		Pihkishan Ids., China,			
Parenga-renga Harbour,				E. Coast	8 30	17	
New Zealand	7 54	7		Pillar Cape, Tasmania .	1 0	6	
Passage Id., Banda Sea .	noon	6		Pimlea Harbour, Africa,			
Passandava Bay, Mada-				E. Coast	4 30	12	
gascar, W. Coast	5 0	15		Pio Quinto Port, Babuyan			
Paterson's Inlet, New				Islands	6 0	6	
Zealand	1 10	5	6	Pitty, Hindostan, W.C.	10 5	9	
Patta B., Africa, E. Cst.	4 30	10		Plettenberg Bay, Africa,			
Paul, St., Island, Indian				S. Coast	3 10	6	
Ocean	11 0	3		Plymouth, New, New			
Paumben Pass, Bay of				Zealand	9 30	12	9
Bengal, W. Coast	1 30	2		Pomba B., Africa, E. Cst.	4 0	15	11
Pegasus Port, N. Zealand	11 50	8	6	Pootoo Island, China, E.			
Peh-tang-ho, Yellow Sea	3 33	10	7½	Coast	8 15	12	
Pei-ho or Peking River				Portland Bay, Australia,			
(entrance), Yellow Sea*	3 40	10	7½	S. Coast	Midnight	4	
(Tien-tsin)	7 0	4½		Possession Cape, Torres			
Pelican Lagoon, Kanga-				Strait	9 0	6	
roo Id., Australia	5 0	6		— Id., Torres			
Pelorus Sound, New Zea-				Strait	1 0	9½	
land	9 35	11	7	Post-Office Id., Torres			
Pemba Channel, Mozam-				Strait	1 0	9½	
bique	4 0	11		Poverty Bay, N. Zealand	6 5	6	

* Time and rise much affected by winds.

PLACE.	High Water, Full and Change.		RISE.		PLACE.	High Water, Full and Change.		RISE.	
			Spgs.	Nps.				Spgs.	Nps.
	H. M.	ft.		ft.		H. M.	ft.		ft.
Pratas Shoal, China Sea .	4 0	5			Raujpoor (G. of Cambay), Hindostan, W. Coast	2 15	18		13
Preservation Inlet, New Zealand	11 20	8	6		Red Bay, Ceylon, S. Coast	2 20	2½		
Prince Frederick Harbour, Australia, N.W. Coast	12 0	28			Red Island, Durian Strait	5 0	10½		
Princess Royal Harbour, Australia, S. Coast	11 56	1-4			Refuge Cove, Bass Strait	12 5			
Pulicat Shoals, Coromandel Coast	9 25	2½			Rendezvous Id., Borneo, S.W. Coast		8		
Pulo Aor, Sumatra, N.E. Coast		5			Resolution B., Marquesas	2 30	4		
— Condore, China Sea, W. Coast*	2 30	6½			Reunion Id., (St. Pierre)	noon	3½		
— Leat, Gaspar Strait	2 30	4			Indian O. (St. Denis)	0 22	2½		
— Mendanao, "	2 30	4			Reunion Id., (St. Gilles)	1 0	2½		
— Panjang, G. of Siam	7 0	2			Indian O. (St. Paul)	1 7	4		
— Timcan (W. side), China Sea, W. Coast	6 0	7½			Rhio, Rhio Strait	10 0	7	5	
Queda, Malacca Strait	12 0	5½			Richmond R., Australia, E. Coast	9 20			
Queen Charlotte Sound (entrance), New Zealand	8 50	8	6		Rivoli B., Australia, S.C.	10 0	4		
Quilimane R. (entrance), Africa, E. Coast	4 15	16			Rocky Id., Gulf of Siam	4 0	4		
Quiloa, Africa, E. Coast	4 45	12			Rodrigue Id., Ind. Ocean	1 45	6		
Rachada Cape, Malacca Strait	5 30	13			Romania Point (Malay Penin.), China Sea, W. Coast	10 30			
Radama Port, Madagascar, W. Coast	4 40	13			Rovama River, Africa, E. Coast	4 0	16	11½	
Ragged Id., Sumbawa, Java Sea	8 10	3			Royalist Port, Palawan, E. Coast	11 0	6½		
— Point, Borneo, E. Coast		7			Ruapuke Id. (Foveaux Strait), New Zealand	1 0	8	6	
Raine Id., Torres Strait	8 10	10			Sabon Id., Durian Strait		10		
Rajahpoor Harbour, Hindostan, W. Coast	11 0	12			Saddle Id., East, China, E. Coast	11 0	14		
Rajang River, Borneo	4 45	13	9		Sado (Yebisu), Japan Sea	5 0	2		
Ramree Road, Bay of Bengal, E. Coast	10 0	12			Saigon (C. St. James)	11 0	8		
Rangoon, Bay of Bengal, E. Coast	5 30	21	14		— (Saigon City), Cochinchina	5 30	9½		
— R. (entrance), Bay of Bengal, E. Cst.	3 15	21	14		Sale Macowa, Red Sea	0 30	2		
Rás Hafún, Africa, E. Coast	6 15	4			Sambilangs, Malacca Str.		12	10½	
Rás Mahommed (Gulf of Akabah), Red Sea	6 0	5			Sand Point, G. of Liautung, Yellow Sea	4 50	7	5½	
Rás Sharmah, Arabia, S.E. Coast	9 0	8			Sandy Cape, Australia, E. Coast	7 50	6-8		
Rás-al-Kheimeh, Persian Gulf	11 45	7			— Id., Madagas. W.C.	5 0	15		
Rás-al-Asidah } Arabia {	8 30	5½			Sang-tau Bay, Yellow Sea	0 55	7	4½	
Rás Shébali } S.E. {	10 0	10			Sanguir Island, Moluccas		6		
Rás-al-Hed } Coast {	9 30	9			Sanmoon Bay (St. George Island), China, E. Cst.	10 20	15		
					San-shui, Si Kiang, China, E. Coast		5-6		
					Saparoca Id., Moluccas		6		
					Sapie Bay, Sumbawa	1 0	10		
					Sarawak R. (Moratabas entrance)	4 0	9	5½	
					— Santubong (entr.)	4 0	10	6	
					— Sarawak Junction	5 0	15-18	9	
					— City Borneo, W. Coast	5 20	15-18	9	

* From a French survey, 1862.

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Sau-o Bay, Formosa . .	10 0	3½		Simidsu, Japan Sea . .	7 30	7	
Sangor Id., B. of Bengal		12		Simoda Port, „ . .	5 0	3-5	
Samarez Reef, Australia,				Simonoseki, „ . .	8 30	8	6
E. Coast	8 0	6		Simon's Bay, Africa . .	2 44	5½	3¾
Sedashigur Bay,* Hin-				Singapore, New Harbour,			
dostan, W. Coast . .				Malacca Strait . .	9 45	10	7½
Sedili R., China Sea, W.				Sir C. Hardy Ids., Torres			
Coast	9 44	7		Strait, E. Coast . .	9 15	10	
Sesham Islands, Hang-chu				Sir E. Pellew Islands,			
Bay, China, E. Coast	11 45	14		Australia, N. Coast .	7 30	4-7	
Seychelle Archip. (Mayhé				Smoky Bay, Australia,			
Id.), Indian Ocean . .	4 0	6½		S. Coast	12 15	6	
Seypan Id., Ladrone Ids.	6 45	2½		Society Bay (Sullivan Bay),			
Shan-lui-tien Banks (W.				Yellow Sea	0 15	8	
part), Yellow Sea . .	2 50	10		Socotra Id., Indian Ocean	7 20	8	
Sháb Kadún, Arabia,				Sofala R., Africa, E. Cst.	4 0	19	
S.E. Coast	9 20	10		South-West Bay, New			
Sháb'bu-saifeh, Arabia,				Providence	7 30	4	
S.E. Coast	9 45	10		— Cape, New			
Shanghai, Yang-tse . .				Zealand	12 0	7	5
Kiang, China, E. Cst.	0 40	10		Spenser Gulf (Thorny			
Shao-king, Si Kiang,				Passage), Australia,			
China, E. Coast . .		3		S. Coast	12 0	6-8	
Sharja, Persian Gulf . .	1 0	6		— Point Lowly . .	7 0	6-8	
Sharks Bay, Naturaliste				— Port Augusta†	8 30	9-12	
Channel, Australia,				— Point Riley . .	5 45	4¾	
N.W. Coast	11 45	6		— Wallaroo	irr.	4-5	
— Denham				Spider Id., China, E. Cst.	10 0	17	
Sound	12 5	5		Staunton Id., Yellow Sea	1 30	8	5½
— Freycinet				Stephen Port, Australia,			
Reach	3 0	5		E. Coast	9 0	6	
— Freycinet				Streaky Bay (Blanche-			
Estuary	4 15	3½		port), Australia, S.C.	1 0	5	
— Cape Perron	12 45	5½		Suadiva Atoll, Maldives .	1 0	4	
— Hamelin Pool	5 0	3½		Sual Port, Luzon . . .		6	
Shefeen Island, Africa,				Suez Bay (head of Gulf),			
S. Coast	4 40	12		Red Sea	2 0	6	
Shiintau Bay, Yellow Sea	1 30	9		Sughrá, Arabia, S.E. Cst.	8 0	6	
Shoal Bay, Australia, N.C.	6 0	18-25	14-20	Surat, Hindostan, W.C.	4 0	19	
—, E. Coast	8 30			Swain Reefs, Australia,			
Shoal Water B., Australia,				E. Coast	10 25	10	
E. Coast	10 30	12-18		Swan Island, Bass Strait	9 35	6	
Si Kiang or West River,				— River, Port Grey,			
China, E. Coast :				Australia, W. Coast .	9 0	1-1½	
„ (San-shui)			5-6	Swift Bay, Australia, N.			
„ (Shao-king) . . .			3	Coast	12 0	21	
„ (Wuchan)			1-1½	Sydney, Australia, E. Cst.	8 38	4¾	4
Siak River, Malacca Strt.	9 0	12		Ta-tsing ho, Yellow Sea .	4 10	10½	8
—, off the town . .		11		Table Bay, Africa, W. Cst.	2 40	5	
Sidmouth Cape, Australia,				Tahri, Persian Gulf . .	5 0†		
E. Coast	9 15	10		Tai-cho ho, Yellow Sea .	0 15	6	
Sillebar R. (Bar), Sumatra	6 0	4½		Taichow Ids., China, E.C.	9 0	14	

* Spring tides rise A.M. 6 feet, P.M. 7½ feet, from October to March; and the contrary during the rest of the year.

† At Port Augusta, when the wind veers round to W. and S., and blows strong, the rise has been as much as 16 feet.—COMMANDER JOHN HUTCHISON, R.N., Admiralty Survey, South Australia, 1862.

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
Tai-Tai Bay, China Sea, E. Coast	H. M. 9 30	ft. 5½		Tomo (Seto-uchi), Japan Sea	H. M. 11 0?	ft. 4½	
Tailung Channel, Canton River, China	1 30	6½		Tongsang Harb., China, E. Coast	11 30	12	
Ta-lien-whan Bay, Yellow Sea	10 47	10½	8	Tooniang Id., Bias Bay, China, E. Coast	8 0		
Tama no Ura Harbour, Goto Id., Japan Sea		6-8	4-6	Towan Id., China, E. Coast	9 20	13	
Tam-Sui Harbour, China Sea, E. Coast	11 45	7-12		Tracy Island, Korea, S. Coast	8 58	11½	8½
Tamar R., George Town, Tasmania	12 5	10	7½	Trincomalie Har., Ceylon, S. Coast	8 18	2	1½
—, Launceston, Tasmania	1 0	12½		Tringano R., G. of Siam, China Sea, W. Coast	8 0	7	
Tamatave, Madagascar, E. Coast	4 18	8		Trinity Opening, Great Barrier Reefs	9 15	7-12	
Tanabé, Ki Channel, Japan Sea	6 0	6	5½	Troubridge Shoals, Aus- tralia, S. Coast	3 30	6	
Tangtang Harbour, Ma- dagascar, E. Coast	4 30	6		Tsang-chow Id., Bias Bay, China, E. Coast	8 30		
Tanjong Api, China Sea		7		Tsau-liang-hai or Chosan Harbour, Japan Sea	7 45	7	5
—, Bolus, Malacca Strait	9 30	10½	8½	Tsu-sima Sound, „	8 30	8	6
Tanna, New Hebrides	5 35	3		Tsugar Strait, „	5 0	5	
Tappanooly Harbour, Su- matra	6 10	6		Turon B., Cochin China	3 0	4	
Taranaki, or New Ply- mouth, New Zealand	9 30	12	9	Tuticorin Harbour, G. of Manar, Bay of Bengal, W. Coast	1 15	2½	1½
Tatiyama Bay, Japan Sea	5 50	5		Tutukaka Harbour, New Zealand	7 0	9	7
Tauranga Harbour, New Zealand	7 10	6	4½	Tweed River (Danger Point), Australia, E.C.	9 45	5-8	
Tavoy R. (entrance), Bay of Bengal, E. Coast	10 30	20		Twofold Bay, Australia, E. Coast	10 0	7	5
Tay-bay-oo-bay, China Sea, E. Coast	10 15	6		Tylatiap Harbour, Java, S. Coast	8 45	3½	
Tebonkos Road, Baly. N. Coast	5 0	6½		Typa Anchorage, China, E. Coast	10 0	7	
Thirsty Sound, Australia, E. Coast	10 45	12-18		Ummen Nakheilah, Per- sian Gulf	7 30?	8?	
Thompson Sound, New Zealand	11 30	8	6	Underwood Port, New Zealand	6 10	8	6
Thorny Passage, Spencer Gulf, Australia, S. Coast	12 0	6-8		Unsang, Borneo	8 0	3½	
Three Hummock Island (E. side), Bass Strait	10 30	10		Upstart Bay, Australia, E. Coast	9 0	6	
Three Kings' Islands, New Zealand	8 0	7		Urakami, Japan Sea	7 30	6	5
Ticao Island (Port San Jacinto), Filipinas	6 30	6		Uranouchi, „			5
Tien-pak Harb., China, E. Coast	12 0	8½		Ursula Id., Palawan, China Sea, E. Coast	11 0	7½	
Tinghae, Chusan, China, E. Coast	11 0	12	9	Ushruff Islands, Red Sea	6 14	2	
Toboe Ali Point, Banka Strait	8 30PM* 10 0AM†	12		Vansittart's Saddle, Yel- low Sea	4 20	10	8½
				Vao Port, Isle of Pines, New Caledonia	8 6	4	
				Venus Harbour, Austra- lia, S. Coast	2 15	6	

* In S.E. Monsoon.

In N.W. Monsoon.

PLACE.	High Water, Full and Change.	RISE.		PLACE.	High Water, Full and Change.	RISE.	
		Spgs.	Nps.			Spgs.	Nps.
	H. M.	ft.	ft.		H. M.	ft.	ft.
Vernon Channel (Chusan Arch.), China, E. Cst.	9 40	14		West River, China, E. Coast, see Si Kiang.			
Vernavab, Hindostan, W. Coast	12 15	16		Western Port, Australia, S. Coast	1 10	8	6
Victoria R., Mosquito Flat, Australia, N. W. Coast	12 19	15-24		Whampoa { In March (Docks), } { In April } { In May & June }	1 40 1 15 0 30	7-8	
— Sandy Island, Australia, N. W. Cst.	1 17	3-10		White Dog Ids., China, E. Coast	9 0	18	
— Turtle Point, Australia, N. W. Cst.	7 15	7-13		Wide Bay, Australia, E. Coast	9 14	10	7
Vincent, St., Cape, Madagascar, W. Coast	4 45	12		William Port, New Zealand	12 45	8	6
— Port St., New Caledonia	5 50	4½		Willis Islets, Australia, E. Coast	8 0	6	
Vladimir, St., Bay, Gulf of Tartary	irr.	2		Willoughby Cape, Kangaroo Id., Australia	4 10	6	
Volcano Ids., China, E. Coast	11 30	15	7½	Wilson Promontory, Australia, S. Coast	2 0	10	
Wahasy Harb. (Ceram), N. Coast, Moluccas	6 0	3		Woodlark Id., Louisiade Archip.	7 15	4	
Waikato R., New Zealand	9 30	12	9	Wreck Reef (Bird Islet), Australia, E. Coast	8 3	6	
Wallis Id., Torres Strait	irr.	7		Wuchu, Si Kiang, China, E. Coast		1-1½	
Wanchu R. (entrance), China, E. Coast	9 0	15½		Wusung River (entrance), Yang-tse-Kiang, China, E. Coast	0 30	15	10½
— (City), China, E. Coast	9 30	15½		— (Pheasant Point)	0 35	13	8
Wang-kia Bay, Yellow Sea	2 30	9	7	Wynkoops Bay, Java	5 0	4½	4
Wang-kia-tia Bay, Yellow Sea	6 0	12	9	Yang ho, Yellow Sea	0 15	6	
Wanganni R., New Zealand	10 15	8	6	Yang-tse Kiang (entr.), China, E. Coast	12 0	15	10
— Inlet, New Zealand	11 20	7	6	Yedo Bay (Yoku-hama), Japan	6 0	6½	4½
Wangari Harbour, New Zealand	7 0	0	7	Yoku-hama, Yedo Bay, Japan Sea	6 0	6½	4½
Wangaroa Harbour, New Zealand	8 15	7		York C., Australia, E. Coast	11 15	10	7
Wangaruru Harb., New Zealand	7 10	9	7	Yung R., Chiuhae, China, E. Coast	11 20	12½	
Wapitagan Harb., Gulf of St. Lawrence	10 30	5	3	— Ning-po-fu, China, E. Coast	1 0	9	
Warnboro' Sound, Australia, W. Coast		3-4		Yung-hing Bay, Japan Sea	5 20	2½	
Warbeek Roads, Africa, E. Coast	4 30	8		Yura Harbour, Japan Sea	6 5	6½	
Waterloo B., Africa, S. Coast	4 0	6		Zambezi River (Pearl Id.), Africa, E. Coast	4 30	12-15	
Wei-hai-wei Harb., Yellow Sea	9 30	9		Zanzibar, Africa, E. Cst. (Channel), Africa, E. Coast	5 20	10	
Wellesley Is., Australia, N. Coast	7 30	8-12		Zaudzi, Mayotta, Comoro Islands	4 10	12	
West Hill, Australia, E. Coast	10 20	24		Zebu Port, Filipinas	12 0	7	
				Zeyla, Africa, E. Coast	7 15	8½	

CHAPTER VIII.

CURRENTS IN THE INDIAN OCEAN, CHINA SEA, AND WESTERN PACIFIC.

129. Currents are the channels through which the waters of the ocean circulate, and their strength and direction depend concurrently on the action of a variety of causes, to each of which it would be difficult to assign the exact portion of effect belonging to it. The rotation of the earth on its axis, the difference of temperature between the tropical and polar seas, evaporation, the direction of the wind, whether perennial, periodical, or variable—these are the chief agencies, sometimes and in some places acting together, at other times and in other places opposing each other; hence it is not difficult to understand that some currents must be *warm*, others *cold*; some are *surface*, others *under* currents; while some are *periodical*, and others *variable*, changing with the periodical or variable winds, now flowing to augment the strength and breadth of a *constant* current—now tending to oppose, though unable to counteract it.

Another distinction of an important character in connexion with currents is their classification (according to their apparent origin) into *drift* and *stream*. Every constant or very prevalent wind (such, for example, as the Trades) that sweeps the ocean, drives before it the surface water in the form of a *drift* current; impelled to leeward, it moves on until it meets some obstruction, all the while tending to produce an accumulation of *flowing* water, which eventually gives rise to a *stream* current. The drift current is generally shallow, and its velocity will depend greatly on the force of the wind and its angle of incidence on the surface: the obstacle opposing its onward progress may be land or a stream current already formed. A *stream* current is the flowing off of the accumulated waters of a drift current in the effort to restore the equilibrium of the general surface-level of the ocean, and it may be of any bulk, depth, and velocity. A drift current when opposed by a stream already formed will either fall into and augment the latter, if the angle which its direction makes with that of the stream current be less than a right angle,—or, if it be greater, the drift itself becomes a stream current, and in this case takes a *parallel* but opposite course to that of the stream by which its progress has been interrupted.

130. Sketch of the General Currents of the Ocean.—Before entering on any details of the currents of the Indian Ocean, it will not be out of place to give a brief sketch of the general circulation of the entire body of waters constituting the three great oceans:—

The Pacific Ocean, owing to its vast extent, allows a fuller sweep to the general currents than either the Atlantic or Indian Ocean. The Antarctic Polar Current, bent eastward by the prevailing winds of those regions, strikes the western coast of America between Lat. 55° and 45° S.; there it divides into two branches, of which one runs southward, doubling Cape Horn, and carrying its waters to the Atlantic;—the second and principal branch passes along the coast of Chili and Peru, cooling the climate of that region by the low temperature of the waters it bears, which are from 18° to 22° Fahr. colder than the neighbouring sea off Lima; this current, to which is given the name of “Humboldt” (who was the first to prove its

origin and abnormal temperature), suddenly quits the coast near Aguja Point, and flows westward to join the great Equatorial Current.

The Equatorial Current in the Pacific occupies a breadth of nearly 50° , and extending on both sides of the Equator, stretches beyond the tropics N. and S.; it follows its peaceful and majestic course unobstructed, with an average speed of from 30 to 35 miles a day, to the chain of islands that fringe the continents of Asia and Australia. On the north it reaches Formosa, and, running upon the coast of China, turns off and passes to the N.E., along the shores of Japan, as the Black Stream—the gulf-stream of the Pacific. On the S., it becomes disturbed by the Monsoons, and loses its way in the labyrinthine mazes of the Indian archipelago, thus producing other and often stronger currents, which add to the dangers of the navigation of those stormy seas.

In the northern part of the Pacific the W. winds reigning there determine a drift current, which advances to the American coast, and conducts the waters southward along the shores of California, whence they doubtless re-enter the Equatorial Current, to commence a new circuit.

The Arctic current seems in the Pacific to be almost nothing. The bank or neck, which connects the neighbouring points of the continents of Asia and America under the water of Behring's strait, hinders the under currents which come from the pole from entering, while the warmer waters of the Pacific pass on the surface unobstructedly into the Frozen Ocean.

In the Indian Ocean, the Equatorial Current, like the Trade-wind, is broken. In the region of the Monsoons, or the northern region, the currents alternate, and follow the direction of the periodical winds, flowing with them six months in one direction, and six months in another. But in the S., where the Trade-wind retains its empire, the normal current holds its way, narrows as it approaches Madagascar, passes north of that island, and, stemmed by the coast of Africa, enters the channel of Mozambique. Jammed into this narrow passage, it acquires the enormous speed of three to five miles an hour, and, reinforced S. of Madagascar by the other branch, it reaches in its rapid course the Cape of Good Hope and the Agulhas bank, the borders of which it follows at a distance from the coast. Here it spreads out and divides; one part encounters the current setting from the Southern Atlantic, and with it re-enters the Indian Ocean; the other branch doubles the Cape, enters the Atlantic, and, flowing at a short distance from the western coast of Africa, proceeds to blend its waters with those of the Equatorial Current of that ocean.

The form of the Atlantic Ocean—the small breadth it presents in the region of the Equator—and the deep windings of the Caribbean Sea and the Gulf of Mexico, in which nearly all the tropical waters of this ocean are accumulated, as in a receptacle having no outlet, give to its currents an aspect peculiarly well marked. The Equatorial Current does not here assume its customary proportions, while the return current—the Gulf Stream—assumes a very striking character.

The Equatorial Current is joined, as we have said, by the current of the Cape of Good Hope issuing from the Indian Ocean: starting from the coast of Southern Africa, it soon extends on both sides of the Equator, widens considerably, and flows across the ocean at the rate of two or three miles an hour. Having reached the coast of America, it divides at Cape St. Roque. One branch flows southward along the coast of Brazil, and, together with the waters of the southern basin, finally takes the route to the eastward. The other and principal branch takes a W.N.W. direc-

tion, sends its waters along the shores of Guayana, enters the Caribbean Sea, penetrates into the Gulf of Mexico, of which it makes the circuit, and passing before the mouths of the Mississippi, arrives at the narrow passage between Florida and the island of Cuba, whence it comes forth under another name: the accumulated and moving waters of the Caribbean Sea and the Gulf of Mexico are thus the inexhaustible source of that current of warm water, which, under the name of the Gulf Stream, makes its way through the Bahamas, flows along the coast of Florida at a rate varying from two to five miles an hour, according to the season, and keeps on its way upon a line parallel to the shore at a short distance from its margin, until it passes beyond Cape Hatteras. The Stream, hitherto narrow, deep, and rapid, meets in this vicinity the cold waters from the N., and more to the N. it encounters the obstruction of the great sand-banks off Newfoundland: repulsed by these, it makes a sudden turn to the E., becomes much broader, spreads over the surface, and goes on with slackened course to the Azores, from whence it bends towards the S., in order to recommence from the coasts of Africa the vast cycle of its never-ending rotation. The warm waters of the tropics conveyed by this current advance northward even beyond the limits just indicated: driven by the S.W. winds prevailing in the North Atlantic, they proceed to bathe the coasts of the N. of Europe, the temperature of which they soften, and often deposit on the lonely shores of Scotland and Norway the plants and seeds of tropical regions,—unanswerable witnesses of their distant course.

On considering the narrow breadth of the Gulf Stream from its origin to Cape Hatteras, one is led to ask how it can be sufficient to cover with warm water the immense surface which it occupies from this point to the Azores. The beautiful observations made under the able direction of Professor Bache give the answer; for numerous thermometrical soundings prove that off that cape the depth of the current is such, that at the depth of 3000 feet it presents nearly the same difference of temperature, compared with the surrounding sea, as it does at the surface. It is evidently these deep waters which appear at the surface when it spreads out; for as it loses in speed, the warm waters are free to ascend and to take the place assigned to them by their less density. The current only changes *form*, and, in advancing, *loses in depth what it gains in width*.

The polar currents of the Atlantic are perceptible chiefly on the coasts of America. Hudson's and Baffin's Bay and the Sea of Greenland pour their waters and their ice along the eastern coast of the American continent, and contribute to lower the temperature of that region.

Such are the most important features presented by the circulation of the waters of the ocean; and as a broad generalization of all atmospheric and oceanic movements, it may be observed that the WINDS (or *aërial* currents), and the CURRENTS of the OCEAN, alike form part of a great system of circulation, the special characteristics of which can be thus expressed:—

1. Between the Tropics, the winds and the oceanic currents have a prevailing direction to the westward.
2. In Middle Latitudes, the prevailing currents of the air and the ocean alike tend towards the eastward.
3. In High Latitudes, the general direction of the winds and of the oceanic currents is from the Poles towards the Equator, *i.e.*, from N. to S. in the Northern Hemisphere, but from S. to N. in the Southern Hemisphere.

The following brief summary of the currents of the ocean—with their mean direction and velocity—will be useful for ready reference:—

North Atlantic Ocean.

PRINCIPAL CURRENTS.	Mean Direction.	Rate.
Equatorial current	W. ...	30 to 50m. per day.
Guayana current	N.W. ...	20 to 30 "
Current of the Caribbean Sea and Gulf of Mexico	— ...	15 "
Gulf Stream	N.—N.E.—& E. ...	60, 30, 20 "
Current of North Africa	S. ...	20 "
Guinea current (along coast)	E.S.E. & E. ...	20 "

SECONDARY CURRENTS.

Current of Bay of Biscay	E. ...	6 to 10 "
Renel's current	N.W. ...	10 to 20 "
Portugal current	S.S.E. & S.E. ...	16 "
Current at Strait of Gibraltar (entrance)	E. ...	12 "
Drift of the N.E. Trade-wind	S.W. ...	10 "
Arctic current (American coast)	S. & S.W. ...	24 "

South Atlantic Ocean.

PRINCIPAL CURRENTS.	Mean Direction.	Rate.
Brazil current	S. ...	20 "
Southern connecting current	E.S.E. & E. ...	15 "
Current on W. coast of Africa	N. ...	15 "
Antarctic drift current	E.N.E. & E. ...	10 to 25 "

SECONDARY CURRENTS.

Drift of the S.E. Trade-winds	N.W. & W.N.W. ...	10 "
Current between the Guinea and Equatorial currents	N.W. ...	12 "
Cape Horn current	N.E. ...	18 to 30 "

Indian Ocean.

PRINCIPAL CURRENTS.	Mean Direction.	Rate.
Equatorial current	W. ...	12, 16, & 22 "
Mozambique current	S.W. ...	18 to 28 "
Agulhas current	S.W. ...	20 to 80 "
Counter current S. of Agulhas current	E. ...	30 "
Counter current of S. Indian Ocean	E. ...	very variable

SECONDARY CURRENTS.

S.W. branch of Equatorial current	S.W. ...	30
Current of S. Australia	E. ...	26 to 14 "
Bay of Bengal and Arabian Sea, variable with the Monsoons	— ...	—

North Pacific Ocean.

PRINCIPAL CURRENTS.	Mean Direction.	Rate.
Equatorial current	W. . .	30m. per day.
Kuro Siwa, or Black Stream	N.E. . .	30 to 50 „
Californian current	S.E. . .	16 „

SECONDARY CURRENTS.

Kamtschatka current	N.W. . .	8 „
Behring's current	N. . .	14 „
Equatorial counter current	E. . .	18 „

South Pacific Ocean.

PRINCIPAL CURRENTS.	Mean Direction.	Rate.
Equatorial current	W. . .	24 „
Current on S.W. coast of Australia	S. . .	12 „
Counter current of S. Pacific	E. . .	20 „
Antarctic drift	E.N.E. . .	very variable
Humboldt or Peru current	N. . .	15 „

SECONDARY CURRENTS.

Mentor's current	N.E. . .	16 „
Current of Cape Horn	S.E. . .	18 „

SPECIAL REMARKS ON THE CURRENTS OF THE INDIAN OCEAN.

131. Equatorial Current.—The Equatorial Current in the Indian Ocean is only found S. of the Equator, its northern limit coinciding with the equatorial limit of the S.E. Trade-wind—namely, the parallel of 10° S. On the meridian of 100° E. its southern limit reaches as far as Lat. 25° S., but, as the current advances westward, it inclines to the northward, decreasing in breadth until, on the meridian of Rodrigues, it does not extend beyond the parallel of 20° S. Off this island it separates into two branches—one flowing S.W., and the other N.W. The S.W. branch of the Equatorial Current entirely surrounds Mauritius, and its northern edge, passing S. of Réunion, reaches the S. coast of Madagascar; here its breadth is 450 to 500 miles, and its temperature 76° Fahr. From thence it flows S.W., to form the Agulhas current, which commences S. of Natal: the S.W. current on this parallel is not more than about 70 or 80 miles across, and its temperature has been found as high as 70° or 72° . Off Réunion the velocity of the current varies from 10 to 15 miles a day: off the S. point of Madagascar it has been found to run from 40 to 50 miles.

The western branch of the Equatorial Current runs W.N.W. and N.W., and passing round the N. end of Madagascar, strikes the African coast near Cape Delgado (Lat. $10^{\circ} 41'$ S.); here it divides into two branches—one, during the S.E. Monsoon, flows northward past Zanzibar towards Cape Guardafui, but during the N.W. Monsoon it is deflected to the eastward before reaching the Equator,—the other branch enters the Mozambique Channel, where, as the well-known MOZAMBIQUE CURRENT, it flows along the E. coast of Africa. The mean breadth of this portion of the Equatorial Current is 360 miles, and off Cape Amber its mean rate is

about 50 miles a day; but it has occasionally been found running from 60 to 70 miles—this strength of the current, however, never extends beyond 50 miles northward of Cape Amber: its temperature is about 78° Fahr.

The velocity of the Equatorial Current in mid-ocean is very variable; sometimes it attains a rate of 20 to 22 miles a day, but its mean is about 12 or 16 miles.

The temperature of this current, from its origin on the eastern side of the ocean until it reaches the meridian of Rodrigues, gradually increases—varying from 72° to 82° Fahr. over that extent.

The following "bottle papers" indicate (approximately) the set of the northern part of the Equatorial Current in the Indian Ocean:—

- (1) A bottle thrown from the *Futta Sultan*, June 10th, 1853, in Lat. $6^{\circ} 10' S.$, Long. $90^{\circ} 40' E.$, was picked up at Brava, E. coast of Africa, in Lat. $1^{\circ} 7' S.$, Long. $44^{\circ} 3' E.$, in 1856.
- (2) A bottle thrown from the *Panther*, Feb. 3rd, 1857, in Lat. $11^{\circ} 19' S.$, Long. $84^{\circ} 21' E.$, was picked up between Brava and Juba Islands, E. coast of Africa, in July, 1857.

132. Mozambique Current.—The Mozambique Current, as just observed, is derived from the Equatorial Current, and follows the line of the African coast from N.N.W. to S.S.E., until off Cape Padrone it unites with the S.W. branch of the Equatorial Current: off Mozambique this current has been known to set S.E. by E. 4 knots an hour; off Cape Corrientes it has been reported as setting from 70 to 90 and even 120 miles a day; but these are probably extreme cases,—the mean velocity from Cape Delgado to Cape Corrientes may be estimated at from 30 to 40 miles a day; it has been found running 40 miles a day off Natal, at the distance of 20 miles off shore. It is said that this current is stronger during the S.E. than the N.W. Monsoon—owing to the accumulation of water from the Equatorial Current which is at that season forced by the wind towards the African shore; but this is uncertain. The temperature of the Mozambique Current ranges from 70° to 75° Fahr.

133. COUNTER CURRENTS AROUND MADAGASCAR.—In that part of the ocean comprised between the Agulhas Current, the S.W. branch of the Equatorial Current, and the S.W. coast of Madagascar, the currents are often very variable, sometimes setting E.S.E. and S.E. between Cape Corrientes and Madagascar, but generally N. and N.E. near the eastern edge of the Agulhas Current, between it and the S.W. branch of the Equatorial Current. These counter currents sometimes attain a velocity of 15 to 20 miles a day.

It has been observed that the S.W. branch of the Equatorial Current flows round Rodrigues and Mauritius, yet does not reach Réunion; off this island it appears to send offshoots setting N.W., N.N.W., and N.

In the area comprised between the E. coast of Madagascar and the bifurcation of the Equatorial Current, the set of the waters is not only variable in direction but in strength also—greatly depending on the prevalent wind of the season.

In the vicinity of the Comoro Islands the currents are uncertain both in strength and direction: to the northward of them, however, a north-westerly current running from 12 to 18 miles a day may be expected, while to the southward of them an easterly current is not unfrequent; through the group the current is westerly; but great caution is required hereabouts, as the set may be 2 or 3 knots either way.

On the W. coast of Madagascar a weak northerly current generally prevails, as is also the case in the middle of the Mozambique Channel southward of Lat. 18° S.

134. Agulhas Current.—On a parallel between Port Natal and Cape Padrone the union of the S.W. branch of the Equatorial Current and that through the Mozambique Channel forms the well-known Agulhas Current, flowing at first near the shore, and thence *following the course of the edge of the Agulhas bank*—but *passing over its southern extreme*; near the meridian of 20° E. its velocity is greatly diminished, and it breaks into two branches—one running to the north-westward into the Atlantic, and the other (obstructed by the Antarctic drift) turns to the eastward as the *counter current* of the Indian Ocean.

The breadth of the Agulhas Current is from 30 to 50 miles; but this as well as its velocity greatly depends on the winds and seasons. Off Cape Recife its rate is sometimes 100 miles a day, and frequently 70 or 80 miles, but by the time it has reached the meridian of 23° or 24° E. it has diminished to 50 or 60 miles a day.

A strong gale from the W. or S.W., lasting for some time, may check the velocity of the Agulhas Current by diverting it earlier into the counter current of the Indian Ocean, but it runs all the stronger afterwards; generally, however, it continues its course in the teeth of the gale, producing thereby a dangerous wall-like sea.

The Agulhas Current, although perceptible on the bank, is comparatively feeble; and near the African coast—especially between Capes Hangklip and Agulhas—there is an easterly set.

The temperature of the Agulhas Current is higher than that of the waters on either side of it—N. or S.—so that it may easily be known whether a vessel is in it or not.

WILKES* remarks that—"On our track from the China seas towards the Cape of Good Hope, we met with but little current until we approached the E. coast of Africa. We had, during this part of our voyage, an opportunity of trying the deep-sea temperature daily, which confirmed the impression that this portion of the ocean is but little liable to submarine streams,

"On approaching the E. coast of Africa, we found ourselves at first influenced by the Polar Stream, then, as we neared the coast, by the Equatorial Stream that sets down the Mozambique Channel. This stream is usually confined to narrow limits, but at some seasons becomes strong enough to throw its waters in a S.W. direction beyond the Agulhas bank. There is little doubt that this Equatorial Stream is superficial, overlying the Southern Polar Stream, a portion of which latter, touching the Agulhas bank, is forced up by that obstruction to the surface. This is evident by its reducing the temperature of the waters, on soundings at the Cape, to 62°. This Polar Stream is divided by the Cape: the eastern part sets along the E. coast of Africa as a submarine stream, and on reaching the island of Madagascar is found to flow N., along its W. shores. The other and larger portion is deflected, and flows to the northward, along the W. coast, and finally forms the Great Equatorial Stream of the South Atlantic."

The following abstract on the currents of the southern extremity of Africa is from

* "Narrative of the United States' Exploring Expedition, 1838-1842." By CHARLES WILKES, U.S.N., Commander of the Expedition, vol. v. p. 477.

CAPT. SIR J. C. ROSS' "Voyage of Discovery in the Southern and Antarctic Regions, 1839-1843":—

1. With respect to the Polar Current:—March 8th, 1840, in Lat. $32^{\circ} 21' S.$, Long. $17^{\circ} 6' E.$, 45 miles from Paternoster Point, sounded in 127 fathoms; expected to find an *elevation* of temperature both of air and sea on approaching the African coast, by reason of the radiation of heat from its shores; but by 1h. P.M. the temperature of the sea had fallen from 70° to $56^{\circ} 5'$ —that of the air being 65° . The cause of the depression of temperature became evident on sighting Cape Paternoster, for a current increasing in strength and coldness, as we neared the land, was found to exist. The following is a summary of the experiments on it:—Barely reaching 40 miles from shore, where the sea is more than 300 fathoms deep, this current spreads over double that distance in shallower parts; 45 miles from land, and at a depth of 120 fathoms, the temperature of the water was 40° , that of the surface 56° ; and 60 miles off land, at 200 fathoms, the temperature was $43^{\circ} 5'$, the surface being 61° . Thus a northerly current of very limited extent, but of considerable force, exists from the Cape of Good Hope along the W. coast of Africa, which in general terms may be represented by a volume of water 60 miles wide and 200 fathoms deep, averaging a velocity of 24 miles a day, and of the mean temperature of the ocean, running between the shores of Africa and the waters of the adjacent sea. The mist which hangs over this stream of cold water is occasioned by the condensation of the vapour of the superincumbent atmosphere, whose temperature is generally so many degrees higher than that of the sea.

2. Next, with respect to the Agulhas and Counter Current of the Indian Ocean:—April 11th, still on the Agulhas bank, the S. limit of which in Long. $21^{\circ} 20' E.$ is between Lat. $36^{\circ} 37'$ and $36^{\circ} 44' S.$, or about 130 miles from Cape Agulhas.

April 13th, 14th. It rained at times 'sheets of water,' violent squalls and momentary calms; rapid changes both in strength and direction of the wind; carried 30 miles S. of our supposed position, and next day 50 miles S.W., by the current, after which it changed to N.W., running at the rate of 68 miles per day, or nearly 3 miles per hour, in direct opposition to the wind.

April 16th, Lat. $41^{\circ} S.$, Long. $25^{\circ} E.$, another change in the current carried us N. $75^{\circ} E.$ 22 miles in 24 hours; we were now S. of that stream which, taking the direction of the Natal coast, is known to extend far out to sea, and got a counter current setting to the eastward at the rate of 1 mile per hour.

135. Counter Current of the Southern Indian Ocean.—This current, so important to vessels bound for Australia, is formed by a S. and S.E. drift from the Equatorial Current of the Indian Ocean uniting with a branch from the Agulhas Current, which is suddenly deflected to the eastward by the cold Antarctic Current flowing towards the Equator, the tendency of which is that it gradually combines nothing with easting, so that off Cape Leeuwin it bifurcates; from this point one branch sweeps northward along the W. coast of Australia, and finally rejoins the Equatorial Current near the Tropic of Capricorn,—while the other branch, setting along the S. coast of the same continent—as the AUSTRALIAN CURRENT—eventually passes into the Pacific.

The velocity of this counter current is very variable—depending greatly on the winds; on the meridian of $30^{\circ} E.$ it sometimes runs from 30 to 40 miles a day, and

its breadth is often from 200 to 250 miles between the parallels of 38° and 42° S. As it advances eastward it probably spreads out, and thereby diminishes its rate, but it has been found to run with considerable strength between the island of St. Paul and Cape Leeuwin during the Austral summer. The north-easterly current on the S.W. coast of Australia sometimes runs from 20 to 30 miles a day.

The temperature of this current is as variable as its velocity.

The following "bottle papers" indicate (approximately) the general set of the current in Great Southern Ocean, between Cape Horn and Australia:—

- (1) A bottle thrown from H.M. Antarctic exploring ship *Erebus* (CAPT. JAMES Ross), April 4th, 1842, in Lat. $53^{\circ} 39' S.$, Long. $60^{\circ} 47' W.$, was picked up at Cape Liptrap, S. coast of Australia, Lat. $38^{\circ} 55' S.$, Long. $145^{\circ} 57' E.$, in September, 1845.
- (2) A bottle thrown from the *Ambarawa*, August 20th, 1845, in Lat. $38^{\circ} 31' S.$, Long. $27^{\circ} 36' E.$, was picked up 10 miles W. of Cape Bridgewater, S. coast of Australia, Lat. $38^{\circ} 24' S.$, Long. $141^{\circ} 12' E.$, May, 1851.
- (3) A bottle thrown from the *Ocean Chief*, Jan. 1st, 1857, in Lat. $42^{\circ} 40' S.$, Long. $42^{\circ} 32' W.$, was picked up at sea by the *Gideon Howland*, in Lat. $39^{\circ} 50' S.$, Long. $36^{\circ} 35' E.$, Dec. 16th, 1857.

MAURY,* speaking of the *S. and S.E. drift current of the Indian Ocean*, says that "it seems to be an overflow of the great intertropical cauldron of India; seeking to escape thence, it works its way polarward more as a drift than as a current. It is to the Mozambique Current what the northern flow of warm waters in the Atlantic is to the Gulf Stream. This Indian overflow is very large, and finds its way S., midway between Africa and Australia, and appears to lose itself in passing round a sort of SARGASSO Sea, thinly strewed with patches of weed. We need not be surprised at such a vast flow of warm water as the currents in the S.W. area of the Indian Ocean indicate, when we recollect that this ocean is land-locked on the N., and that the temperature of its waters is frequently as high as 80° Fahr." He has also marked on his "Chart of Sea Drift" an area extending from Lat. 40° to 50° S., and between Long. 15° and 107° E., indicating the flow of this warm water from the middle of the Indian Ocean. But whether the weed is derived exclusively from that ocean, or whether (as appears most probable) it may not be the result of the two currents—one from the Indian and the other from the Antarctic Ocean—bearing their united drift eastward, is not well-established; certain it is, however, that seaweed is found thereabouts in large quantities. The same authority says that on the polar side of 35° S. "146 log-books make mention of it between the meridians of 40° and 120° E.; but it *most* abounds along *this* line between the meridians of 45° and 65° E., and between the parallels of 42° and 48° S.

Abstracts of the log-books of the following vessels show where this seaweed has been passed by our own Australian traders:—

1853—*Lord Auckland*—Capt. Thompson.

Jan. 2nd—	Lat. $44^{\circ} 4' S.$	Long. $45^{\circ} 52' E.$	} Water discoloured—seaweed.
" 3rd ...	44 53	49 4	
" 4th ...	45 0	52 4	

* See "The Physical Geography of the Sea, and its Meteorology."

1853—*Fly Away*—Capt. M. Sewall.

Oct. 22nd—Lat. 43° 46' S. Long. 56° 7' E.	{	Saw patches of rockweed and kelp.
„ 26th ... 42 45 79 56	{	Saw quantities of rockweed and kelp.
„ 27th ... 42 21 82 40		Saw patches of rockweed.

1853—*Malay*—Capt. S. Hutchinson.

Dec. 24th—Lat. 48° 59' S. Long. 52° 9' E.	{	Passed kelp, and saw a diving water-fowl.
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1854—*Parana*—Capt. F. Langston.

Jan. 8th—Lat. 44° 36' S. Long. 43° 30' E.	
„ 9th ... 44 58 48 36	
„ 10th ... 45 9 52 53	

Between Jan. 7th and 15th, seaweed, birds, and whales reported.

1854—*Kent*—Captain Coleman.

Sept. 27th—Lat. 43° 33' S. Long. 46° 14' E.	{	Saw seaweed.
„ 28th ... 43 26 51 5		
„ 29th ... 43 57 56 11		

1854—*Gertrude*—Capt. W. Phinney.

Oct. 2nd—Lat. 47° 2' S. Long. 70° 3' E.	Water discoloured.
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1855—*Kent*—Capt. Coleman.

July 4th—Lat. 43° 46' S. Long. 48° 26' E.	{	Water green—seaweed.
„ 5th ... 43 16 53 53		
„ 6th ... 43 27 59 37		

1855—*Lady Hodgkinson*—Capt. Wilson.

Sept. 22nd—Lat. 42° 53' S. Long. 52° 34' E.	
„ 23rd ... 43 6 54 27	Birds numerous
„ 26th ... 45 10 70 37	Much seaweed about.
„ 27th ... 45 29 76 15	Much seaweed.

1856—*Sir Ralph Abercrombie*—Capt. Boyd.

Aug. 17th—Lat. 44° 21' S. Long. 45° 31' E.	{	Penguins—sea greenish.
„ 18th ... 43 46 51 12		
„ 19th ... 43 34 56 56		

1856—*Maid of Judah*—Capt. Marchant.

Aug. 30th—Lat. 42° 18' S. Long. 78° 0' E.	Seaweed.
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1857—*Norfolk*—Captain Coleman.

May 9th—Lat. 44° 11' S. Long. 44° 13' E.	{	Seaweed.
„ 10th ... 44 0 49 4		
„ 11th ... 44 4 54 16		

1859—*Essex*—Capt. J. S. Atwood.

Jan. 15th	—Lat. 43° 5' S. Long. 81° 27' E.	} Seaweed.
„ 16th	... 43 25 87 49	
„ 17th	... 43 36 91 10	
„ 18th	... 43 21 94 35	

1860—*Norfolk*—Capt. J. S. Atwood.

May 2nd	—Lat. 42° 55' S. Long. 52° 57' E.	} Seaweed.
„ 3rd	... 42 56 59 44	

1861—*Norfolk*—Capt. J. S. Atwood.

Dec. 20th	—Lat. 45° 48' S. Long. 57° 40' E.	} Seaweed.
„ 21st	... 45 25 59 44	
„ 22nd	... 45 35 65 42	
„ 23rd	... 45 11 71 24	
„ 24th	... 45 7 78 27	
„ 25th	... 45 9 84 27	
„ 26th	... 45 19 90 3	

1863—*Essex*—Capt. J. S. Atwood.

Oct. 23rd	—Lat. 43° 59' S. Long. 44° 38' E.	} Seaweed.
„ 24th	... 43 59 49 50	

The frequent occurrence of seaweed and birds hereabouts has often led seamen to think there are more islands scattered on this route than are already laid down on the chart, but this is not probable. CAPT. J. FAWCETT, of the *Harriet Humble*, says:—10th Nov. 1853, being in Lat. 43° 44' S., Long. 40° 47' E., the sea became very dark, being green and deeply discoloured, as if we were on soundings; and the following day a piece of tangle was picked up, which, from the freshness of its stem, appeared to have been recently broken off. This discoloration of water continued until we had reached the meridian of 53° 30' E., and it then rather suddenly resumed its natural colour. The temperature of the water when discovered was 44° in 45° E., and in 53° E. 46·5°, air being between 47° and 49°, and the wind from W. to N.N.E.; in 54° E. Long. the temperature of the water suddenly rose to 55°; and this circumstance, coupled with the appearance of soundings and floating tangle, induced me to believe in the existence of a very considerable bank hereabouts. Had we been becalmed, I should certainly have tried for bottom; on a former voyage I noticed a similar discoloration of water hereabouts, but then, as now, had plenty of wind propelling us along, thus preventing me trying a cast for soundings, and a person is loth to heave-to in a fair wind, merely to satisfy his curiosity as to bottom or no bottom; though bottom I have no doubt could be obtained, and that at no very great depth.

“We sailed on nearly an E. course at least 550 miles from the time discoloured water was first discovered, and its temperature fell, until it regained its natural deep blue again and a higher temperature.”

We could produce additional testimony, all tending to the same effect—viz., that over a linear distance of 30 to 50 degrees of Long. seaweed and birds are frequently seen, that the water has a discoloured appearance as if in soundings, and that fogs

are very prevalent: we have also three records of earthquake shocks. Captains not unfrequently enter in their logs, when noticing the discoloured water, that they should like to try a cast for soundings, "but the wind being fair, they are unwilling to heave-to." If an opportunity offers for taking a cast of the lead, they would do well to try.

We would also call attention to CAPT. SIR J. C. ROSS's experience in this part of the ocean when on his Antarctic cruise:—

Nearing the 40th parallel, and to the eastward of the meridian of Cape Agulhas, he was carried 30 miles to the southward of his supposed position, and on the next day 50 miles to the S.W.,—he next encountered a N.W. current. May 3rd, in Lat. $47^{\circ} 17' S.$, Long. $58^{\circ} 30' E.$, he passed seaweed, and was accompanied on his course by an albatross, a large dark petrel, speckled cape-pigeon, stormy petrel, &c. Visiting Kerguelen Island, he spent 68 days in Christmas Harbour, on 45 of which it blew a gale, and there were only three days on which neither snow nor rain fell (June, July): thence proceeding to the eastward, towards Tasmania (July 21–24), he found "seaweed in abundance, current strong, a general tendency of the surface waters to the eastward, occasioned probably by the westerly winds, which, at this season at least, prevail almost as steadily as do the Trade-winds in equatorial regions: several kinds of petrel, the only birds seen: the temperature of the sea rose suddenly from 37° to 46° Fahr., extending over a space of 86 miles; it had previously been at 35° ."

136. Australian Current.—This current flows to the eastward along the S. coast of Australia, being strongest between Point d'Entrecasteaux and King George Sound, where its velocity is sometimes from 24 to 36 miles a day: in the bight it is comparatively weak, but generally strong at some distance from the land. Towards Bass Straits the easterly set is from 26 to 24 miles a day, and then it turns to the southward along the W. coast of Tasmania: finally passing the S. point of that island, and running E. and N.E., it loses itself in the Pacific. In Bass Strait the current is greatly complicated by the tides. The breadth of this current is generally less in summer than in winter, especially after strong southerly gales have sent up large masses of ice and icebergs to the parallel of $45^{\circ} S.$: again, after strong westerly winds have blown continuously for weeks in succession, its velocity is considerably augmented.

137. In the northern part of the Indian Ocean the currents and surface-drifts are complicated by the Monsoons, and vary with the seasons; as a consequence they are very irregular, and often change in a very capricious manner.

138. Currents in the Arabian Sea.—As already observed (p. 210), the northern part of the Equatorial Current of the Indian Ocean from the meridian of Rodriguez turns to the N.W.-ward, and, as two of the "bottle papers" (p. 211) show, this northerly direction continues for at least a part of the year—probably during the period of the S.W. Monsoon. But between the parallels of $5^{\circ} N.$ and $5^{\circ} S.$, and between the meridians of 50° and $80^{\circ} E.$, it may be said that good observations on the direction of the currents in this area at the different seasons of the year are so few that nothing is known for certainty of their general set; they pro-

bably depend on the Monsoon and its strength. Be this as it may, however, there is always, on the northern edge of the Equatorial Current, an easterly set varying from 18 to 30 miles a day.

During the S.W. Monsoon the current N. of the Equator sets N.N.E. along the African coast, at the rate of 40 to 60 miles a day, spreading out to the eastward as it advances, and consequently losing in velocity; it passes through the channel between Cape Guardafui and Socotra at the rate of 30 to 50 miles a day, and continuing its N.E.-ly course reaches the Arabian coast near Kosair, and so flows onward to the head of the bay at the rate of 20 to 30 miles a day. In the middle of the bay the current is more or less easterly, inclining to S.E. as it approaches the western coast of Hindostan, and its velocity varies from 12 to 30 miles a day.

The island of Socotra (and perhaps a plateau surrounding it) offers an obstruction to the direct progress of the N.E.-ly current, and the consequence is that to the southward of this island, to the distance of 150 miles, there is a great whirl of the stream; it strikes off eastward on the parallel of Rás Hafún, but near the meridian of 55° E. it turns to southward as far as Lat. 5° N., when it curves to the westward and finally completes the whirl by flowing N. On the northern edge of this large eddy the velocity is often 4 or 5 miles an hour, but rarely more than 1 or 1½ miles on its southern edge. On the northern side of Socotra it is supposed that a similar whirl on a smaller scale exists; but this is uncertain. HORSBURGH says that the currents run with the prevalent winds to the N.E., and that when these abate in strength, an equally rapid current sets in the opposite direction,—such may be the case near the land.

During the N.E. Monsoon, especially when it is strongest, the current sets with the wind to the southward and eastward, from Rás Jezírat to the Straits of Bab-el-Mandeb, but soon changes its course to E. and N.E. when southerly winds are prevalent.

On the E. coast of Arabia, during this period, the currents are very irregular and variable, changing from one direction to another without any apparent cause. From Rás Jezírat to Rás-al-Hed a N.E.-ly current sets at the rate of 18 to 24 miles a day, and is only checked when the Monsoon is very strong from the northward. During January and February a weak current, variable in direction, is felt along the coast; and late in February a strong northerly set, 20 to 35 miles a day, has been found running between Rás Madraka and Rás-al-'Awáni. In March the N.E. current is comparatively weak, but in April it is again strong along the whole coast.

COMMANDER J. P. SAUNDERS, who was surveying here in the brig *Palinurus*, says that, “as early as the 9th February the winds set in from the southward, and with the southerly winds an easterly current from Ras Seger to Ras Risút.

“As we approached Ras Seger the currents became stronger, running constantly from half a knot to 2 knots per hour to the eastward, with light S.S.W. winds lasting for a few hours during the day, and then succeeded by calms which lasted the remainder of the 24 hours. The currents are not so strong, and the winds are more favourable to the W.S.W. of Rás Farták.”

139. Currents of the Gulf of Aden.—As is the case in the vicinity of Socotra, so the current in the Gulf is in a continual state of whirl or eddy *during the S.W. Monsoon*. On the Arabian side it runs to the eastward as far as Rás Rehmat, whence it strikes off in a S.E.-ly direction towards Cape Guardafui, then turning west-

ward along the African coast as far as the meridian of 47° E., it curves to the N.W.-ward. On the same meridian the current from the STRAITS OF BAB-EL-MANDEB, which has heretofore been running to the eastward, also curves up N. and N.W.—so completing and augmenting the eddy. The velocity of this current varies throughout the Gulf from 12 to 24 miles a day.

During the N.E. Monsoon the currents have been found so irregular that they baffle all accurate description; they appear, however, to be greatly under the control of the wind which, when it blows strong, drives the water before it; but the whirl is always more or less present in the centre of the Gulf.

On the Arabian shore the set is generally southward and westward unless checked by a southerly wind, when it changes its direction to E. and N.E. On the African (or Somali) coast it frequently runs to the eastward, but may set in the opposite direction without any apparent cause.

140. Currents of the Red Sea.—The currents of the Red Sea are almost entirely regulated by the winds. When a southerly wind prevails, the current flows to the Northward; and with a northerly wind, it sets to the Southward,—its strength also depending on that of the wind; during the change of the Monsoons there is scarcely any current.

Off Jiddah, in different seasons, the current attains a velocity of 1 or $1\frac{1}{2}$ miles an hour. North of Jiddah it varies greatly throughout the whole year; but a strong wind may give it a velocity of 20 or even 40 miles per day.

From May to October, in the *northern part* of the Red Sea, the level of the water is nearly 2 feet lower than during the other months of the year—the effect of strong northerly winds prevalent during that season over the whole area of the sea; the result is a continual current flowing through the Strait of Bab-el-Mandeb into the Gulf of Aden, which is so rapid that even with a stiff breeze from S.W., a vessel is sometimes unable to make head against it.

From October to May, when southerly winds prevail in the lower part of the Red Sea, the current changes and sets rapidly to the northward; the mass of water having no outlet, now accumulates in the northern part of this sea, and attains a greater elevation than during the northerly Monsoon.

The temperature of the water of the Red Sea has been found at 86° Fahr. in the strait of Bab-el-Mandeb; 85° off Mocha; 84° to 82° south of Jiddah; 77° in the North part of the Red Sea; and 71° at its extremity.

CAPTAINS MORSEBY and ELWON, in the “Red Sea Pilot,” observe that the currents seem to be entirely governed by the winds; during the prevalence of southerly breezes, they run to the N., and with northerly winds to the southward. It is also probable that they increase according to the strength of either, as there was little or none at all during the prevalence of light variable airs previous to the setting in of the S. winds.

1829. In November, the current during a strong S. wind set to the N.W., about 1 mile per hour off Jiddah harbour.

1830. In December, lat. 21° N., on the Arabian side, it set to the N. $1\frac{1}{2}$ mile per hour.

1831. In November, off the Outer Reefs on the Arabian side, it set along them N.N.W. 1 mile per hour.

1832. In February there appeared to be no current in the neighbourhood of Jibbel

Teer during light winds. In August of the same year, the current in the S. part of the sea set to the S. 1 mile per hour.

1832. In the beginning of October there seemed to be no current; and afterwards, on the N. part of the Farsan banks, it was setting to the N. about $\frac{1}{2}$ of a mile per hour amongst the banks and islands on the Outer reefs. With the exception of those already mentioned there was an imperceptible and irregular flow of tide and current through the several deep-water channels, but intermixed so much with eddies from the numerous islands and shallows, that it was quite impossible to ascertain it with any correctness.

CAPTAIN MORSEBY further remarks that "the currents in the Red Sea, from Jiddah to Ras-Mohammed, are various all the year; no particular direction can be assigned to them. It may be generally remarked, they set with the prevailing winds, which, when strong, cause a current of sometimes 20 and 40 miles a day. If the wind continues long in the same quarter, they sometimes set against it, which can be seen by the short, deep swell, in a N.W. wind, against which the best sailing vessels make nothing for the first and second days, when all at once they unexpectedly get to windward. Southerly winds, which sometimes prevail from October to May, generally bring a current from 20 to 30 miles a day with them. After a north-wester has been blowing, and light winds prevail, a current generally sets to the northward, more especially on the Arabian coast; on which account the Arabian side, with the northerly winds, is the best to work on, and not the Egyptian coast, which the old navigators preferred on account of its being more clear of shoals. On the Arabian coast a vessel will be able to take advantage of the winds, if she is near the reefs and coast, which winds almost always bear several points more from the land as the night advances, and particularly in the early part of the morning, and are well open to seaward during the day. This is not the case on the Egyptian coast, when northerly, N.E., and easterly winds prevail; at times, from November to March, they cause a strong current to the westward, and as the wind becomes light, it sets back again to the eastward."

141. The following additional remarks on the CURRENTS IN THE RED SEA, in the GULF OF ADEN, and on the ARABIAN COAST, are by CAPTAIN S. B. HAINES, I.N., who was engaged for a considerable time surveying those parts:*

"It is an established fact that the water is raised to a higher level in the northern parts of the Red Sea during December, January, February, and March, from the force of the strong southerly winds that then blow up that sea; and that in July, August, and September, it is several feet lower from the force of the strong N.N.W. winds blowing down towards the Straits. This fact is proved by the 'Durable' shoal, which, though situated in the middle of the sea, is at one time sufficiently dry to have a tent pitched upon it, and at another season is covered with water. The same difference of elevation may be also observed on the coral reefs near Jiddah.

"On the Arabian coast, from Ras Isolette to the Straits of Bab-el-Mandeb, in shore, during the strength of the N.E. Monsoon, the current runs with the wind. In March and April (and sometimes as early as February) this current changes, and it flows towards Isolette during the S.W. Monsoon. In April, I have measured the

* "Jour. Roy. Geographical Society," 1845, p. 150.

current with the patent log, and the vessel at anchor, and found it setting up the coast at the rate of 2 miles per hour, and much faster off the Palinurus shoal. In May, June, and July, I have also measured the current at different stations on the Arabian side between Aden and the Straits, when at anchor, in from 6 to 10 fathoms, and found it 2 and $2\frac{1}{2}$ miles E.N.E., varying in rapidity with the strength of the wind. During the N.E. Monsoon it sets with equal velocity into the Red Sea. This would materially tend to prove the effect of pressure; but strange as it appears, though the wind is the same on the Sómálí* coast, or the S. side of the Gulf of Aden, during the N.E. Monsoon, the currents are sometimes running in a precisely contrary direction without any apparent cause. This led me, at one time, to imagine that the narrow entrance to the large body of water within the Red Sea (which is, moreover, reduced by the islands called the Brothers) forms a kind of barrier or point of deflection; that the current from the Mozambique channel rushing past Ras 'Aseir at 3 or 4 miles per hour, bifurcates at that point, one branch going northwards, while the other, diminished in rapidity by the absence of the strong southerly wind, sweeps along westward as far as the Straits, when being influenced by the current out of the Red Sea, it turns up eastwards, gradually recovering its former velocity, as it again comes under the influence of the Monsoon. While the two coasts forming the Gulf of 'Aden have their own currents, the central part of the sea has others running in every direction, except during strong breezes, when pressure undoubtedly influences the whole. Thus, for instance, a vessel in July, crossing over from Burnt Island with a strong westerly breeze, will find the current change from W. to N.W., N., N.E., E.N.E., increasing in strength as she approaches the Arabian coast, and will probably be prevented from fetching it within twenty miles of 'Aden under a press of canvas. During the N.E. Monsoon, of course, a contrary rule prevails; and a vessel leaving Berberah for 'Aden will work up some 15 or 20 miles E. of Siyárah before she ventures to stretch across to the Arabian coast.

"A vessel running up her northing on the east side of the African coast during the S.W. Monsoon, and wishing to stand for Aden or the Red Sea, should be very careful for the last two or three degrees, as N.N.E. and N.E. currents will be met with. I have found a current of three or four miles an hour, which, as you round the Cape, sweeps more eastward towards Socotra; in a sailing vessel, therefore, the Cape should be rounded close, otherwise she may lose her passage, as I have known to be done by a fast-sailing vessel.

"Northwards of Tahl Far'ún and the Brothers, from June to September, I have always experienced a strong N. or N.E. current, which renders it difficult to fetch the anchorages on the north side of Socotra. In July, when in the latitude of the north side of Socotra, and only $1\frac{1}{2}$ degrees west of Ras 'Aseir, I have had light airs and calms, with a current 58 miles due S., while in previous years, and in almost the same position, I have found a N. current, which gradually drew eastward as the vessel stood to the S.E.

"On the north side of Socotra in March and April, I invariably found a strong W.

* This current on the Sómálí coast in the N.E. Monsoon is very uncertain. The natives say, that when the current on the Arabian coast is running one way, that on the Sómálí coast is generally opposite. In the N.E. Monsoon vessels have met strong northerly currents when to the northward, or rather when Ras 'Aseir was open, which, as soon as the cape was shut in, changed to the westward. Again, currents frequently set to the eastward, between Zella and Berberah, during the N.E. Monsoon.

current, so much so that I have known a fast 10-gun brig take twenty days to make Tamaridah from Kolonsir, and she then succeeded only by standing over to the Arabian coast, and working up along it eastwards before she stood across; and I was obliged to anchor my vessel at the first place where I could obtain anchorage ground, and proceed in one of my boats to Tamaridah, throughout March, owing to the light airs and strong currents.

"The true cause, therefore, of these currents appears to me to be principally the pressure occasioned by the prevailing monsoons, increasing and decreasing in the same ratio as the winds, and influenced in some degree by the moon's age, and consequent change of the tides, which are by no means regular."

142. Currents of the Persian Gulf.—From May to September a current flows into the Persian Gulf, and from September to May it sets outwards. In March and April, during the little *shemal*, when a northerly set prevails, a vessel working to windward may make good 20 or 25 miles in twenty-four hours.

From September to April the current sets southward in the space between the Persian coast off Ras Task and the opposite coast of Arabia; and it is very seldom at this period that the current is found setting towards the Persian Gulf.

From March to September, though northerly winds prevail in the gulf, the current in the strait of Oman sets against the wind with so much strength that a vessel might make 20 miles a day to windward.

In October, on the coast of Persia, with the N.E. Monsoon, the current flows Southward till March; in April it changes with the S.W. Monsoon, and then flows Northward. When the S.W. Monsoon is at its height the current sets rapidly to the Eastward along the Persian coast.

CAPT. C. G. CONSTABLE and LIEUT. A. W. STIFFE, I.N., in the Persian Gulf Pilot, observe that—

"The greater part of the currents supposed to exist in the gulf are probably tides; a vessel crossing the gulf in six or eighteen hours would, of course, attribute the error in her position to a current. Currents, which are always very weak, are probably confined to the northern end of the gulf, where the tides are less strong than near the entrance, and during a north-wester or south-easter, are replaced by a slight current setting with the wind; after the strength of the north-wester is over, a slight counter-current may be experienced.

"McCLUER states, and others have repeated after him, that on the fourth day of a *shemal* a current will be found setting 1 knot per hour against the wind, so that a vessel will be able to make good way to windward; but this statement requires further corroboration, at any rate asserting it as an invariable occurrence.

"On the Bâtneh coast, particularly near Muskat, where the tide stream is imperceptible, there is, during the summer months (when the S.W. Monsoon prevails outside), a set towards the N.W. not exceeding 1 knot per hour. Ships coming out of the gulf should not then attempt to work down close to this coast. During the winter months, when north-westerns prevail in the gulf, there is an almost continual set from $\frac{1}{2}$ to 1 knot per hour, or even more, to the south-eastward, so that a ship would find it very difficult to beat up to Muskat near the coast."*

* These remarks on the currents are written with a full knowledge of the Wind and Current Charts published in 1856 by the E.I.C., from which they differ widely.

143. Currents on the West Coast of Hindostan.—From November to March—the period of the *N.E. Monsoon*—the currents along the northern portion of this coast are generally weak and variable, but from Calicut to Cape Comorin they set to the S.E.-ward with a velocity of 20 to 30 miles a day.

In March and April, when strong N.W. winds are prevalent, a S.E.-ly current runs along the entire coast. A northerly current is not unfrequent between Cape Comorin and Anjenga during January.

During the S.W. Monsoon a southerly current is generally experienced, varying from 5 to 10 miles a day on the northern part of the coast, and increasing to 20 or 30 miles a day along the southern part from Cochin to Cape Comorin; off Bombay this southerly current is rarely found, and to the northward of this port, when the wind is strong from the southward, a northerly current may be expected. The set of the stream from the overflow of the large rivers is first from the coast, and then to the southward.

The *INDUS* discharges an immense volume of water into the Arabian Sea during the flood season—between July and September; the current, which is at first south, diverges to the S.S.W. and S.S.E., and attains a breadth of 250 miles, but it is not wholly lost in the general oceanic set until its seaward course has reached 300 miles.

144. Near the *Laccadives*, during the S.W. Monsoon, S.-ly and S.W.-ly currents are found, particularly in March. Among the islands the direction of the current is S.S.W.; in the channel separating them from the Malabar coast the set is about S.S.E.

In the *NINE DEGREE CHANNEL* the current generally runs S.W., and rarely to the northward. In February, March, and April, its direction may be S.S.E.

The velocity of the current during this season between the *Laccadives* and the coast varies from 20 to 26 miles a day; amongst the islands it is from 18 to 24 miles a day.

From 40 to 60 leagues westward of these islands, W. and W.S.W. currents are prevalent, flowing at the rate of 8 to 12 miles a day. However, between the islands, a northerly current is occasionally found flowing at the rate of 8 or 10 miles a day.

145. About the *Maldives* the current more generally sets to the eastward than in any other direction, but modified by local causes.

When the S.W. Monsoon blows in its strength—during June, July, and August—the current sets easterly in the vicinity of the North Atoll; while at the same time, but generally in July and August, the set is W.N.W. near the southern part of the group—in the Equatorial Channel and about the South Atoll.

To the eastward of the North Atoll, generally in March and April, it runs W.; and on the contrary, near the South Atoll, between the Equator and the parallel of 4° or 5° S. Lat., it sets E.N.E.; this current has often a velocity of 50 to 65 miles a day, but sometimes it is weak and variable. In May it runs strong to the eastward near the Equator, sometimes setting at the rate of 50 to 70 miles a day near the South Atoll, between the parallels of 2° N. and 2° S.

In the Equatorial Channel and in the latitude of the South Atoll, from October to January, the current flows to the eastward; while between the parallels of 3° and 5° N., and between the *Maldives* and Ceylon, it sets westward with great strength.

Among the islands N. of the Equator the current runs S.W., and among those situated S. of the Equator it runs S. and S.S.E. at this season of the year.

During the N.E. Monsoon, but especially in November and December, on the meridian of Point de Galle, the current sets at the rate of 30 to 35 miles a day, decreasing in strength on its Equatorial edge.

146. Currents in the Gulf of Manaar.—Throughout the Gulf of Manaar and off Colombo the currents are uncertain *during the N.E. Monsoon*; sometimes, however, they have been found setting to the S.W. at a rate of 18 or 20 miles a day. *During the S.W. Monsoon* a current runs into the gulf at the rate of 8 miles a day, and setting northward, follows the direction of the coasts into Palk Bay. Generally there is the greatest variation in the strength and direction of the currents during the change of the Monsoons.

147. Currents round Ceylon.—On the E. coast of Ceylon, *during the N.E. Monsoon*, but especially in October and November, a strong current sets to the southward along the coast; rounding the S. coast it takes a westerly direction as far as Point de Galle, and sometimes as far as Colombo. Its velocity has been estimated to average 40 to 48 miles a day; and on rare occasions it has been found to amount to 94 miles.

On the W. coast of Ceylon during the same season the currents are very variable. Sometimes a fresh N.N.E. wind blowing for several days will produce a moderately strong current setting northward along the coast; this is probably a continuation of that which on the E. coast takes a southerly direction, and on the S. coast of the island flows to the westward.

During the S.W. Monsoon the current flows to the eastward on the S. coast of Ceylon, and northward on its eastern coast: its velocity is never so great as during the N.E. Monsoon—at least near the coast of the island—and it is less in proportion as it approaches the shore; off the N.E. part of the island it has been estimated to run from 10 to 20 miles a day. From May to September no current is found on the E. coast of the island; while out at sea the set may be strong to N.N.E. and N.N.W. When the westerly winds are in full force, there is little or no current within 15 or 18 miles of the land.

CAPT. W. J. S. PULLEN, when surveying the dangers on the S.E. coast of Ceylon (in May, June, and July, 1860), found “the currents in the vicinity of the GREAT and LITTLE BASSAS REEFS alike remarkable for their rapidity and eccentricity. In the line of and between the two reefs, that is, about 6 miles off shore, during the S.W. Monsoon, the current sets along the coast to the N.E. at the rate of 1 to 2 miles per hour, only diverging from this, its apparently natural course, when within the influence of the broken ground of the reefs. The rate appears to be influenced by the strength of the wind, and is, consequently, most irregular.

“Towards the close of July, when running a meridian distance to the Great Bassas from Galle, notwithstanding that he had allowed fully 10 miles easterly current, he found that he had drifted outside the line of the Bassas Reefs; and at daylight, instead of having them in sight, was at least 10 miles to the S.E. of them—no bottom with 100 fathoms of line; set by a current $26\frac{1}{2}$ miles in 14 hours, or 1.85 the hour, on about a S. by E. course. Nor was this the strongest current

experienced, nor in the only place. About half-way between the two reefs a current of $2\frac{1}{2}$ knots, on an E. by N. course, was found.

"Midway between the line of the reefs and the shore the direction of the current assumes a more northerly trend, and the rate is reduced, until it at length becomes absorbed in an in-shore eddy, which was almost invariably found setting along the coast to the S.W. at the rate of half a mile per hour.

"Between Point de Galle and the Bassas the current sets along the line of coast, the rates varying at different times, without any apparent cause, from 1 to 2 miles per hour, but said at times to attain the rate of even 4 knots. To the northward of the Little Bassas, close in on the eastern shore, a decided southerly set was experienced at the rate of nearly a mile an hour, which increased to a velocity of 2 knots near Trincomalie."

From September to March the southerly current is generally strong off Trincomalie, but especially so during October and November, when it sometimes runs from 50 to 70 miles a day.

148. Currents in the Bay of Bengal.—According to D'APRES DE MANNEVILLE, the currents depend entirely on the Monsoons; *during the N.E. Monsoon* flowing S. and S.W., but to the N. *during the S.W. Monsoon*.

In April the general movement of the waters is to the N. and N.E., the current attaining its greatest strength (varying from 10 to 20 miles a day) in April and May.

In the middle of the gulf, during March and April, the current is weak and variable; between the Coromandel coast and the Nicobars, as well as at the entrance of the Strait of Malacca, it frequently sets S.W.; in the northern part of the bay it often flows southerly in March, and northerly in April.

During the S.W. Monsoon, in the eastern part of the bay and near the Strait of Malacca, the current often has a southerly set, like that near the Malabar coast.

At the distance of 40 or 50 leagues from the coasts, in the middle of the Bay of Bengal, the S.W.-erly current begins regularly about the middle of October or beginning of November—the time *when the N.E. Monsoon is well established*: before this the current is variable, setting S.S.W. and even N.W., or to some point between these two directions.

In January the S.W.-erly current loses its strength; and in February ceases in the middle of the bay, and perhaps on the coasts also, where, however, if there be any set, it runs towards the N. and N.W.

149. West Coast of the Bay of Bengal.—The current generally sets to the northward about the end of March, its velocity increasing in April and May, during which southerly winds prevail with great regularity. After May it generally slackens or ceases, and during the subsequent months generally runs southerly, though not always. At the beginning and during the strength of the N.E. Monsoon the current has been known to run $2\frac{1}{2}$ and 3 knots an hour to the southward along the Coromandel coast, abating, however, in January. The northerly current along the coast of Coromandel and all the eastern coast of Hindostan from Ceylon to Balasore, varies in direction between N. and N.E.—sometimes even E.N.E. In August, the current from the swollen waters of the Ganges is strong and extends far to seaward, contributing to modify the northerly set, and partially arresting it.

During September to November a current setting W.N.W. or W.S.W. frequently prevails on the coast of Bengal. In March, the current along the entire coast most frequently flows to the southward—rarely to the northward. In the middle of the bay, during March and April, the current is very weak and variable.

150. Currents on the East Coast of the Bay of Bengal.—On the eastern side of the Bay of Bengal, and near the Strait of Malacca *during the S.W. Monsoon*, the current sometimes sets to the southward.

During the N.E. Monsoon, near the Nicobar Islands, and also between them and the island of Junkseylon, a strong N.W. current is found, which sometimes, however, sets N. Between Cape Negrais and Chittagong, the current is seldom strong at any season, but from the middle of December to May a southerly current is occasionally experienced there, and from June to September a northerly set.

Throughout the bay, in the month of December, there are no currents but those produced by the tides.

151. Currents in Malacca Strait.—The general current in Malacca Strait is to the northward all the year round, especially in the middle of the channel. *During the N.E. Monsoon*, while it is running northward from Arroa island to Junkseylon and Pulokondo, it occasionally sets to the southward, along the Malay coast, where it is always more or less complicated by the tidal stream.

During the S. W. Monsoon the set of the current along the coast of Pedir, and thence out of the Strait, is to the westward; whilst at the same time, on the opposite side, between Pulokondo and Junkseylon, it runs to the northward.

152. Currents on the West Coast of Sumatra.—On the west coast of Sumatra the current is seldom strong, generally not more than 12 to 18 miles a day.

The Monsoons are so variable on this coast that they seldom influence the current to any great extent, still the general prevalence of westerly winds is such as to drive a considerable body of water towards the west coast of Sumatra, whence it sets to the S.E. along the coast; it very rarely runs N. In June and July, between Analaboe and Acheen Head, a N.W. current, running 20 or 30 miles a day, has been experienced.

After the month of August, near Acheen, and thence along the S.W. coast of Sumatra, as well as on the south coast of Java, the current sets strongly to the eastward. A portion of the westerly current from Malacca Strait very frequently turns the N.W. point of Sumatra, and sets southward along the coast.

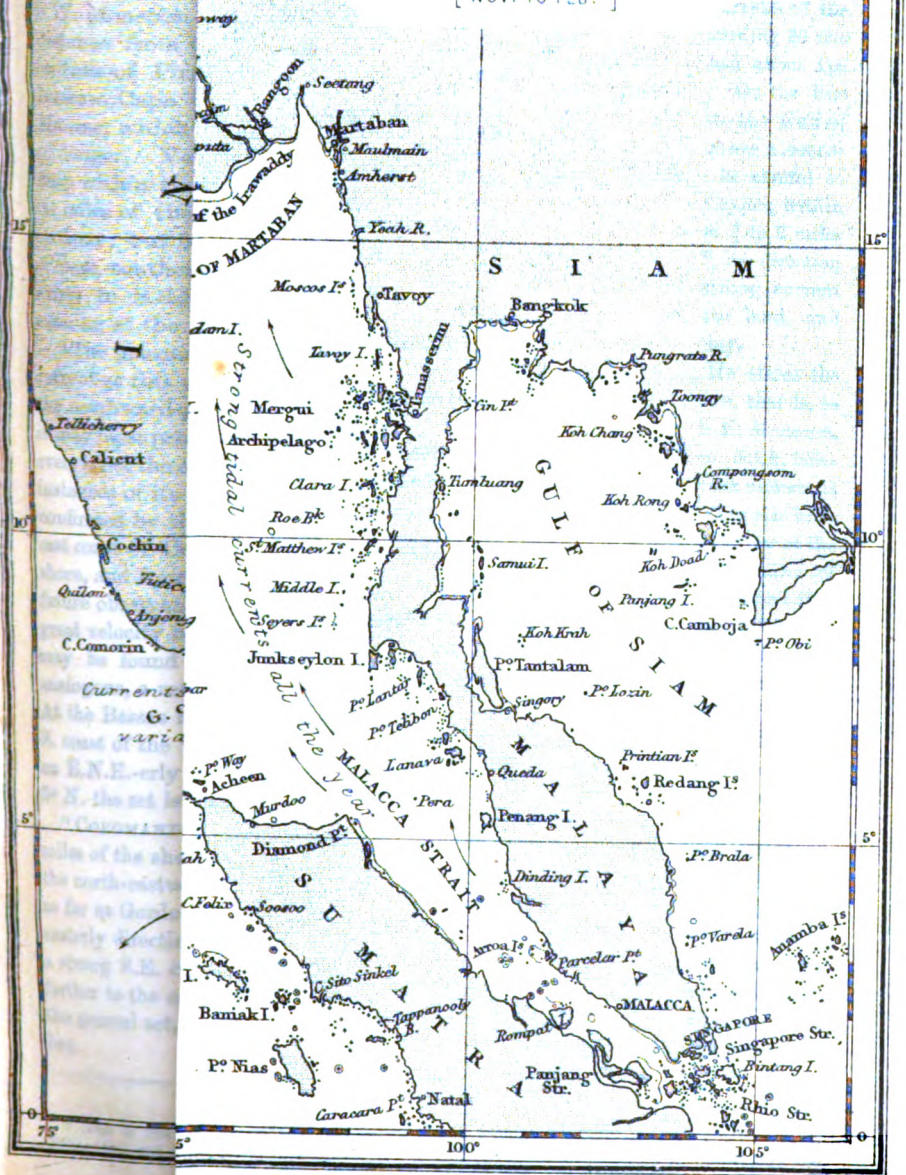
153. In Sunda Strait, from January to April, the current sets to the eastward, and during the rest of the year it has a westerly direction. The velocity of these currents is sometimes as much as 3 and $3\frac{1}{2}$ knots an hour.

154. Throughout the Bay of Bengal the currents are rarely, if ever, as strong as in the Arabian Sea; and they are always influenced by tidal currents near the coast. Owing to the difference in the set of the currents in the Northern Indian Ocean during the two Monsoons, two Charts of that part have been compiled, illustrating the general set during the prevalence of each periodical wind.

CURRENTS IN THE BAY OF BENGAL

During the N.E. Monsoon

[NOV^r TO FEB^y]



The first part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present. The author then proceeds to a detailed examination of the various factors that have shaped the development of the United States, including the role of the individual, the influence of the environment, and the impact of the social and economic conditions of the time.

In the second part of the paper, the author discusses the various theories of the origin of the United States. He examines the theories of the "divine right" of kings, the "social contract" theory, and the "natural rights" theory. He then discusses the various theories of the origin of the United States, including the theories of the "divine right" of kings, the "social contract" theory, and the "natural rights" theory.

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Most of the foregoing observations on the Bay of Bengal are from D'APRES DE MANNEVILLETTE, who has been, more or less, followed by all subsequent writers. It remains to draw the attention of the navigator to a paper* on the CURRENTS OF THE BAY OF BENGAL DURING THE S.W. MONSOON, by J. A. HEATHCOTE, Esq., I.N. :—

"CEYLON.—From the S.W. corner of the peninsula of India, the current of the S.W. Monsoon runs in a direction varying from S.E. to S.S.E., according to the distance from the land, and at the rate of $\frac{1}{2}$ to $1\frac{1}{2}$ mile per hour, until about the latitude of Point de Galle, it is diverted into a more easterly course. On the line between Cape Comorin and Point de Galle, there is a strong set into the Gulf of Manaar, which begins from 30 to 35 miles outside this line, and may prove a source of danger. Vessels from Bombay to the eastward should therefore be careful to keep within the limits of the favourable S.E.-ly current. South of Ceylon, within 30 miles of the coast, the current runs strongly to the eastward from $\frac{1}{2}$ to 2 miles an hour; but farther south, that is, between the parallels of 4° and 5° , its direction is more southerly, or about E.S.E. On the east coast of Ceylon a strong current exists to S.S.E. and S., taking more or less the direction of the land, and running at the rate of $\frac{1}{2}$ to $1\frac{1}{2}$ mile an hour, or as much as 40 miles a day.

"The inaccuracy of a deduction of HORSBURGH is here apparent. He states the current at this season to be here running in an entirely opposite direction, that is, to the northward; for he argues that, as it runs to the southward in the N.E. Monsoon, it may most probably run in a contrary direction in the opposite Monsoon. Such, however, is not the case. The southerly current is well established;† not only are numerous instances of its effects on record, but the result of my own investigations has also been confirmed by the observations of officers very recently employed on the survey of the east coast of Ceylon. This current is felt not farther than from 40 to 50 miles off shore, and from its eastern limits a N.E.-ly set begins. I think it very possible that future observations may prove that this current is a return of that which flows with great velocity round the S.E. corner of Ceylon to the N.E.-ward, a portion of which may be found to bend to the northward; for, under circumstances somewhat analogous, a return current of this description is found off Cape Guardafui in Africa. At the Bassas rocks it is met by that already described as setting eastward off the S. coast of the island; and they both together then take a N.E.-erly, and afterwards an E.N.E.-erly direction across the bay; except that in the vicinity of the parallel of 5° N. the set is less northerly, while S. of that parallel it becomes E.S.E.-erly.

"COROMANDEL.—On the coast of Coromandel a northerly set prevails within 30 miles of the shore, as far N. as the parallel of 15° ; outside these limits it turns to the north-eastward. North of the parallel of 15° it takes the direction of the land as far as Gordeware Point, and thence trends in an easterly and afterwards a north-easterly direction across the bay. From False Point nearly to Vizagapatam we have a strong S.E. current of $\frac{1}{2}$ to $1\frac{1}{2}$ mile per hour, within 30 miles of the coast; but, farther to the eastward, it gradually succumbs to the influence of the wind, and joins the general set, first in a north-easterly and then in an easterly direction across the bay.

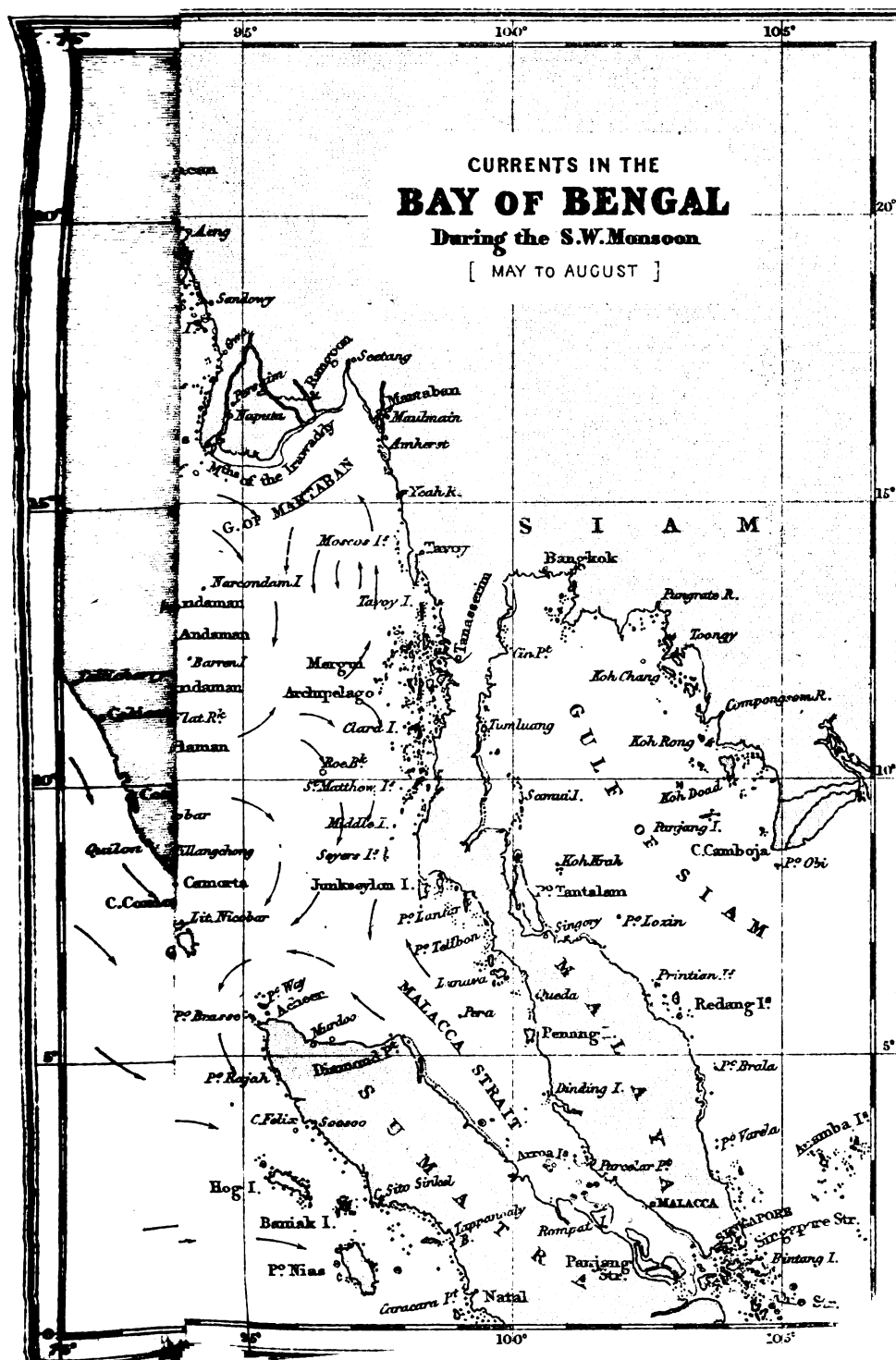
* "Jour. Roy. Geographical Society, 1862," p. 234.

† Logs of the *London*, July, 1830, of the *Warren Hastings*, and of the *Kellie Castle*, May and June, 1833, and of H.M.S. *Cambrian*, July, 1850, &c. &c.

"ARACAN.—On approaching the coast of Aracan the current becomes more northerly, and finally is governed by the form of that land, and runs strongly to the N.N.W.-ward. It thus becomes a very dangerous current for vessels making Akyab during the S.W. Monsoon. In such cases it is frequently necessary to heave-to off the port during the night; and if the existence of this current be not known, and proper precaution be not taken to keep to the southward, the vessel may be drifted into dangerous proximity to the reefs to the eastward of the harbour. In some of the works on this subject, all mention of this current is omitted, in others it is represented as running in a contrary direction; it is therefore the more necessary to call attention to it, as either the want of information on the one hand, or the existence of erroneous information on the other, may lead to injury to the greatly increasing trade of Akyab.

"CIRCULATION OF CURRENTS AND TIDAL WAVES.—This northerly current along the coast of Aracan may probably have a very intimate connection with the southerly current on the coast of Ganjam. They may both belong to the same system of circulation, the Aracan current finding its way to the westward along the sea-face of the Sunderbunds, and becoming the southerly current at False Point, and being again thrown on the coast of Aracan, as before described. But, if this be the case, any positive trace of the westerly movement is not to be discerned, or at least is most difficult to recognise in the peculiar rotatory tides which are found to seaward of the Sunderbunds. These tides set, at different periods of each tide, towards every point of the compass. The flood begins at W., at the first quarter it flows W.N.W., at half-flood it is about N., the last quarter being to E.N.E. The ebb begins at E., half-ebb runs about S., and the last quarter ebb W.S.W., thus forming a complete rotation. But although these rotatory tides go far to hide the current itself, its effects while working its way to the westward are observable in the configuration of the sand-banks off the mouths of the Ganges. The current would here exert its greatest force, and these sands are curved to the westward in a remarkable manner, their very form proving that they are under an influence stronger than that which bends the banks off the mouth of the Hoogly into their S.S.E.-erly position; the latter being due to the S.W. Monsoon itself, while the former is the effect of the current of the same Monsoon concentrated, as it were in a funnel, by the shores of Aracan. That the position of the banks off the mouths of the Ganges is *not* caused by the N.E. Monsoon, admits of but little doubt; for this portion of the sea is peculiarly sheltered from the N.E. winds, and they cannot be supposed to exert a force sufficient to affect the position of these sand-banks, as, were it so, the effects of this force would be apparent in a much greater degree to the westward; and the sands at the entrance to the Hoogly would lie in a south-westerly direction instead of their present south-easterly one.

"THE S.E. CURRENT.—A strong current to the south-eastward at the rate of $\frac{3}{4}$ to $1\frac{1}{4}$ mile per hour begins about Lat. 18° and Long. 90° , flows down towards Prepara Island, and then turns more easterly into the Gulf of Martaban. There is, no doubt, an accumulation of waters in the N.E. portion of the bay caused by the steady blowing of the S.W. Monsoon across the whole breadth of the sea; and this current seems to be the result of these waters attempting to find an exit. It may be of important advantage to ships from Calcutta bound to ports to the eastward, for it will materially help them in getting to the southward against the wind. From its eastern edge the currents turn off to the N.E.-ward, until near the coast of Pegu



they become governed by the form of the land, and take a course to the N.N.W., joining those on the coast of Aracan already described.

“**ANDAMAN ISLANDS.**—The Andaman Islands play an important part in the system of currents of the S.W. Monsoon. They present an obstruction to the general set of the waters in the middle of the sea; and the same phenomena are observable in their vicinity as are to be seen wherever fluids in motion meet with an impediment under similar conditions. The currents rushing to the eastward round the N. and S. extremes of the islands meet at a short distance beyond them, become confused and irregular, and throw up high rippings; while immediately under the shelter of the islands an eddy is found, running to the northward from $\frac{1}{2}$ to 1 mile per hour. That portion of the sea to the westward of the Andaman Islands is wisely avoided during the S.W. Monsoon, the reefs lying to windward of the islands presenting dangers to which every prudent mariner would gladly give a wide berth; and I have therefore been unable to find examples of actual experience of the currents to the west of the Andamans. But it is more than probable that the north-easterly set extends close up to the islands; the waters becoming, in a certain measure, heaped up on their west side, and making their way through them and round them wherever they find an opening. Evidence of this action is particularly observable at the eastern mouth of the narrow strait which separates the South and Middle Andaman. This strait was closely examined on the occasion of the expedition—of which DR. MOUNT was the head—appointed, towards the close of the Indian mutinies, to select a site for a penal settlement in these islands. I may remark, *en passant*, that the manuscript of the original survey of the Great Andaman by LIEUT. BLAIR, executed at different periods between 1788 and 1796, and drawn on a large scale, was in the hands of the expedition, and was found to be beautifully accurate in all its details. It was our sure guide in the intricacies of channels of which no other knowledge but that afforded by this chart was to be obtained; and in those few places where it is deficient in the representation of details, we found that they had not been passed over until it had been ascertained that they could be of no practical utility. The geographical position of these islands has also been determined so far satisfactorily, that though it may not be incapable of a still nearer approach to exact truth, yet it has, I believe, attained already to a higher degree of accuracy than can be claimed for the positions at present assigned to many places of far higher commercial importance.

“**MIDDLE STRAIT, GREAT ANDAMAN.**—The strait between the Middle and South Andaman is one of peculiar formation; it is for the most part a narrow deep crevice, between the mountains by which it is bounded on both sides, and which are in no part distant from it much more than 300 yards, while at places the rocks completely overhang it. The channel is thus narrowed at one or two points to about 80 yards, its general breadth being from 400 to 500 yards. Its depth varies, but it is mostly deepest where it is narrowest, 25 fathoms being found where the rocks abut immediately upon the channel, and 6 fathoms where they are more distant; a depth of from 12 to 14 fathoms is, however, very generally found throughout the narrow part of the strait—its western portion, where it runs north and south, being both broader and shallower. Its western entrance from the sea has now a depth of from 4 to 6 fathoms, it having been filled up to some extent during the last seventy years, while the interior of the strait has suffered scarcely any perceptible change. We found no variation in the depth nor in the contour of the shore; even small islets of less than 50 yards in length appearing in precisely the same state as to size, eleva-

tion, and position, as represented by the first surveyor. But while the depths before mentioned are found in the strait itself, its eastern mouth is almost closed by a bank of sand and mud, which has but from 6 to 10 feet water on it; and this, I believe, may be looked upon as the effect of the current of the S.W. Monsoon, which being driven, as before described, upon the west coast of the island, finds its way through this narrow strait, and deposits at its exit the sediment which it had taken up or set in motion on its passage. The area of drainage of this strait, though small, is sufficient to throw into it a considerable quantity of silt and sand; and the very form of this bank indicates that it has come out *from* the strait, and not that it has been thrown *into* the strait by any effort of the winds and currents of the N.E. Monsoon; and, moreover, were this latter the case, some corresponding effects would surely be observable at some of the other openings on the same side of the island, such as Port Cornwallis, the entrances north and south of Sound Island, and Port Blair, at all which places instead of shoals we find deep water. The strait between North and Middle Andaman is completely closed; it is now no longer a strait, if it ever was one; and this is not at all certain, for BLAIR had not the opportunity of surveying it. He probably found it impossible to enter even in a boat, as we did.

"In the open sea between the Mergui Archipelago and the Andamans, the influence of the prevailing wind again shows itself in a north-easterly set of $\frac{1}{2}$ to $1\frac{1}{2}$ mile per hour.

"A S.E.-ly and S.S.E.-ly current sets with considerable force down through the Mergui Archipelago and past the Seyer Islands; and from lat. 10° N. and long. 95° E., a strong current in the same direction sets, at the rate of $\frac{3}{4}$ to $1\frac{1}{2}$ mile per hour, into the entrance of the Malacca Strait. This current may probably be found some degrees farther to the eastward; but I have been unable to gather any facts in support of such a theory, though I know of nothing in opposition to it.

"The Ten-Degree Channel, between the Little Andaman and Car-Nicobar island, is so seldom made use of as a passage for ships during the S.W. Monsoon, that I have not been able to gather a sufficient number of facts to establish the existing current.

"SUMATRA.—On the north coast of Sumatra the current of the S.W. Monsoon follows the form of the land to the westward; but this portion of the sea is sheltered from the influence of the wind. A slight return current to the eastward may be experienced in about lat. $6\frac{1}{2}^{\circ}$ N.

"Between Acheen Head and the Great Nicobar an extraordinary current is found running to the south-westward in the teeth of the Monsoon at the rate of $\frac{3}{4}$ to $1\frac{1}{2}$ mile per hour; it extends to the parallel of 5° N., and nearly to long. 92° E., when it turns to the S. and S.E. Where this current meets the ordinary N.E.-ly set, strong rippings are observed. It may be taken advantage of by ships bound westward from the Straits of Malacca, and though it is at present but little known, its existence is well substantiated by the experiences of the *Herefordshire* in August, 1825; the *Orwell* in July, 1832; the *Marquis Huntley* in August, 1831; H.M.S. *The Royalist* in June, 1845; the *Cambrian* in July and August, 1844; the *Serpent* in 1845, and again 1851; and others."

185. Currents in the Indian Archipelago—S. of the Equator.—Among the **Islands of the Indian Archipelago**, the waters of the ocean being subdivided into a number of comparatively limited areas, there is no space for the development of the Equatorial Current; hence whatever currents prevail are under the control of the prevalent wind of the season, being westerly with northing during the E. and S.E. Monsoon—easterly with southing during the W. and N.W. Monsoon—modified at all times by the tidal streams.

As before observed (p. 226), the current is easterly in the **Strait of Sunda** from January to April, and westerly during the remainder of the year—setting sometimes at the rate of 60 or 80 miles a day.

In the **Java Sea**, both the easterly and westerly current is influenced by the set of those in the straits of Sunda, Banka, and Gaspar. JANSSEN, speaking of the currents in this region, says:—"It is sufficiently important to fix the attention, seeing that these circumstances have great influence upon the winds in the many straits of the Archipelago, in which strong currents run most of the time. Especially in the straits to the east of Java these currents are very strong. I have been unable to stem the current with eight-mile speed. However, they do not always flow equally strong, nor always in the same direction. They are probably the strongest when the tidal current and the Equatorial Current meet together. It is said that the currents in the straits during the E. Monsoon run eighteen hours to the N. and six hours to the S., and the reverse during the W. Monsoon. The passing of the meridian by the moon appears to be the fixed point of time for the turning of the currents. It is probable that the heated water of the Archipelago is discharged to the N. during the E. Monsoon, and to the S. during the W. Monsoon."

In the **Gaspar, Carimata**, and other straits in this part of the Archipelago, the currents set southerly with the N.E. Monsoon, and northerly with the S.W. Monsoon, but their direction greatly depends on the lay of the land and on the tidal stream; in fact, the latter are very strong throughout the whole Archipelago and in the China Sea, where the in-draughts between the islands produce strong eddies, and overfalls—resulting from the meeting of the streams over an uneven bottom—are very common. It should also be remembered that the time of high water at F. and C. varies in the two Monsoons, not being a *constant* as in other parts of the ocean.

In the Strait of **Macassar** the current is more frequently southerly than northerly throughout the year; it is always strong during the N.E. Monsoon, but especially so in December, January, and February; during the S.W. Monsoon if there is any current it as often sets gently to the S. as to the N.

Into the **Sea of Celebes** and the **Sulu Sea** there is generally a weak W. or S.W. current from the Pacific in both Monsoons, subject, however, at times, to a strong easterly set along the north shore of Celebes and the south shore of Mindanao. Hereabouts the currents are always remarkable for their variability—for from this part of the sea originates the Easterly Counter Current of the Pacific Ocean.

The currents are very rapid at all times in the narrow channels separating the chain of islands extending from Java to Timor.

In the **Arafura Sea** the set is still with the prevalent Monsoon, and its velocity depends on the force of the wind—seldom, however, exceeding 20 or 30 miles a day.

In the **Banda Sea and Molucca Channels** the strength of the current is greater during the N.W. Monsoon than when the S.E. Monsoon is prevalent; but

as the direction of the wind is less regular here than in the neighbouring seas, so is the direction of the current.

On the **N.W. Coast of Australia** a north-easterly current prevails, derived from the northerly current which, from Cape Leeuwin, sets along the west coast of the continent to join the Equatorial Current of the Indian Ocean. It is met with all the year round, but its velocity is very uncertain—probably never more than 12 to 18 miles a day, except in the Westerly Monsoon, when a strong easterly current sets through that part of the ocean southward of Java and the Sunda islands, and with this unites, to pass into the Arafura Sea. It may be also a prolongation of this north-easterly current which, on the north side of the Serwatty islands, sets to the eastward during the S.E. Monsoon, where, in the Arafura Sea, the current is westerly.

156. The Currents of the China Sea.—The currents of the China Sea are uncertain, depending for direction and velocity on the general prevalence and strength of the Monsoons—varying as these vary.

1. *During the N.E. Monsoon :—*

In the south-western part of the China Sea, along the east side of Malacca and the south coast of Cochin China, the current generally sets to the southward about the middle of October, and continues in that direction till the month of April. In March it sets constantly southward between the Anamba Islands and Singapore, with the light easterly winds and calms prevalent during that month.

On the **east coast of Cochin China**, and near the island of Hainan, the current, variable between S. and S.W., commences about the middle of September; it is strongest near the coast from 15° to 11° N. Lat., and becomes weaker in proportion as it flows to the southward.

During the strength of the N.E. Monsoon, from the parallel of 14° N. to Cape Padaran, the current near the coast frequently runs at the rate of 40, 50, and even 60 miles a day. This velocity, however, is not persistent, and it is certainly weaker near Cape Padaran, as well as across the entrance of the Gulf of Siam, where its direction is S.W.

Near the south coast of China, at this season, the current generally takes a W.S.W. direction, nearly parallel with the coast, and it is especially rapid after strong winds or a typhoon. At about 25 leagues from the land it is never so strong as in shore and between the islands; it is also stronger in shoal water than where the soundings are 30 or 40 fathoms.

In the Formosa Channel—between the island and the main—the current sets south. When the wind is strong, it takes a S.W. or southerly direction in the strait between the south end of Formosa and the north side of Luzon; here, however, when the wind is variable, the set is often northerly.

On the **west coast of Luzon** the current is very variable—sometimes southerly and sometimes northerly, as is the case on the coast of Palawan, where it depends entirely on the wind, and only becomes strong in proportion as it is driven by the gale.

2. *During the S.W. Monsoon :—*

In the middle of the China Sea a northerly set begins in May, or sometimes

at the end of April. When the S.W. Monsoon is strong, the current sometimes maintains a northerly and N.E. set until September; but when the Monsoon is light or moderate, the current is variable: thus there is no constancy during this season, and after the first burst is over, if there is any set it is as likely to be to the S. as to the N.E.

Off the coast of **Cochin China**, north of Cape Padaran, the current is always weak during the S.W. Monsoon; and between this cape and the Gulf of Tonquin it sometimes sets to the northward and sometimes to the southward.

With a N.W. gale prevailing in the Gulf of Tonquin, as well as to seaward, the current near the **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 currents in that case is oblique to that of the wind.

On the south coast of **China**, the current, during strong S.W. winds, sets to the eastward with the trend of the coast. The freshes generally produce a westerly current, and its rate between Macao and the island of St. John is from 1 to 2 miles an hour—its direction varying between W.S.W. and W.N.W.; this is but a temporary set, not lasting throughout the Monsoon.

Off the coasts of **Luzon** and **Palawan** the current sets to the northward during the whole of the S.W. Monsoon; but close in shore it is weak and scarcely felt.

Strong westerly winds near the **Bashee Isles** produce an easterly current; the set is more frequently, however, to the northward, varying at times from N.N.W. to N.E., and strong.

157. The late Commander W. T. BATE, R.N., referring to the vicinity of Palawan, where he had been employed surveying, says:—

"In the **Palawan Passage**, or **Balabac Strait**, the currents are influenced by the prevailing winds, the set being found to be in the direction in which it is blowing, with a velocity proportionate to the wind's force. Westerly winds are remarked as forcing through the strait a strong current to the eastward.

"In the **North Balabac Strait**, the current also depends greatly on the prevailing winds. It has been observed in both straits, that in the months of November and December, after a succession of westerly winds, the current sets constantly to the eastward, slackening only on the ebb tide; while in July, after a continuance of unusually fine weather, with light E. and S.E. winds, it sets with the same velocity, —viz., from $\frac{1}{2}$ to $2\frac{1}{2}$ knots in the opposite direction. The mean velocity observed for thirteen consecutive hours was $1\frac{1}{2}$ mile.

"In **Oologan Bay**, no perceptible current has been observed, except after heavy rains, or when westerly winds have prevailed, when there is a slight out-draught.

"On **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 $8\frac{1}{2}$ knots an hour to the northward."

158. Gulf of Siam.—In both Monsoons, the China Sea current barely enters the Gulf of Siam, but rather sets across its entrance between Pulo Obi and the Redang islands. At the head of the gulf, during the N.E. Monsoon, a strong westerly current is frequently found, against which it is necessary to guard when making the

Bangkok River, to avoid being set to leeward. From Cape Chong P'ra to Cui (or Sano-roi-yot) Point a northerly current may be expected during the S.W. Monsoon. Generally, near the land, the set is with the prevalent Monsoon, and strong in proportion to the force of the wind; but in the middle of the gulf the current is weak and variable.

Along the **East Coast of China** the current is northerly during the S.W. Monsoon, and southerly during the N.E. Monsoon; varying in velocity from 1 to 3 or 4 knots an hour, according to the strength and duration of the wind, and frequently throwing ships out of their reckoning.

Off the **Pescadores**, a northerly set of four knots an hour has been experienced during the Southerly Monsoon, with the flood to the northward, slacking, however, with the ebb, but not ceasing entirely: the "China Pilot" says that navigators "may safely allow that the effect of the current and tidal stream together, will set a ship, according to the prevailing Monsoon, seventeen miles in one tide."

To the eastward of Formosa, about **Hotel-tobago**, the currents are also changeable with the Monsoons.

159. Currents of the Western Pacific.—The **Great Equatorial Current** of the **PACIFIC** flows steadily from the American Continent towards the Islands of the Indian Archipelago, at the average rate of from 30 to 24 miles a day; slightly stronger, however, in its northern than in its southern area, and on the western side of this ocean presenting many anomalies.

The **Equatorial Counter Current** in the Pacific sets to the eastward, between the parallel of 6° north and the Equator, separating the Great Equatorial Current into two distinct bodies of water; it is probably due, in the first instance, to the *drift* of the Monsoon, and then augmented by a set from the North and South Equatorial Currents, as they are turned aside by the opposing shores of New Guinea and the 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 **Bessel Current**, takes a N.N.W. direction, passing between the New Hebrides and Solomon's Group, and thence by the south coast of New Guinea towards Torres' Straits. Its average velocity is 8 or 10 miles a day. Within the Barrier reefs it is not so much the current as the tidal streams which require attention.

About the meridian of 170° E. another branch declines to the southward, and on the parallel of Sandy Cape is well marked as the **Current of the East Coast of Australia**. Its course is successively W.S.W., S.W., and S.S.W., and finally becomes south, running along the eastern coast of Tasmania. Its velocity is very irregular, varying from 24 to 60 miles a day, and is persistent in its southerly course all the year round off the Australian coast, often strongest during S.E.-ly gales, when it takes a westerly direction towards the land; close in shore and in the bights there

is generally an eddy current setting to the northward at the rate of 10 or 20 miles a day.

The **North Equatorial Current**, in the vicinity of the Caroline Archipelago, is partially under the influence of the Monsoons which prevail there; from May till October, the westerly set is greatly diminished, and during the strength of the S.W. Monsoon the current occasionally flows very slowly (six miles a day) to the E.N.E. and N.E.; from October to May, the general westerly set of the equatorial current is prevalent, but it inclines to W.S.W. and even S.W., and probably at this season a portion of it may be deflected into the easterly counter current. To the northward and westward of the 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.

160. The following remarks on the Japan current are from the observations of **LIEUT. SILAS BENT, U.S.N.**, made during the period of the American expedition to Japan in 1852-54:—

“The existence of a N.E. current on the coast of Japan was noticed by **COOK**, **KRUZENSTERN**, and other explorers, and has, of course, not escaped the attention of more recent intelligent navigators; but I believe no systematic series of observations upon it have hitherto been made.

“The Japanese are well aware of its existence, and have given it the name of ‘Kuro-Siwo,’ or Black Stream, which is undoubtedly derived from the deep blue colour of its water when compared with that of the adjacent ocean.

“The fountain from which this stream springs is the great equatorial current of the Pacific, which, in magnitude, is in proportion to the vast extent of that ocean when compared with the Atlantic.

“Extending from the Tropic of Cancer, on the north, to Capricorn, in all probability, on the south; it has a width of near three thousand miles, and with a velocity of from 20 to 60 miles per day, it sweeps to the westward in uninterrupted grandeur, around three-eighths of the circumference of the globe, until diverted by the continent of Asia, and split into innumerable streams by the Polynesian Islands; it spreads the genial influence of its warmth over regions of the earth, some of which—now teeming in prolific abundance—would otherwise be but barren wastes.

“One of the most remarkable of these offshoots is this **Kuro-Siwo, or Japan Stream**, which, separated from the parent current by the Bashee islands, and south end of Formosa, in latitude 22° N., longitude 122° E., is deflected to the northward along the coast of Formosa, where its strength and character are as decidedly marked as those of the Gulf stream on the coast of Florida. This northwardly course continues to the parallel of 26° N., when it bears off to the northward and eastward, washing the whole S.E. coast of Japan, as far as the Straits of Tsugar, and increasing in strength as it advances, until reaching the chain of islands to the southward of the Gulf of Yedo, about the meridian of 140° E., where its maximum velocity, as shown by our observations on one occasion, was 72, 74, and 80 miles respectively per day. Its average strength from the south end of Formosa to the Straits of

Tsugar is found to be from 35 to 40 miles per twenty-four hours, at all seasons that we traversed it.

"Near its origin, the Kuro-Siwo, like the Gulf stream, is contracted, and is usually confined between Formosa and the Majico-sima group, with a width of one hundred miles. But to the northward of this group it rapidly expands on its southern limits, and reaches the Loo Choo and Bonin Islands, giving it a width to the northward of the latter of about five hundred miles.

"To the eastward of the meridian of 143° E., in latitude 40° N., the stream takes a more easterly direction, allowing a cold current to intervene between it and the southern coast of Yesso, where the thermal change in the water on leaving the stream is from 16° to 20° . But from the harassing prevalence of fogs during the limited stay of the squadron in that vicinity, the reports and tables do not furnish sufficient data to prove *conclusively* the predominant direction of the cold current through the Straits of Tsugar, particularly as the tide ebbs and flows through them with great rapidity. Yet from what we have, I am inclined to believe that it is a current from the Arctic ocean, running counter to the Kuro-Siwo, and which passes to the westward through the Straits of Tsugar, down through the Japan Sea, between Corea and the Japanese islands, and forms the hyperborean current on the east coast of China, which is known to flow to the southward, through the Formosa Channel into the China Sea. For to the westward of a line, connecting the north end of Formosa and the south-western extremity of Japan, there is no flow of tropical waters to the northward; but, on the contrary, a cold counter current filling the space between the Kuro-Siwo and the coast of China. As far as this cold water extends off the coast, the soundings are regular, and increase gradually in depth; but simultaneous with the increase of temperature in the water, the plummet falls into a trough similar to the bed of the Gulf stream, as ascertained by the United States' Coast Survey.

"The surface of this counter current is, no doubt, influenced in some measure by the S.W. Monsoon, and during the season of that wind a portion of it is forced out between Formosa and Japan, to mingle its waters with the Kuro-Siwo; but so well is its existence known to vessels trading on the coast of China, that they very rarely, if ever, attempt to *beat* to the northward through the Formosa channel, but almost invariably make the passage to the eastward of Formosa during the prevalence of adverse winds, though those winds may be stronger there than in the Formosa channel.

"Of the power of these two currents I can speak from experience, in addition to the facts disclosed by the observations now under consideration; for in the winter of 1848, when attached to the U.S. ship *Preble*, commander JAMES GLYNN, and bound from Hong Kong to Japan, we struggled for three days, after leaving the port, against this south-west current, setting down through the Formosa channel, without making a single mile on our course to the eastward, and were compelled to resort to the expedient of working along in-shore, and anchoring whenever the tide was combined with the current against us. A number of days were thus toilsomely spent before reaching Breaker Point, on the coast of China. We then stretched across the channel, in the middle of which we felt the full strength of the south-west or counter current. But on doubling the south end of Formosa, we immediately fell into the Kuro-Siwo, and were borne by it ninety-two miles, dead to windward, in less than three days, whilst lying-to, under storm-sails, in a stiff gale from the northward and eastward.

"There is an increased temperature of both the air and the water the moment this stream is entered, but a predominant thermal change in the water, which almost invariably continues superior in temperature to that of the air until leaving the stream again. On the north-western edge of the stream the transitions are sudden and extreme, varying, according to the latitude, from 10° to 20° . On the south-eastern side, the change is less abrupt, and from the gradual approximation of the thermal ranges of the air and water, its outline is rendered less distinct and definite.

"Along the borders of the stream where it chafes against the torpid waters of the ocean and counter currents, as also in its midst, where whirls and eddies are produced by islands and the inequalities in its bed, strong tide-rips are constantly encountered which often resemble heavy breakers on shoals and reefs, and become finger-boards, as it were, to warn the seaman of the otherwise unseen influence which may be bearing his ship far from the intended track, and, perchance, upon some of the many fearful dangers that sprinkle that region of the sea.

"The Gulf Stream, as delineated in the Coast Survey Report of Professor A. D. BACHE, for 1854, has a striking resemblance to the Kuro-Siwo. The thermal changes in the Kuro-Siwo indicate a depression of only a few degrees in the water thermometer, and should more properly, perhaps, be termed *cool strata*, as compared with the rest of the stream, for in all instances these strata maintain a superior temperature to the atmosphere above them; and if the hyperborean current is, as I have supposed, entirely separated from the Kuro-Siwo by its passage through the Straits of Tsugar to the westward of Japan, I am inclined to think that there is no counter-current *underlying* the Kuro-Siwo, as is the case with the Gulf Stream. This, however, can be determined only by experiments with the deep-sea thermometer, and the usual apparatus for determining sub-surface currents, none of which were made by the expedition, as its special object was of primary importance, and all other subjects within the field of our observations were necessarily of subordinate consideration, and were obliged to be made as opportunity and the ordinary facilities of our situation would permit.

"LIEUT. M. F. MAURY says, that 'the maximum temperature of the Gulf Stream is 86° , or about 9° above the ocean temperature due to the latitude.' This maximum temperature coincides pretty nearly with that of the Kuro-Siwo, as shown by the daily means of our observations; but the difference between the temperature of the Kuro-Siwo and the 'ocean temperature due to the latitude' is, by the same observations, shown to be greater than that of the Gulf Stream, amounting on an average to about 12° .

"There is a floating sea-weed found in the Kuro-Siwo, similar in appearance to the *fecus natans* of the Gulf Stream; but the specimens collected by the expedition were unfortunately lost before being submitted to botanists for examination, and it is therefore yet undetermined whether they are identical or not.

"It may not be uninteresting to state, that LIEUT. W. L. MAURY found sprigs of coral while surveying off the harbour of Simoda, in latitude 35° N.

"There is a striking coincidence not only in the *recurvation* of these oceanic streams, but of the general coincidence in *their* recurvation with that of the storms of the Northern Hemisphere. MR. REDFIELD is of the opinion that the recurvation of storms between the parallels of 20° and 30° north and south latitude, in all parts of the world, as shown by observations, is but partially dependent upon the influence of land, and is 'to be ascribed mainly to the mechanical gravitation of the

atmospheric strata as connected with the rotative and orbital movements of the different parts of the earth's surface.'

"These atmospheric meteors, originating generally about the tenth parallels of latitude, north and south, are impelled by this influence directly towards the poles, but are at the same time borne to the westward by the Trade winds. This compound force gives them an oblique direction to the north-west and south-west, until arriving at the outer limits of these winds, about the parallels of 25° or 30° , where the storms become released from their influence, and continuing their course to the north and south towards portions of the earth's surface, having less rotative velocity than that from whence they came, they gradually *recurve*, and soon assume a path to the north-east and south-east, which they pursue until dissipated by expansion, or have fulfilled their mission by a restoration of the atmospheric equilibrium, a disturbance of which had probably given rise to them. The converse of this rotatory influence of the earth is thus described by DR. HADLEY and DR. FRANKLIN :—'The air under the Equator and between the tropics being constantly heated and rarefied by the sun, rises; its place is supplied by air from the higher and polar latitudes, which, coming from parts of the earth that had less motion, and not suddenly acquiring the quicker motion of the equatorial earth, becomes an east wind blowing westward, the earth moving from west to east and *slipping under* the air.' This general law of nature operates in the same manner upon the waters of the ocean as upon the atmosphere, when, by any disturbing cause, portions of the former are set in motion from about the Equator, modified, of course, by such local obstructions of continents, islands, &c., as may be encountered in their path.

"REDFIELD furthermore says :—'The Gulf Stream from Florida to Newfoundland is for the most part imbedded or stratified upon a current which is setting in the opposite direction in its progress from the polar regions. By this action the great stream of drift ice from the polar basin is brought within the dissolving influence of the Gulf Stream; and the Grand Bank itself, perhaps, owes its origin to the deposits which have resulted from this process during a long course of ages. The icebergs being carried southward by the deeper Polar Current, their rapid destruction is here effected by the tepid water of the Gulf Stream. These two streams of current, like other currents, both atmospheric and aqueous, pursue each its determinate course, the Gulf Stream being thrown eastward by the greater rotative velocity which it acquired in latitudes nearest the Equator, and the Polar Current being thrown westward along the shores and soundings of the American continent and its contiguous ocean-depths by the tardy rotation which it derived in higher latitudes. Were the influence of winds wholly unfelt upon the ocean, it is probable that the same system would still be maintained in all its essential features by the mechanical influence of the earth's rotation, combined with an unstable state of equilibrium.'

"MAURY, in a paper 'On the Gulf Stream and Currents of the Sea,' read before the National Institute (U.S.), April, 1844, says :—'A geodetic examination as to the course of the Gulf Stream does not render it by any means certain that it is turned aside by the Grand Banks of Newfoundland at all, but that in its route from the coast of Georgia, as far towards the shores of Europe as its path has been distinctly ascertained, it describes the arc of a great circle as nearly as may be. Following the line of direction given to it after clearing the straits of Florida, its course would be nearly on a great circle, passing through the poles of the earth. That it

should be turned from this, and forced along one inclining more to the east, requires after it leaves these straits the presence of a new force to give it this eastward tendency. And have we not precisely such a force in the rate at which different parallels perform their daily rounds about their axis? In consequence of this the stream, when it first enters the Atlantic from the Gulf, is carried with the earth around its axis at the rate of about two miles and a half a minute faster towards the east than it is when it sweeps by the Grand Banks of Newfoundland.

“That this explanation as to its eastward tendency should hold good, a current setting from the north towards the south should have a westward tendency. Accordingly, and in obedience to the propelling power derived from the rate at which different parallels are whirled around in diurnal motion, we find the current from the north which meets the Gulf Stream on the Grand Banks taking a south-westerly direction, as already described. It runs down to the Tropics by the side of the Gulf Stream, and stretches as far to the west as our shores will allow.’

“That this theory of rotative influence may or may not be correct, it is not my province to discuss; but I was forcibly struck with these coincidences of recurvation when the tracks of the Gulf Stream and Kuro-Siwo, together with the paths of the hurricanes, were traced upon the same chart; and I have made these quotations to show what hypotheses are entertained by some of the eminent men who have given much attention and study to the subject, and from a conviction that they are in some measure, at least, sustained by the results of our observations upon the Kuro-Siwo; for, notwithstanding the configuration of the eastern shores of the continents of America and Asia are undoubtedly the original cause of the deflection to the northward of the whole of the Equatorial Current of the Atlantic by the Gulf Stream, and of a portion of that of the Pacific by the Kuro-Siwo, or Japan Stream, yet were no influences, such as MR. REDFIELD and LIEUTENANT MAURY refer to, operating upon these streams, would not their natural inclination from the inertia of their westward flow be to hug the coast and wash their whole length to the Arctic Sea, or until that inertia was overcome by their friction against the continents? Yet this is not the case in either instance, for it has been well established by MR. BACHE that a counter current flowing to the southward and westward intervenes between the Gulf Stream and the coast of the United States as far as the peninsula of Florida; and, as I have before stated, as far as our observations extend, they prove conclusively that there is a very important counter current intervening between the Kuro-Siwo and the main coast of Asia.

“The influence of the Kuro-Siwo upon the climate of Japan and the west coast of North America is, as might be expected, as striking as that of the Gulf Stream on the coasts bordering the North Atlantic. From the insular position of Japan, with the intervening sea between it and the continent of Asia, it has a more equable climate than we enjoy in the United States; and since the counter current of the Kuro-Siwo does not make its appearance on the eastern shores of the islands south of the straits of Sangar, and as these islands, in their geographical position, have a more eastwardly direction than our coast, the Kuro-Siwo, unlike the Gulf Stream, sweeps close along this shore, giving a milder climate to that portion of the empire than is enjoyed in corresponding latitudes in the United States.

“The softening influence of the Kuro-Siwo is felt on the coasts of Oregon and California, but in a less degree, perhaps, than that of the Gulf Stream on the coasts of Europe, owing to the greater width of the Pacific Ocean over the Atlantic.

"Still, the winters are so mild in Puget's Sound, in latitude 48° N., that snow rarely falls there, and the inhabitants are never enabled to fill their ice-houses for the summer; and vessels trading to Petropaulowski and the coast of Kamtschatka, when becoming unwieldy from accumulation of ice on their hulls and rigging, run over to a higher latitude on the American coast and thaw out, in the same manner that vessels frozen up on our own coast retreat again into the Gulf Stream until favoured by an easterly wind.

"And in a late address before the American Geographical Society, by DR. HAWKS, when speaking of the routes for a railroad to connect the Atlantic States with the Pacific coast, he cites the remarks of MR. JOHNSON and other eminent surveyors, to show that the precipitation of moisture to the westward of the Rocky Mountains, in Oregon territory, is, with rare exceptions, in the form of rain throughout the year, and seldom as snow; and as the prevailing winds on that coast are from the westward, they are unquestionably ameliorated by the warm waters of the Kuro-Siwo, which, impinging upon the Aleutian islands, are thence thrown against the shores of Oregon and California, and form the southerly current on those coasts, to again fall into the great equatorial current of the Pacific.

"The whole of the Kuro-Siwo is not, however, obstructed by the Aleutian islands, for experience shows that there is a current flowing to the northward through Behring's Straits, which is no doubt derived from this stream. This is, perhaps, underlaid by an arctic current flowing to the southward, which, rising to the surface after passing the narrow defile of the Straits, supplies the counter current to the Kuro-Siwo before spoken of.

"In studying this subject, in connexion with others having a bearing upon it, the hypothesis has forced itself upon my mind that that portion of the Kuro-Siwo which finds an outlet into the Arctic Ocean through Behring's Straits, continues its course to the northward and eastward, after clearing Icy Cape, and is the cause of that open sea, with its high temperature, seen to the northward of Greenland by DR. KANE; and from the *unity* of its flow in a given path, it leaves the vast fields of ice lying to the southward and eastward, between that path and the north coast of America and west coast of Melville Island, in a great measure unaffected by its dissolving influence; for it is in that direction that our enterprising whalers who resort to those seas find their most open cruising-ground, and I have heard of no instance in which that open water has been explored to its limits in a north-east direction from Behring's Straits. The same physical laws operating upon the Gulf Stream produce similar results upon it after passing Spitzbergen, and the mass of water from these two streams thus accumulated about the pole (after parting with their warmth) find no outlets except those to the southward, between Spitzbergen and the east coast of Greenland, and through the passages among the islands leading into Baffin's Bay, and thus form the streams known as the Greenland and Labrador currents; these, uniting in the North Atlantic, become the counter-current to the Gulf Stream after passing Newfoundland.

"In the passage of the United States' steam frigate *Mississippi* from Simoda, Japan, to the Sandwich Islands, in October, 1854, the thermometer manifested a cold aqueous space between the meridians of 155° E. and 170° W., and the parallels of 30° and 35° N., which bears a general correspondence in the Pacific Ocean to the position of the Sargossa Sea in the Atlantic."

COMMANDER CHAS. BULLOCK, R.N., says that "in June, 1861, the Japan current

ran steadily at the rate of 70 miles a day from Cape Chichakoff towards the gulf of Yedo ; but on approaching the great chain of islands south of the gulf it diminished in velocity and curved to the southward."

The general direction of the Currents in the Indian Ocean is shown on *four* Charts which accompany this work.

In the northern part of this ocean—north of the parallel of 10° S. and thence to the Asiatic continent—it is well known that the currents are under the influence of the Monsoons ; hence the general Chart, entitled "CURRENTS OF THE INDIAN OCEAN," gives the direction of the main streams for the whole year, *only* to the south of the parallel of 10° S. Between Lat. 6° S. and 4° N. the currents for three or four months set strongly to the westward, and then (after a brief interval) for the same number of months the general westerly set receives a great check, with perhaps a tendency to the eastward—according to the Monsoons—but always subject to deviations from variable winds ; and these currents are often *very strong in the vicinity of the islands, atolls, and banks of this region.*

Special CURRENT CHARTS are given for the ARABIAN SEA and the BAY of BENGAL. The materials for the former sea were taken from the Chart and Memoir of Lieut. A. D. Taylor, and appertain to the S.W. Monsoon. For the latter (the Bay of Bengal), and for the same season, the paper of Mr. J. A. Heathcote, I.N. (*see* p. 227-230) furnished some of the detail, the rest being obtained from log-books and other observations ; the "Currents in the Bay of Bengal, during the N.E. Monsoon," were compiled from various authorities.

Note.—COAST OF COROMANDEL.—COMMANDER R. HOBSON, of H.M.S. *Vigilant*, reports in a letter from Madras, dated August, 1864, that, during a passage from Cuddalore to that place, an unusually strong north-easterly current of at least 3 knots an hour was experienced. Mariners are hereby warned of the uncertainty of the currents in this vicinity.

CHAPTER IX.

ICE AND ICEBERGS IN THE SOUTHERN INDIAN OCEAN.

INTIMATELY connected with the currents and S.W. winds of the Great Southern Ocean is the flotation of Ice and Icebergs within the range of the ordinary tracks of vessels bound to Australia, India, and China ; and a few remarks, showing where these dangers to navigation may be generally expected in the greatest numbers, will appropriately find a place in this work.

It is a recognised fact, that the bergs of the Southern hemisphere are more stupendous, larger, and far more lofty than those commonly met with in the Northern hemisphere — at least, on the track of an ordinary commercial voyage. The researches of COOKE, D'URVILLE, WEDDELL, WILKES, and ROSS, sufficiently explain, how the enormous solid masses of ice, detached from the shores of an Antarctic conti-

nent, drift for months to lower latitudes, melting by degrees, and crumbling to pieces, and yet appear between certain meridians on the parallels of 40° to 37° , of sufficient size to crush all before them.

Heavy drifts of ice and icebergs along the ordinary route of passenger-ships to Australia and India are not of annual occurrence, though icebergs are constantly reported by vessels on the return voyage from Australia *via* Cape Horn; they are also more frequently encountered in the South Atlantic than in the Southern Indian Ocean—though, in rare instances, they have been reported off the Cape of Good Hope—it is, therefore, necessary to be vigilant, and keep a sharp look-out for them.

In the South Atlantic, the area included between the parallels of 40° and 50° S., and the meridians of 30° and 5° W., is especially notorious for ice, and emigrant ships have frequently been in great jeopardy thereabouts. More to the eastward, the Spanish ship *Constancia*, and the French ship *Harmonie*, reported icebergs in Lat. $35^{\circ} 50'$ S., Long. $17^{\circ} 50'$ E., in April, 1828; and, three weeks later, ice islands were seen by the *Eliza*, in Lat. $37^{\circ} 31'$ S., Long. $18^{\circ} 17'$ E.; these bergs were all of very large size, but fast thawing and tumbling to pieces. The *Constant*, September 13th, 1844, sailing E.S.E., near the parallel of $38^{\circ} 10'$ S., when on the meridian of 24° E., fell in with a large cluster of ice-islands, and was not entirely clear of them until she had sailed 180 miles. H.M.S. *Guardian*, December, 1789, was nearly lost by striking on a berg, in Lat. $44\frac{1}{2}^{\circ}$ S., Long. $44\frac{1}{2}^{\circ}$ E. These are instances sufficient to indicate the necessity of a good look-out.

By far the greater number of icebergs may be expected in the Southern hemisphere during the months of September, October, November, December, January, February, March, and April; they are of rarer occurrence from May to August, but still sufficiently often reported during these months as to require incessant vigilance. On the route to the colonies, the chance of meeting ice from September to May is three times as great as during June, July, and August. It is possible that some of the bergs seen in very low latitudes may have taken more than one season to find their way thither.

Looking at the distribution of icebergs over the *whole* of the Southern ocean,*—“one thing is quite evident, that there is far greater danger from ice during the summer months, in the southern hemisphere, than during the winter. Of about 550 reports of ice sighted, nearly half occurred in November, December, and January—while there are only five reports of ice having been seen in June, and only three in July. One-fifth of the reports relates to ice sighted in December, and the ice seen in June and July together is to that met with in December alone rather less than 1:13. The decrease from January to April is less rapid than the increase from August to November, and the probability of falling in with ice in the autumn months of March and April is as 5:3 nearly, compared with the chance of sighting it during the spring months of September and October, although more ice has been seen in December than in any other one month.

“The temperature of the water does not seem to be an *infallible* guide as to the vicinity of ice, although *generally* on approaching ice there is a marked diminution in the temperature of air and water—but especially the latter.”

The *lowest latitudes* in which Icebergs have been found in the Southern Indian Ocean are—

* Meteorological Paper, No. 13, Art. “Icebergs in the Southern Ocean.”—Board of Trade.

October	in Lat. 41 0 S.
November	„ 39 50
December	„ 39 24
January	„ 34 0
February	„ 47 13
March	„ 42 30
April	„ 36 0
May	„ 45 0
June	„ 43 38
July	„ 45 0
August	„ 40 25
September	„ 37 8

The following catalogue is a record of ice-positions, obtained from the log-books of Colonial and Indian traders;—a portion of it was originally published in the *Mercantile Marine Magazine* for 1858, and has been collated with the *Catalogue of Ice* in the twelfth number of the *Meteorological Papers* published by the Board of Trade.

DATE.	LAT. S.	LONG. E.	DESCRIPTION.
	° ' "	° ' "	
1840 October	37 0	12 0	} Five icebergs.
	to 38 0	to 14 0	
... .	36 57	13 47	Two large icebergs.
...	36 10	16 1	Two icebergs.
1853 ...	53 0	19 0	An iceberg.
...	53 12	21 23	Three icebergs and field ice.
...	55 20	28 10	An iceberg.
1854 ...	51 10	26 20	An iceberg.
...	50 9	29 26	A large iceberg.
...	50 39	40 10	A large iceberg?
...	50 39	46 10	A large iceberg?
1855 ...	54 31	126 0	} Fifteen icebergs, some a mile long.
...	54 0	131 0	
...	55 54	138 23	About twenty large icebergs.
1856 ...	41 47	36 21	} Iceberg 200 feet high, and ice island 400 feet high.
...	42 45	39 52	
...	48 17	41 49	A small piece of ice.
...	41 0	42 0	An iceberg 70 feet high.
...	47 42	69 56	A large iceberg.
...	47 38	73 0	} Two icebergs. No change in the temperature of the water.
1858 ...	44 50	9 34	
...	47 26	10 34	Iceberg 300 ft. high, 600 ft. long.
1839 November	44 0	87 30	} Numerous icebergs, 400 feet high.
	to 45 0	to 100 0	
1840 ...	39 50	33 40	An iceberg.

ICE AND ICEBERGS

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1853 November	52	26	...	19 42	An iceberg, 1500 feet long.
...	52	20	...	27 47	3 icebergs.
...	51	3	...	32 21	Numerous icebergs.
...	51	20	...	37 6	
...	52	0	...	53 0	An iceberg.
...	53	20	...	74 19	"Saw land" ? ice.
...	53	51	...	86 40	An iceberg.
1854 ...	43	18	...	8 15	Four large icebergs.
...	49	0	...	22 30	Several icebergs.
...	52	0	...	25 0	Thirty-three icebergs.
to 53 0	...	...	to 45 0	...	
...	50	10	...	29 26	A large iceberg.
...	50	0	...	30 0	An iceberg.
...	51	0	...	32 0	Three icebergs.
to 52 0	...	...	...	...	
...	52	0	...	32 0	About thirty icebergs.
to 53 0	...	...	to 45 0	...	
...	51	0	...	41 0	Numerous icebergs.
to 52 0	...	...	to 45 0	...	
...	50	39	...	46 10	Large iceberg breaking up.
...	53	0	...	88 0	Fifty-seven icebergs.
to 54 0	...	...	to 102 0	...	
1855 ...	47	50	...	2 0	A very large iceberg.
...	49	45	...	13 42	Four small icebergs.
...	49	0	...	39 0	One large and 3 small icebergs.
1856 ...	49	19	...	7 30	Two icebergs.
...	49	30	...	10 45	Six small icebergs.
...	50	50	...	15 0	"Plenty of ice about."
...	41	0	...	42 0	Three large icebergs.
...	40	51	...	43 27	Four large icebergs 500 ft. high.
...	41	46	...	44 0	Iceberg 172 ft. high.
...	41	23	...	46 28	An iceberg.
...	46	30	...	49 20	Passed close to ice.
...	48	0	...	52 0	An iceberg.
...	41	0	...	52 48	An iceberg.
...	52	0	...	53 0	An iceberg.
1857 ...	48	55	...	32 18	Four small icebergs, much loose ice.
1858 ...	47	51	...	36 33	A large iceberg.
1859 ...	51	0	...	55 0	Struck some ice.
...	44	45	...	56 10	Many large icebergs.
...	44	0	...	68 0	Much ice.
1772 December	49	46	...	19 58	Numerous icebergs.
...	54	55	...	21 44	
1789 ...	44	30	...	44 30	An iceberg—vessel struck and nearly lost.

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1832 December	54	20	...	5 24	Immense number of icebergs.
...	60	11	...	10 23	Surrounded by ice and icebergs.
1840 ...	40	24	...	29 0	A large iceberg.
...	39	24	...	39 0	An iceberg.
...	57	30	...	147 0	An iceberg.
1853 ...	49	0	...	28 37	An iceberg.
...	48	30	...	35 20	An iceberg.
...	53	0	...	95 20	An iceberg.
1854 ...	50	0	...	2 30	Two icebergs.
...	50	0	...	3 0	} Numerous icebergs.
to 53 0	to 22 0				
...	51	17	...	6 1	Four large icebergs.
...	52	0	...	9 52	Nine icebergs.
...	52	29	...	15 23	Four icebergs.
...	52	12	...	15 24	Eight icebergs.
...	50	0	...	15 25	Four icebergs.
...	47	33	...	18 10	Two icebergs.
...	50	30	...	19 30	Icebergs.
...	49	26	...	22 24	An iceberg.
...	53	0	...	23 0	} Forty icebergs.
to 54 0	to 25 0				
...	47	30	...	23 30	Icebergs.
...	50	26	...	29 13	An iceberg.
...	49	50	...	34 0	An iceberg.
...	49	40	...	34 30	Icebergs.
...	48	0	...	35 30	An iceberg.
...	49	0	...	36 0	Icebergs.
...	48	0	...	41 0	Two icebergs.
...	44	0	...	46 0	} Numerous icebergs.
to 45 0	to 51 0				
...	52	53	...	73 50	"Saw land." P ice.
...	53	0 {	...	85 0	} Numerous icebergs.
			to 99 0		
...	52	30 {	...	84 0	} Numerous icebergs.
			to 102 0		
...	56	30	...	90 0	Icebergs.
1855 ...	49	20	...	2 30	Several icebergs.
...	47	10	...	4 38	A small iceberg.
...	49	30	...	6 0	Ice and icebergs.
...	47	22	...	6 6	Two icebergs.
...	49	43	...	6 18	Many icebergs.
...	48	51	...	9 26	} Eighty icebergs, and much drift ice.
...	47	40	...	9 55	
...	47	43	...	10 59	A large iceberg.
...	47	30	...	11 0	Twelve icebergs.

ICE AND ICEBERGS

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1855 December	47	50	...	11 26	{ Seventeen icebergs, during the day; air 55°; water 45°.
...	48	0	...	13 21	An iceberg.
...	48	0	...	15 0	Thirty-three icebergs.
...	48	2	...	15 39	Twelve icebergs.
...	43	33	...	18 10	Two large icebergs.
...	49	15	...	23 43	{ A small iceberg; air 54°; water 41°.
...	40	30	...	24 0	Ice.
...	48	13	...	24 47	{ One large and many small icebergs.
...	48	0	...	26 10	Two icebergs.
...	48	40	...	26 17	Two large icebergs.
...	49	43	...	26 49	An iceberg.
...	48	12	...	30 0	Four icebergs.
...	49	50	...	31 27	A large iceberg.
...	48	48	...	31 40	A large iceberg.
...	50	0	...	32 0	Three icebergs.
...	48	19	...	34 21	Many icebergs.
...	49	9	...	37 14	Two icebergs.
...	50	39	...	37 34	Three large icebergs.
...	48	11	...	37 43	A large iceberg.
...	50	48	...	40 43	Three large icebergs.
...	48	21	...	43 31	Two icebergs.
...	48	30	...	45 0	Three large icebergs.
...	51	0	...	46 14	A large iceberg.
...	48	35	...	48 28	A large iceberg.
...	49	30	...	49 5	Two small icebergs.
...	48	14	...	50 56	Two large icebergs.
...	48	22	...	54 41	An iceberg 200 ft. high.
...	50	30	...	60 0	A large iceberg.
...	51	39	...	61 34	A large iceberg.
...	52	0	...	62 30	An iceberg.
...	51	48	...	64 2	A large iceberg.
...	47	40	...	74 22	A piece of ice.
1856 ...	50	14	...	42 54	{ Four large icebergs; one 700 ft. high.
...	51	0	...	43 44	A large iceberg.
1859 ...	46	0	...	47 0	A large iceberg.
1773 January	51	0	...	59 0	Icebergs.
1841 ...	65	40	...	173 6	{ A stream of ice, S. by E. and N. by W.
1850 ...	34	50	...	18 30	{ A piece of ice, very flat, 30 ft. long, 100 ft. thick, in sight of Cape of Good Hope.
...	34	0	...	20 20	{ An iceberg seen from the Cape of Good Hope.

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1851 January	51	27	...	26 37	{ An ice island much decayed; large fields of ice to the southward.
...	51	33	...	31 47	Much ice.
...	52	32	...	37 7	Much ice.
...	52	50	...	43 3	Much ice.
...	53	10	...	46 46	Much ice.
...	53	30	...	54 45	{ A large tabular-shaped ice island.
...	56	48	...	83 16	{ Much broken ice; many tabular ice islands all high and large, and fresh from the barrier; immense fields of ice to the southward.
...	56	35	...	88 42	Much ice, in large fields.
1855	45	33	...	15 33	{ Three icebergs, 100 ft. long, 150 ft. high.
...	45	45	...	21 0	Icebergs.
...	47	0	...	37 46	Icebergs.
...	47	15	...	38 14	An iceberg, 200 ft. high.
...	50	0	...	41 0	Icebergs.
...	47	20	...	41 10	Numerous icebergs.
1856	48	15	{	10 0	{ Thirteen large icebergs.
...	...	...	to	15 0	
...	49	10	...	14 0	Icebergs.
...	48	30	...	15 27	A large iceberg.
...	49	0	...	17 0	Three icebergs.
...	44	25	...	18 14	{ A large iceberg, surrounded by large pieces.
...	49	4	...	19 20	A large iceberg.
...	45	31	...	21 6	Seven icebergs.
...	48	50	{	21 0	{ Six icebergs.
...	...	...	to	24 0	
...	49	10	{	25 0	{ A large iceberg, and some loose ice.
...	...	...	to	27 0	
...	49	10	{	29 0	{ Several small icebergs, one very large one; much loose ice.
...	...	...	to	31 0	
...	50	5	...	37 35	A large iceberg.
...	49	41	...	40 29	A very large iceberg.
...	45	30	...	45 30	Numerous icebergs.
...	45	26	...	46 3	{ One large iceberg, and a large piece.
...	47	48	...	49 28	A large iceberg.
...	50	20	...	113 0	Fifty-five icebergs.
...	50	11	{	113 0	{ Eleven icebergs, and some loose ice.
...	...	...	to	118 0	

ICE AND ICEBERGS

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1857 January	50	52	...	17 39	{ A large iceberg, drifting north-ward. Temperature of air, 47°; water, 37°.
...	52	15	...	23 40	
...	50	30	...	32 4	A small iceberg.
...	50	18	...	36 0	A small iceberg.
...	50	10	...	39 15	An iceberg.
...	50	36	...	51 40	{ A small iceberg, which separated into several pieces.
1859 ...	45	8	...	11 54	
1774 February	53	30	...	6 35	Three icebergs.
1775 ...	57	20	...	4 0	An iceberg.
...	54	26	...	24 21	Numerous icebergs.
...	52	50	...	26 30	Two icebergs.
1840 ...	50	0	...	120 25	Icebergs.
...	55	30	...	145 30	Icebergs.
1848 ...	48	0	...	37 30	{ An iceberg, 6 to 7 miles in extent.
...	49	30	...	41 0	
...	50	0	...	107 0	An iceberg.
...	46	0	...	134 0	Icebergs.
1849 ...	49	10	...	30 15	A large iceberg.
1855 ...	47	13	...	20 0	Several icebergs.
...	50	0	...	107 0	An iceberg.
...	46	0	...	134 0	Icebergs.
1856 ...	46	59	...	12 15	An iceberg.
1774 March	53	17	...	11 50	Icebergs.
...	48	30	...	14 30	Two icebergs.
1839 ...	66	0	...	98 0	{ Numerous icebergs.
to 67 0	to 102 0				
1840 ...	50	0	...	140 0	Icebergs.
...	47	3	...	10 51	An iceberg.
1849 ...	49	54	...	35 15	Many icebergs and kelp.
...	50	44	...	39 28	An iceberg.
...	52	18	...	110 9	Iceberg, very high.
1855 ...	52	39	...	5 4	Many ice islands.
...	53	14	...	14 41	An iceberg, 960 feet high.
...	52	0	...	0 0	{ Numerous icebergs.
to 53 20	to 23 0				
...	53	14	...	20 44	Nearly beset in the ice.
...	53	0	...	28 0	A few pieces of ice.
1856 ...	46	50	...	3 11	Icebergs.
...	48	12	...	24 0	Five very large icebergs.
...	48	15	...	25 23	Seven icebergs.

DATE.	LAT. S.			LONG. E.		DESCRIPTION.
	°	'		°	'	
1856 March	48	4	...	29	22	Several icebergs.
...	46	0	...	37	30	Icebergs.
...	49	21	...	37	35	One very large iceberg.
...	51	0	...	51	0	{ A very large iceberg; much loose ice.
...	47	26	...	54	38	{ Three icebergs. Air, 51°; water, 38°.
...	47	20	...	55	0	Three icebergs, 100 ft. high.
1857 ...	42	30	...	66	0	Two large pieces of ice.
1828 April	35	50	...	18	50	A cluster of icebergs.
...	37	31	...	18	17	Five very large icebergs.
1853 ...	36	0	...	20	0	Numerous icebergs.
1854 ...	51	0	...	26	0	An iceberg.
...	53	0	...	80	0	Two icebergs.
1855 ...	48½	0	...	6	0	{ Numerous icebergs.
to	49	0	...	to	12	
...	48	44	...	6	43	{ An ice island, 300 ft. high, and many ice fields; and in the evening passed numerous icebergs and pieces.
...	48	43	...	11	45	{ A large iceberg, 400 ft. high; and much broken ice.
...	43	30	...	13	0	Numerous icebergs.
...	48	57	...	22	30	Several large icebergs.
...	49	59	...	24	55	A large iceberg.
...	46	0	...	27	0	Numerous icebergs.
1856 ...	49	59	...	0	30	{ Steering N.N.W., parallel with a line of 47 icebergs.
...	49	30	...	5	0	{ Several large icebergs and much loose ice.
...	49	32	...	8	30	Field ice and icebergs.
...	49	30	...	9	0	Iceberg and drift ice.
...	48	35	...	11	0	Forty icebergs.
...	47	15	...	16	33	Thirty icebergs.
...	46	50	...	20	23	Two icebergs.
...	48	30	...	22	0	Large iceberg.
...	47	30	...	29	25	An iceberg.
...	48	0	...	37	45	An iceberg.
...	46	0	...	39	30	An iceberg.
...	50	0	...	42	0	Several icebergs.
...	48	44	...	43	0	An iceberg.
...	45	0	...	52	40	Several icebergs.
...	47	0	...	53	0	Several icebergs.
...	47	20	...	58	0	An iceberg.
...	47	53	...	58	30	A small iceberg.
...	47	53	...	59	8	A small iceberg.

ICE AND ICEBERGS

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1839 May	39	30	...	16 41	An iceberg.
1840 ...	47	17	...	58 50	Small iceberg.
1855 ...	49	0	... to 31	11 0	Numerous icebergs.
...	48	0		18 0	
...	47	48	...	28 26	{ A small piece of ice. Temperature of air, 47°; water, 40°.
...	49	0	...	37 0	
...	45	0	...	37 40	A very large iceberg.
...	48	0	...	38 0	An iceberg.
...	47	0	...	38 0	{ A large iceberg near Prince Edward's islands.
1856 June	45	10	...	48 43	
...	43	38	...	50 48	{ A large iceberg. Air, 39°; water, 39°.
1857 ...	61	41	... to 44	48 0	
...	...	...		44 0	Pack ice.
1840 July	48	41	...	69 6	{ Saw a broken-up iceberg in the N.W. bay, Christmas harbour.
1853 ...	49	0	...	50 0	
1856 ...	45	0	...	59 30	An iceberg.
1863 ...	50	45	...	53 20	Two rocks (?) Icebergs.
1840 August	38	9	...	0 1	Many icebergs, and fields.
...	38	30	...	1 0	Icebergs and loose ice.
...	36	38	...	13 15	Two ice islands.
...	36	10	...	13 40	Two icebergs.
...	41	30	...	14 10	{ An iceberg, 400 ft. high, and 1000 ft. long.
...	37	30	...	14 40	
...	40	25	...	19 0	{ An iceberg, 300 ft. high, and 400 feet long.
1863 ...	52	1	...	67 51	
...	52	12	...	71 1	An iceberg.
1840 September	37	30	...	10 0	An iceberg.
...	38	0	...	12 0	An iceberg.
...	37	0	...	13 0	An iceberg.
...	41	30	...	14 10	{ An iceberg, 1000 feet long and 400 feet high.
...	37	45	...	14 50	
...	37	0	...	15 0	An iceberg.
...	37	0	...	15 0	{ An iceberg, 1000 feet long and 400 feet high.
...	40	30	...	19 0	
...	...	...	...	...	{ An iceberg, 400 feet long and 300 feet high.

DATE.	LAT. S.		LONG. E.		DESCRIPTION.
	°	'	°	'	
1840 September	40	20	...	26 0	{ One large iceberg, and four small icebergs.
...	37	30	...	36 19	{ Icebergs.
to	38	47			
1844 ...	37	8	...	24 0	{ Four icebergs, 100 to 200 ft. high.
...	38	10	...	24 0	{ Many large icebergs on a surface of 180 miles, S.E. and N.W.
...	38	0	...	24 0	{ Numerous icebergs.
to	39	15	to	27 0	
...	39	4	...	25 50	Numerous icebergs around.
1853 ...	52	10	...	37 7	Two large icebergs.
...	49	0	...	43 0	An iceberg, 500 feet high.
1854 ...	49	40	...	0 20	Icebergs.
...	48	0	...	45 0	An iceberg.
1855 ...	48	15	...	41 54	{ An iceberg. Temperature of water, 42°; air, 35°.

The approximate northern limit of icebergs in the Southern Indian Ocean is shown on the Wind Charts which accompany this work.

These remarks may be aptly closed with some observations by DR. SCORESBY, F.R.S., for many years an active whaling captain, and well acquainted with ice and icebergs; they were made during his passage in the *Royal Charter* to Australia.*

March 31st, 1856; at noon, Lat. 47° 30' S., Long. 52° 43' E., wind W. increasing in the afternoon to a hard gale, and ultimately in squalls with showers of rain and sleet, it blew fiercely. An object of some alarm and much excitement, to be met with at night, in a heavy sea and gale, and showery weather, was announced at 7:30 P.M., as being seen. Two icebergs, indeed, showing ominously in the showery sky, were then on the port beam; and soon afterwards a third appeared on the port bow.

April 1. For convenience of description, I have deferred the account of the icebergs and the storm—as just noticed under the previous day's remarks—to the present period, when an iceberg clearly within view, and a sea at its most majestic attainment of grandeur, afforded more precise means of attempting the description satisfactorily; that is, if any description suggested by personal contemplations could accurately convey a picture of one of the sublimest operations of "the stormy wind and tempest," with the exciting and solemnising incident of the dangers of our progress in the period of darkness amid the mighty icebergs of Antarctic forma-

* Journal of a Voyage to Australia and Round the World for Magnetical Research, by REV. W. SCORESBY, D.D., F.R.S., &c. p. 118.

tion. These topics lead us backward a few hours in time to the evening of 31st March.

Though the line of track up to or beyond the latitude of 46° S. had led us within a well-known range of icebergs, yet, when we had advanced so far to the eastward as the 59th degree of longitude, beyond which it appears icebergs are but rarely seen in our parallel, we were led to hope, and earnestly to hope, as the evening closed in with a heavy gale, hard squalls, and perplexing showers of sleet or hail, and a greatly rising sea, that the risk of falling in with icebergs had happily been passed. But we were disappointed. The "look-out," stimulated by promise of reward from the captain, reported at 7.30 P.M. an iceberg on the port-bow. All was now excitement—a mixture of curiosity and apprehension—and the forepart of the poop became speedily crowded with the passengers from below. The object of interest and peril could only be recognised, however, as it gradually came nearer on the port-beam, by that characteristic luminosity by which this peril to the navigator is happily, and, I may add, providentially indicated. But the disappointing indistinctness in this case—or, as some might have thought, the doubtfulness of the reality—were very soon superseded by another announcement from the chief officer, that he thought we were coming to another iceberg ahead of the ship, or a little on the port-bow. The ominous luminosity now left no doubt of our nearer approach towards another of these formidable incumbrances and perils belonging to this track of navigation. The ship's course being altered somewhat to starboard, brought us sufficiently far clear of it; but as it approached the beam of the ship in direction it became sufficiently conspicuous, shining out of a dense black shower in that quarter, to enable us to judge both of its general form and magnitude. Its form was in a waving outline of considerable breadth, it might be two hundred to three hundred yards, with a height possibly of one hundred feet, or more. It was a white luminosity on a dark or almost black background of a rain or snow-shower.

Altogether, three icebergs were discerned through the darkness and haze; but whilst CAPTAIN BOYCE pursued his course amongst them, some reduction of the sails was judiciously made, and for a time the maintop-gallant sail, mizentop sails, and fore course, were taken in. At 10 P.M., however, the weather being clearer—the sky, indeed, by no means so dark as usual in the absence of the moon, with a slight Aurora Australis yielding us obvious advantage—the foresail was again set, and throughout the night our course, E. $\frac{1}{2}$ N. (true), was pursued, mercifully, without interruption either from the icebergs or the extremely heavy sea, which had been greatly augmented under the continuance and violence of the storm.

A fair estimate of our danger from the icebergs could not be easily made. In a gale so heavy, with the occurrence of ice in uncertain and undeterminable quantity and distribution, no considerate person could be free from solemn thought or apprehension; but the regulation of these feelings under such circumstances is a matter of much importance to personal comfort, and with the Christian matter for peculiar submission to, and repose on, the Divine providential will and guidance. Rationally considered, the special dangers on the one side are meeting with a succession of icebergs after shifting the course or partially hauling to, so as to render the *weathering* of a second or third iceberg, or the getting a large ship of the clipper class sufficiently off the wind in time to wear clear of the danger, impracticable—besides the possibility of another of these formidable enemies to security appearing in the line selected for escape. Over and above this must be noted the special and

even more formidable danger of falling in with detached fragments of ice, lumps from fractured and wasting bergs lying low in the water, and without the provision of luminosity for making themselves visible, yet in masses sufficiently great to stave in the bows or utterly destroy the strongest existing ship. Such dangers encountered in darkness, aggravated by showers, or haze or fog, are not to be rationally contemplated without some serious or anxious thought.

But, on the other hand, the question of danger ought to embrace the probable extent, number, magnitude, and frequency of icebergs on any given track, in comparison with the magnitude or width of the spaces amongst them. To the proportion in favour of safety must be added the effects of watchfulness on the part of the navigator, forming some previous estimate of his position of danger; the chances of the icebergs being passed in daylight, moonlight, or in moderate weather, or revealed when in the way by their luminosity; and, finally, the results of experience in the comparative fewness of the accidents demonstrated by the small additional premium, and the moderateness of the premium generally demanded by Underwriters for the insurance of ships voyaging to Australia or New Zealand. So estimated, the result comes out there is risk, and considerable risk, to ships voyaging through seas liable to the danger of icebergs; yet the risk, taken on an average, and in a merely intellectual or commercial point of view, is but small. In our particular case, the risk from separated fragments of the bergs we passed was lessened by the course we pursued and the steady direction of the gale, as fragments in a gale and heavy sea will always be found nearly astream of the iceberg—that is, in the line of the wind from the berg—to windward or to leeward; but we, in keeping far on one side, did not intersect or come near this usual line of icy débris and fragments. Hence, as a cautionary rule for sailing among icebergs at night, I would recommend the passing them, if possible, well on one side, in respect to the direction of the wind, and not to intersect the stream-line of the ice.

Not seeing more of icebergs during the night, it was hoped that we had passed beyond their region into an entirely free sea. But about 7.30 A.M. I was called by the Captain with the announcement that there was another large iceberg on the port bow. So far as the sight only was concerned, this was an announcement of considerable interest, as I naturally felt it, in the opportunity of comparing these mighty *flotations* of the Antarctic with the familiar ices of the Arctic regions. Hastily equipping myself for the exposure to the gale—for the thermometer was at 39°, and the decks sprinkled with hail, and the wind blowing violently—I arrived on the poop in good time to see the berg in its best approach and nearest position. It was already nearly on the port beam, and, although perhaps a mile to a mile and a half off, was abundantly conspicuous, and, as viewed with an opera glass, discernible in its particular features.

Of the mass, when covered, as sometimes it nearly was, with the broken, dashing waters of a heavy sea, it was difficult to judge. Probably it would be hardly less than 300 yards to a quarter of a mile in its greatest width, and possibly 150 to 200 feet high in its loftiest peaks; for it had two pointed peaks rising up like spires out of the solid mass, with one or more smaller elevations of a like kind betwixt or annexed to them. Pictured as it happened to us, on the dark storm-like face of a snow shower, its native whiteness shone out with characteristic conspicuousness, though no longer displaying the luminosity of those seen in the darkness of night. The spectacle of this floating ice-island in the assault and burst of the white waters

of an incidental highest wave—a wave, probably, of 40 feet altitude, and much breadth and massiveness of water—striking its steep or vertical face towards the west, and flying upward, and throwing a splendid white canopy over the greatest part of the windward elevations—was magnificent.

CHAPTER X.

ON THE SPECIFIC GRAVITY AND TEMPERATURE OF THE WATER OF THE INDIAN OCEAN.

Indian Ocean and Adjacent Seas.—In the Indian Ocean, including under that head the sea as far as 50° S. and 140° E., the region (or line) of lowest specific gravity appears to be near the equator or a little to the south of it, whereas in both the Atlantic and Pacific the line of least density is to the north of the equator in the belt of equatorial rains and calms. There is a marked decrease in density towards the east in the bay of Bengal and towards Sumatra, occasioned no doubt by the accession of the fresh water from the rivers Ganges, Mahanuddy, and Irawaddy; but taking the means of zones of 10 degrees there is but little difference in either the specific gravity or temperature from 20° N. to 20° S.

In the neighbourhood of Sumatra and Java, in Banca, Sunda, and Gaspar straits the specific gravity is exceedingly variable.

Though the specific gravity of the South Indian ocean is less on the whole than that either of the South Atlantic or the South Pacific, some of the highest densities on record have been found in the South Indian. CAPTAIN HEDDLE of the *Calliance*, when going from Melbourne to Calcutta, between Lat. 30° and 10° S., Long. 100° and 90° E., found two of 1.0349 and 1.0362 respectively. The last is the highest observation (well authenticated) on record, with the exception of CAPTAIN HARRINGTON's 1.0442 to the southward of Australia; but CAPTAIN HEDDLE is a careful observer and there is no reason to doubt his accuracy.

Sea of Japan, Yellow Sea, &c.—The density of the water (at surface) in the neighbourhood of the Japan islands and near the east coast of China and Chinese Tartary is somewhat variable. The greatest recorded in these seas is 1.0354, found in Lat. $40^{\circ} 40'$ N., Long. $138^{\circ} 6'$ E. by H.M.S. *Pique*. 1.0320 (and over) has been not unfrequently recorded, but upon the whole the mean specific gravity is not high; and near the mouths of the larger rivers, especially the Yang-tse Kiang, it is very low indeed. Near the mouth of the Peiho also it was on one occasion found to be as low as 1.0053.

The sea-water temperatures generally appear rather high for the latitudes. The range of temperature, especially near the coast, is considerable. In the gulf of Pe-Chili a range of 52° has been observed; 82° being the highest and 30° the lowest temperature recorded. The occasionally very low temperatures in this locality seem to be caused by the ice brought down by the Peiho river.

Red Sea.—The mean of some 200 observations gives 1.0286 as the mean density of the Red Sea.

The density seems to be greatest in the northern parts of the sea, and to decrease gradually southwards towards Aden. The maximum observed is 1·0321, in the bay of Suez, by H.M.S. *Cyclops*. The minimum 1·0252 by the steamer *European*, near Aden.

Dividing the sea into two parts, north and south of latitude 20°, we have the following result :—

Mean density of the whole		1·0286
„ Northern half		1·0297
„ Southern half		1·0272

being an excess of ·0025 on the side of the Northern half.

The mean temperature of the Red Sea is 79°·3. Above latitude 20° it is 77°·4, and (the mean of the observations) below that latitude it is 81°·5.

The highest temperature recorded is 94°.* Temperatures as high as 90° occur not unfrequently. The lowest temperature reported is 64°.†

Of the three oceans *South of the Equator*—the Atlantic, the Pacific, and the Indian—the Atlantic is the heaviest and the coldest; while the Indian is the lightest and the warmest; and the Pacific is between the two; as below :—

South Atlantic	. Specific gravity		1·02676
	Temperature		66°·66
South Pacific	. Specific gravity		1·02658
	Temperature		67°·70
South Indian	. Specific gravity		1·02630
	Temperature		69°·28

In conclusion, the result of the whole inquiry serves to show that the *chief* differences in oceanic specific gravity arise from local or special circumstances. It is high in regions where evaporation is rapid, as in the trade winds, and low in those parts of the ocean where much rain falls. It is the highest of all (on the average) in arms of the sea, such as the Red Sea, where there are no rivers and but little rain; and lowest near the mouths of great rivers, such as the St. Lawrence or the Plate, or in seas like the Black Sea and the Baltic, where the accession of fresh water is great. It is low also in high latitudes in the vicinity of ice.

The highest surface temperature anywhere recorded is 94° in the Red Sea near Aden. The highest temperatures recorded elsewhere‡ are 88° and 89°. These have been found not unfrequently in the Indian Ocean near the equator. CAPTAIN MAURY speaks of a temperature of 95° as being not uncommon in the Red Sea, but there is no record here of any temperature above 94°.

Changes of temperature in sea water are frequently abrupt, and in studying the temperatures (p. 256—260) as given, it should be borne in mind that it is the fact of these temperatures being the means of all observations within squares of ten degrees that causes the transitions to appear gradual.

In the neighbourhood of the Cape of Good Hope the changes of temperature are, as is well known, both sudden and frequent.

The register of H.M.S. *Encounter* states, that when in Lat. 39° 30' S., Long.

* Steamer *European*, at Aden, 2nd September, 1857.

† H.M.S. *Cyclops*.

‡ With the exception of a temperature of 91°.

15° E. in February 1860,—"At 6 A.M. upon drawing water from alongside it appeared quite warm to the hand," and the temperature was found to be 72°, which was 17° higher than it had been the previous day at noon, when the ship was in the same latitude, but 1° 53' further to the westward. The specific gravity (*uncorrected* for temperature) continued unchanged at 1·0285, and a northerly current of 19 miles had been experienced.

The *Sebastian Cabot*, CAPTAIN QUIRK, in very nearly the same position and in the same month found the surface temperature at 6 A.M. to be 57°, at noon 73°, and at 6 P.M. the same day 76°. This was in Lat. 39° 25' S., and Long. 16° 30' E. to 18° 30' E., current E.N.E. about 12 miles per 24 hours.

Farther to the southward, the *Pomona*, CAPTAIN BERGEN, Lat. 41° to 43° S., Long. 15° to 25° E., found the temperature of the water varying from 48° to 64°, changing frequently; though no great difference was observed in the specific gravity (*uncorrected*.)

In illustration of the effect of heavy rains, in at least temporarily diminishing the specific gravity of the surface, a most remarkable instance was observed by DR. C. K. ORD, of H.M.S. *Hermes*, when that ship was lying in Simon's bay in August 1859. On the 4th of that month at 9 A.M. the specific gravity was 1·0266, and in one hour it was reduced by the heavy rain that fell to 1·0193, the water becoming "brown in colour, merely brackish in taste, and its current setting distinctly outwards." By noon the density had increased to 1·0253, and at 3 P.M. the surface had recovered its former density of 1·0266. The next day the specific gravity was again reduced by heavy rain and again rose.

The *temperature* of the surface was also temporarily lowered from 58° to 55°, the temperature of the rain being 50°.

SPECIFIC GRAVITY AND TEMPERATURE OF EACH SQUARE OF TEN DEGREES IN
THE INDIAN OCEAN :—

Between the parallels of 30° and 20° N.* :—

1.	Long. 50 to 60 E.	temp. 78·0; sp. gr. 1·0283
2.	" 60 to 70 E.	" 77·3 " 1·0259
3.	" 70 to 75 E.	" 79·0 " 1·0261
4.	" 85 to 90 E.	" 80·3 " 1·0212
5.	" 90 to 95 E.	" 76·7 " 1·0238

Between the parallels of 20° and 10 N. :—

	Long. 40 to 50 E.	temp. 81·1; sp. gr. 1·0270
8.	" 50 to 60 E.	" 77·9 " 1·0275
9.	" 60 to 70 E.	" 80·9 " 1·0284
10.	" 70 to 80 E.	" 82·4 " 1·0270
11.	" 80 to 90 E.	" 81·5 " 1·0249
12.	" 90 to 100 E.	" 81·1 " 1·0242

* The numbers before the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

Between the parallel of 10° N. and the Equator :—

	Long.	40° to	50° E.	temp.	$80^{\circ}5$;	sp. gr.	1·0264
15.*	"	50 to	60 E.	"	80·9	"	1·0270
16.	"	60 to	70 E.	"	82·9	"	1·0269
17.	"	70 to	80 E.	"	82·6	"	1·0267
18.	"	80 to	90 E.	"	82·5	"	1·0260
19.	"	90 to	100 E.	"	83·0	"	1·0251

Between the Equator and the parallel of 10° S. :—

23.	Long.	40° to	50° E.	temp.	$79^{\circ}6$;	sp. gr.	1·0226
24.	"	50 to	60 E.	"	81·4	"	1·0266
25.	"	60 to	70 E.	"	82·0	"	1·0270
26.	"	70 to	80 E.	"	82·2	"	1·0270
27.	"	80 to	90 E.	"	82·3	"	1·0262
28.	"	90 to	100 E.	"	82·3	"	1·0259
29.	"	100 to	110 E.	"	83·0	"	1·0250
	"	110 to	120 E.	"	82·7	"	1·0256
	"	120 to	130 E.	"	82·8	"	1·0265

Between the parallels of 10° and 20° S. :—

30.	Long.	30° to	40° E.	temp.	$80^{\circ}8$;	sp. gr.	1·0261
31.	"	40 to	50 E.	"	81·1	"	1·0267
32.	"	50 to	60 E.	"	79·4	"	1·0265
33.	"	60 to	70 E.	"	77·5	"	1·0266
34.	"	70 to	80 E.	"	78·5	"	1·0263
35.	"	80 to	90 E.	"	79·1	"	1·0263
36.	"	90 to	100 E.	"	78·6	"	1·0266
37.	"	100 to	110 E.	"	78·7	"	1·0266
	"	110 to	120 E.	"	81·7	"	1·0264
	"	120 to	130 E.	"	82·7	"	1·0259
	"	130 to	140 E.	"	79·5	"	1·0256

Between the parallels of 20° and 30° S. :—

38.	Long.	30° to	40° E.	temp.	$74^{\circ}1$;	sp. gr.	1·0265
39.	"	40 to	50 E.	"	73·6	"	1·0266
40.	"	50 to	60 E.	"	75·1	"	1·0265
41.	"	60 to	70 E.	"	75·0	"	1·0268
42.	"	70 to	80 E.	"	74·2	"	1·0268
43.	"	80 to	90 E.	"	70·8	"	1·0269
44.	"	90 to	100 E.	"	69·6	"	1·0269
45.	"	100 to	110 E.	"	69·7	"	1·0271
	"	110 to	115 E.	"	72·6	"	1·0271

* The numbers before the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

Between the parallels of 30° and 40° S. :—

47.*	Long. 20° to 30° E.	temp. 69°0; sp. gr. 1·0270
48.	" 30 to 40 E.	" 69·3 " 1·0267
49.	" 40 to 50 E.	" 66·3 " 1·0268
50.	" 50 to 60 E.	" 62·4 " 1·0269
51.	" 60 to 70 E.	" 60·7 " 1·0266
52.	" 70 to 80 E.	" 60·6 " 1·0268
53.	" 80 to 90 E.	" 59·3 " 1·0264
54.	" 90 to 100 E.	" 59·2 " 1·0263
55.	" 100 to 110 E.	" 62·4 " 1·0270
	" 110 to 120 E.	" 61·8 " 1·0269
	" 120 to 130 E.	" 58·7 " 1·0267
	" 130 to 140 E.	" 58·4 " 1·0267
	" 140 to 150 E.	" 58·7 " 1·0262

Between the parallels of 40° and 50° S. :—

57.	Long. 20° to 30° E.	temp. 52°9; sp. gr. 1·0261
58.	" 30 to 40 E.	" 50·4 " 1·0260
59.	" 40 to 50 E.	" 48·4 " 1·0256
60.	" 50 to 60 E.	" 49·3 " 1·0257
61.	" 60 to 70 E.	" 51·2 " 1·0259
62.	" 70 to 80 E.	" 49·4 " 1·0256
63.	" 80 to 90 E.	" 48·5 " 1·0258
64.	" 90 to 100 E.	" 47·4 " 1·0259
65.	" 100 to 110 E.	" 48·7 " 1·0259
	" 110 to 120 E.	" 49·9 " 1·0261
	" 120 to 130 E.	" 51·2 " 1·0260
	" 130 to 140 E.	" 53·0 " 1·0260
	" 140 to 150 E.	" 56·0 " 1·0264

Between the parallels of 50° and 60° S. :—

	Long. 20° to 30° E.	temp. 36°0; sp. gr. 1·0263
	" 30 to 40 E.	" 35·5 " 1·0257
	" 40 to 50 E.	" 35·2 " 1·0260
	" 50 to 60 E.	" 36·5 " 1·0261
	" 60 to 70 E.	" 36·1 " 1·0259
	" 70 to 80 E.	" 35·1 " 1·0259
	" 80 to 90 E.	" 36·9 " 1·0256
	" 90 to 100 E.	" 39·0 " 1·0257
	" 100 to 110 E.	" 38·0 " 1·0259
	" 110 to 120 E.	" 37·8 " 1·0255
	" 120 to 130 E.	" 40·0 " 1·0254
	" 130 to 140 E.	" 48·0 " 1·0252
	" 140 to 150 E.	" 45·0 " 1·0245

* The numbers before the "Long." are those of the ten degree squares on the "Wind Charts of the Indian Ocean" which accompany this work.

SUMMARY :—INDIAN OCEAN AND CHINA SEA, &c., as far as 140° E.

Lat. 20° North to 50° South.

ZONES.	MEANS.		MAXIMA.				MINIMA.			EXTREME RANGE.		Approximate Number of Observations.
	Specific Gravity at 62° F.	Temperature.	Specific Gravity.	No. of Square on Chart.	Temperature.	No. of Square on Chart.	Specific Gravity.	No. of Square on Chart.	Temperature.	Specific Gravity.	Temperature.	
North.												
20° to 10°	1.0261	81.2	1.0326*	14	91	13	1.0091†	12	62	0235	29	1800
10° "	1.0259	82.4	1.0301	17	88	18, 19, 20	1.0198	21	76	0103	12	2100
South.												
0° to 10°	1.0258	82.0	1.0304	25	89	23	1.0127‡	29	69	0177	20	2040
10° " 20°	1.0263	79.8	1.0362	36	87	37 ^a	1.0230	33	67	0132	20	1700
20° " 30°	1.0268	72.3	1.0349	44	82	38, 40, 41	1.0230	41	58	0129	24	2200
30° " 40°	1.0267	62.3	1.0333§	55	80	48, 49	1.0204	47	52	0129	28	3600
40° " 50°	1.0259	50.0	1.0303	57	68	59	1.0225	60	34	0078	34	2800

* The *Harbours* from Shanghai found the specific gravity at the surface 1.0326 (nearly) on three successive days; Lat. 19° N. to 14° 40' N., Long. 117° 30' to 114° E. No current was perceptible, except on the third day, when a N. 34° E. 31 m. current was experienced.

† The ship *Zeele Beyle*, from Bombay to Moulemain, 15° 17' N., 96° 52' E. The water was of a dull muddy green, "almost drinkable," and the density continued maintaining as the ship approached Moulemain.

‡ The *Cambou*, close to the land on the east coast of Sumatra. Captain Fawcett remarks that the "water is remarkably fresh."

§ Two greater densities in these latitudes have been recorded, both by Captain Harrington of the *Orestion*. The first was in 39° 15' S., 131° 5' E., where Captain Harrington entered in his register and has noted as "extraordinary but correct" a density of 1.0442 (corrected); and again in 38° 7' S., 109° 56' E., he reports that he found the specific gravity to be as much as 1.0448.

In higher Latitudes than 50° S. :—

Lat. 50° to 60° S., Long. 20° to 140° E. ; mean sp. gr. 1·0258 ; mean temp. of water, 37°·4.

Max. sp. gr. 1·0283 in Long. 60° to 70° E.

Min. sp. gr. 1·0234 in Long. 130° to 140° E.

Max. temp. of water 45° in Long. 130° to 140° E.

Min. temp. of water 34° in Long. 110° to 120° E.

SPECIFIC GRAVITY AND TEMPERATURE OF EACH SQUARE OF TEN DEGREES
IN THE CHINA SEA.

Between the parallels of 40° and 30° N. :—

Long. 115 to 120 E.	temp. 64·0 ;	sp. gr. 1·0173
„ 120 to 130 E.	„ 60·0	„ 1·0222
„ 130 to 140 E.	„ 66·2	„ 1·0239

Between the parallels of 30° and 20° N. :—

Long. 110 to 120 E.	temp. 74·4 ;	sp. gr. 1·0249
„ 120 to 130 E.	„ 72·4	„ 1·0255
„ 130 to 140 E.	„ 78·8	„ 1·0266

Between the parallels of 20° and 10° N. :—

Long. 100 to 110 E.	temp. 82·2 ;	sp. gr. 1·0244
„ 110 to 120 E.	„ 81·0	„ 1·0254
„ 120 to 130 E.	„ 80·6	„ 1·0256
„ 130 to 140 E.	„ 82·1	„ 1·0262

Between the parallel of 10° N. and the Equator :—

Long. 100 to 110 E.	temp. 83·0 ;	sp. gr. 1·0247
„ 110 to 120 E.	„ 82·4	„ 1·0249
„ 120 to 130 E.	„ 83·4	„ 1·0250
„ 130 to 140 E.	„ 83·6	„ 1·0259

These observations (pp. 254–260) are selected and condensed from the Twelfth Number of Meteorological Papers published by the Board of Trade in 1865.

Twenty-five different elements have been observed in the water of the ocean, or in plants and animals of the sea: *oxygen, hydrogen, chlorine, bromine, iodine, fluorine, sulphur, phosphorus, carbon, nitrogen, silicon, iron, manganese, magnesium, calcium, strontium, barium, sodium, potassium, silver, copper, lead, zinc, cobalt, nickel*; but only those printed in *italic* are predominant. Of these, chlorine, sulphuric acid, lime, and magnesia may be determined with great exactitude.

Saltness of the Ocean.—The mean result of several analyses by REGNAULT gives :—

WATER	96.470
SALINE INGREDIENTS— 3.505.	Chloride of Sodium 2.700
	„ Magnesium 0.360
	„ Potassium 0.070
	Sulphate of Lime 0.140
	„ Magnesia 0.230
	Carbonate of Lime 0.003
	Bromide of Magnesium 0.002
Loss, including Iodides, Silica, &c.	0.025
	<u>100.000</u>

According to FORCHHAMMER,* the mean of 140 complete analyses gives 3.430 of salt in *one hundred* parts of water, unequally distributed over 16 regions; but the specimens being principally taken at low latitudes, he regards this mean as too high.

The mean saltness of the Atlantic is 3.577; of the Californian Pacific 3.522; of the Japanese Pacific 3.443; and of the Indian Ocean 3.413.

CHAPTER XI.

DEEP-SEA SOUNDINGS IN THE INDIAN OCEAN.

Deep-Sea soundings have not been tried for to the same extent in the Indian as in the Atlantic Ocean; those for the laying down of the Red Sea and India Telegraph are the principal. The following were made by CAPTAIN W. J. S. PULLEN, R.N., in H.M.S. *Cyclops*, on the voyage to Aden in 1857, previous to his sounding the Red Sea; this is an important paper, as the observations and remarks tend to clear the chart of many *vigiâs* to the southward and north-eastward of Madagascar.

“Between the parallels of 35° and 40° S. many doubtful dangers are marked on the charts; and on nearing them, the lead was brought into play. Two of these, I think, may be fairly expunged from the position they have so long held.

“The first was the Brunswick, on which is marked 85 fathoms,—deep enough, certainly, for any ship that floats; but to remove all doubt, I had two casts not far from it of 1410 and 1102 fathoms without reaching bottom.

“The next was the Atalanta shoal, seen by two ships, an American and a Dutchman; both give the position different. I therefore laid it down on our chart in three several places. I passed from the westward between the most northern position and the first of the southern ones, and got four deep casts, besides several of 50 and 80 fathoms in their vicinity. The first was down (by intervals of time noted) to 1110 fathoms. I felt doubtful about the cast, and as there was no time to get another cast before dark, lanterns were placed, and the lead was let go, getting as good a series of intervals as with many soundings we have made by daylight;

* The full detail of the analyses is :—Videnskabernes Selskabs Skrifter.—V. RÅKKE, 1860.

moreover, proving that our first cast was right, for this time the lead was down at 1120 fathoms; and, as a further satisfaction, the valve bringing up a specimen of the bottom, appearing to be fine, light-coloured sand, over a hard bottom. The next morning, having laid by nearly all night with 800 fathoms, I found no bottom; and a little further N.E. the lead was down at 900 fathoms. Here the valve brought up a specimen again similar to that which we had the preceding night, with a small pebble on it; and when a portion of this specimen was placed under the microscope, it proved to be some of the most beautiful species of the *Diatomaceæ* that can be imagined.

"From this last sounding the course was more northerly, and considering what could have given rise to the report of pointed rocks, and how to account for finding such shoal water so far from any land, six and eight hundred miles—the Crozets on the one hand, and south point of Madagascar on the other—thought it possible that at a less depth might be met with, and further, that this vicinity ought to have a closer examination. However, looking to the westward, something like a break caught my eye, but being the only person who could see it, I thought I was deceived by the *mirage*, and perhaps imagination, from dwelling so long on the subject of rocks, and went below.

"In the course of half an hour the officer of the watch reports passing broken water to the S.E., just in the opposite direction to where I had seen a like object, but this time there was certainly no deception; the description given was, that it had the appearance of water rushing and foaming over broken ground, like a mill-stream. From the distance, with a glass, it most decidedly looked like breakers; and being under steam, almost a dead calm, I bore away for it; nearing it, it lost the appearance of *break*, but showed a white milky substance, in large patches, spread over a considerable surface, with strips of dark water between, showing as the deepest water; this, together with the long undulating motion from the S.W. swell, had caused it to appear from a distance, as if breaking. I steamed through, and with 145 fathoms found no bottom.

"This appearance, I have no doubt, without examination, has given rise to the reports of so many dangers seen between these parallels; and one circumstance which took place with us will, I think, show how one may be deceived. The captain of the fore-castle, not knowing that the course had been altered, or that anything unusual was going on, suddenly looked out ahead, and shouted most lustily, 'Broken water ahead, sir!' This, too, when we were close to it.

"About the Brunswick shoal, also, for two days we were passing through what at a distance might be taken for sand-spits, which on examination proved to be a small gelatinous polypi, with a small crustacea in the head of a yellow and brownish appearance, which, seen in such immense quantities, might easily deceive at a distance, especially in former days. What to call the white substance I do not know; there were infusoriæ and small crustaceæ found amongst it.

"Steering now to pass to the westward of Mauritius, a little south of the parallel of 20°, distant from the land 90 miles, I could not get bottom with 1375 fathoms of line. This first showed me the improbability of the Indian Ocean being of less depth than the Atlantic. Proceeding northward, I passed up to the westward of Cargados Garajos, Saya de Malha, east of Seychelles, and crossed the Equator in 58° 20' E., getting a cast 9 miles south of it, with 2380 fathoms; no bottom.

"Between 40 and 50 miles west of the northern part of the Cargados got bottom with 1400 fathoms of line. In Lat. 14° 41' S., and Long. 58° 43' E., no bottom

with 1570 fathoms. In Lat. $10^{\circ} 30' S.$, and Long. $58^{\circ} 52' E.$, no bottom with 1320 fathoms; here the ship was passing through strong tide-rips looking like breakers, or rather a rush of water over uneven bottom; in fact, it was one of the first overfalls that we had met; on first view it appeared as if numbers of fish at the distance were swimming about just under the surface, or the albacore in chase of the flying fish. Passing near where 185 fathoms are marked on the chart N.W. of the Saya de Malha, no bottom with 200 fathoms.

"Wind now light from northward; when I was close to the doubtful George island, and about $\frac{2}{3}$ of a mile west of its southern part, 2000 fathoms of line would not reach bottom; temp. of surface $81^{\circ} 5$, at the greatest depth $38^{\circ} 2$. Passed over this island nearly a mile within its southern point, and not finding the ship on shore, conclude that such an island never existed here. Steaming to pass near Rose Galley rocks, the next morning, 5 miles south of the most western one, found bottom with 2254 fathoms of line, the valve bringing in plentiful specimens from that depth; and the thermometer sent down showed a minimum temperature of 35° . The thermometers are hardly to be depended on, for up to this time I have invariably found that on their return the tell-tale in the maximum column has shown very different from what it did on starting—viz., the surface-temperature, from which we may conclude that the minimum tell-tale has moved also. MR. McLEAB, the astronomer at the Cape, also spoke of it taking up one of our deep-sea thermometers when he was on board, and quite altering the indices with a very little motion, less than the line is likely to give it on its passage up and down.

"After this sounding near the Rose Galley rocks I passed about 1 mile west of the westernmost one, and could not detect the slightest break or disturbance in the sea anywhere. Approaching Swift bank, I commenced sounding with 150 fathoms only, and carried a line of that depth over the bank without reaching bottom."

CHAPTER XII.

WHALING-GROUNDS IN THE PACIFIC, ATLANTIC, AND INDIAN OCEANS.

THE following observations are extracted from COMMANDER WILKES' "Narrative of the United States' Exploring Expedition, 1838-1842."

The principal whaling-grounds in the Pacific are indicated below; they are confined particularly to spaces which have been known in the Pacific Ocean by names well understood among the whalers, such as the "on-shore ground," and the "off-shore ground," "middle ground," &c. These spaces, however, have wide limits; thus, for instance, the "on-shore ground" embraces the whole extent of ocean along the coasts of Chili and Peru, from the island of Juan Fernandez to the Galapagos islands; and the "off-shore ground" the space between Lat. 5° and $10^{\circ} S.$, Lon. 90° and $120^{\circ} W.$

The following list embraces all the different grounds in the Pacific visited by whalers:—

1. The on-shore ground.
2. „ off-shore ground.
3. In the neighbourhood of the Hawaiian islands.

4. In the neighbourhood of the Society islands.
5. " " Samoan group.
6. " " Feejee group.
7. " " Kingsmill group.
8. Along and to the south of the equator, from the coast of South America to the Kingsmill group.
9. Across the South Pacific, between the parallels of 21° and 27° S.
10. " North " " " 27° and 35° N.
11. In the neighbourhood of the east coast of New Zealand.
12. The Middle Ground, between New Holland and New Zealand.
13. The coast of Japan, and between it and the Bonin islands.
14. The N.W. coast of America.
15. Coast of California.

These, it will be seen, embrace a large field, and it might be supposed that a ship could hardly miss finding the animals. Such, however, is not the case. A vessel may visit all these places, and yet return home a "clean ship," if she happened to be out of season. It appears from experience that whales in their migrations congregate in the above-named places at certain times of the year, and those who are acquainted with the business endeavour to be early on the cruising-grounds. I shall now point out the times, according to the best information, at which the whales visit the several grounds, and although not a whaler, I hope to give such information as may be useful to this adventurous class of my countrymen.

For convenience of description, the cruising-grounds may be considered as included within four distinct sections or belts.

These belts are from twenty to twenty-five degrees of latitude in width.

The first of which I shall speak is that between the equator and the northern tropic; the second, between the tropic and latitude 50° N.; the third, between the equator and the southern tropic; and the fourth, between the southern tropic and Lat. 50° S.

Within the tropics, whales are almost always to be met with. There are, however, particular places within this zone where they chiefly congregate. Whales are found in the first belt on the north side of the equator, to the southward of the Sandwich islands, and thence westward as far as the Mulgrave islands, for the greater part of the year; but the only spot or space they are known to abound at any particular season within this belt, is to the westward of the Galapagos; they pass and repass over the rest of this space in their migrations, and may generally be found near to, or around the small islands.

In the second belt, they range from the coast of Japan to the north-west coast of America, and California; this they frequent from May till November. In the month of July they are found off the Bonin islands, and between them and the coast of Japan. They frequent the space lying to the northward of the Hawaiian islands, and comprehended between the parallels of 28° and 35° N., and within the meridians of 145° and 165° W., from June to October; and resort to the north-west coast of America in August and September; and to that of California in November and January.

The third belt comprises the ocean from the coast of South America to the Kingsmill group, including the Marquesas, Society, and Friendly islands, the Samoan and Feejee groups. Within these are the spaces known as the "on-shore and off-shore

grounds." The latter the whalers frequent from November to February, and along this third belt they are found until the months of July and August, by which time they reach the Kingsmill and Feejee groups. There are, however, stragglers to be met with in this space during all seasons.

The fourth belt extends from the southern tropic to the latitude of 50° S. The most profitable time for cruising within it is in the months of March, April, and May, to the eastward of New Zealand. After that date, along and between the parallels of 22° and 28° S., from the coast of New Holland to that of South America. The portion of sea between New Holland and New Zealand is called the "middle ground," and is frequently found very profitable.

From an examination of the particular localities in which whales are found most numerous at certain seasons, and connecting these with my own observations on currents, I am induced to believe the places of their resort will point more correctly to the neutral points, or spaces of no current, than any other data that we yet possess.

These must naturally become the rendezvous or feeding-places of these animals. The determination of these points will therefore throw additional light on the system of currents in the ocean, by pointing out the neutral spaces. When the chief resorts of whales are connected with the currents shown to exist by the observations of the Expedition and others, they will be found to correspond in a remarkable manner with the neutral spaces.

I have myself paid much attention to acquiring information in relation to the position of these grounds, from the masters of whale-ships, but have usually found their reports at variance one with another, and they have sometimes differed as much as five degrees in assigning their limits. Their position, no doubt, varies much in different years; but even this will not explain all the discrepancies of the statements.

If we examine the seasons of the appearance of whales at certain islands, they will generally be found to be between the beginning and the end of the summer of the climate, during which time animal life is most prolific, and the food of the whale consequently abounds near the particular group. I have frequently been told, and it is generally believed, that whales are partial to warmth, and frequent few places outside the tropics. This, if true, would be singular enough; but the main reason for their frequenting the summer seas at particular seasons is the procurement of food, which is there to be found in greater abundance; and there appears to be little doubt that in migrating these animals move with the currents, until they find their food in plenty, and then continue in such locality until it is exhausted.

A number of instances are known in which, at certain seasons, strong currents have been experienced in places where, three months afterwards, they were found to have ceased altogether, or even to have changed their direction. I have now particular reference to the N.W. coast.

Having pointed out the different belts in the Pacific, I will now refer to the localities in the Atlantic and Indian Oceans, where the sperm-whale fishery is most successful.

These, in like manner, are found to correspond, and are connected with the obstructions of the submarine currents, or the places where, from opposing causes, they become lost.

In the Atlantic Ocean :

1. Off the Azores or Western islands.
2. „ Cape De Verdes.
3. North of the Bahama banks.
4. Gulf of Mexico.
5. Caribbean sea.
6. To the eastward of the Windward islands.
7. North coast of Brazil.
8. South coast of Brazil.
9. Carrol ground, or a space of ocean lying between St. Helena and Africa.

In the Indian Ocean :

1. Off the southern end of Madagascar, and between it and Africa.
2. „ northern end „ „ „
3. The coast of Arabia.
4. West coast of Java.
5. North-west coast of New Holland.
6. South coast of New Holland, and between it and Van Diemen's Land.

The periods or times allotted to these fisheries coincide with the times at which it might be expected that the food of the whale would be most plentiful, if brought by the polar streams.

The Atlantic fishery is for the most part carried on in a smaller class of vessels than those used in the Pacific; the voyages are of less duration, and less capital is therefore required in this business than the other. In speaking of cruising-grounds, I shall follow the order in which they are visited.

The first in point of time is that near the Azores. This ground does not extend more than 200 miles from these islands, and lies principally to the southward of them. Here whales are found during the summer months, and as late as October. These islands, it will be well to remark here, lie in the route of the Great North Polar Stream, and form an obstruction to its passage; consequently the food is arrested in its progress and is accumulated here.

The next ground visited is off cape Blanco and the cape De Verdes, and it is also searched by the outward-bound ships of the Pacific fleet.

The whalers of the Atlantic next pass to the north coast of Brazil, in the months of October, November, and December, and thence to the Brazil bank, and off the mouths of the Rio de la Plata, where they fish in January and February; after this they seek St. Helena and the Carrol Ground, which lies from fifty to two hundred miles south-east of that island, towards the cape of Good Hope. On the latter ground they remain during the months of March, April, and May; and thence they pass to the westward, along the South American coast, to the eastward of the Windward islands; thence to the Bahama banks, cape Hatteras, and along the coast of the United States, home.

The smaller class of whalers seldom extend their cruising to the south of the line; but after they have visited the first two whaling-grounds, they usually pass to the westward, towards the islands of Fernando de Noronha, and thence along the South American coast, till they reach the Windward islands. They frequent the Caribbean sea in the months of January and February, and farther to the westward, off the peninsula of Yucatan and Cuba, in April; after which time they

proceed through the gulf of Mexico, to cruise off the Bahama banks, and cape Hatteras, in May. Thence they pass northward, on either side of the Gulf Stream, to the eastern side of the Grand banks.

In the Indian ocean, the south part of Madagascar, off point Dauphin, is visited in March and April; in May, June, and July, the ground of the south-west cape of Madagascar, in the Mozambique channel, and upon both sides of that channel. The whalers usually recruit in St. Augustine's bay, where supplies are to be had in abundance, and both wood and water are easily procured. After this, they usually spend some time off cape Corrientes, with the cape and headlands on either side, and visit the Comoro isles. Sperm whales are frequently found in numbers among these islands, and ships usually do well in their vicinity. The African coast, from Mozambique to Zanzibar, is good ground, and the latter place is also a good port for repairing.

Some ships extend their cruising during the north-east Monsoon, from October to April, to the Arabian coast, but the African is generally preferred. The Chagos Archipelago at times affords some success, but it is very doubtful ground, and has not been often frequented. The proper season is during the south-west Monsoon.

The most profitable ground in the Indian ocean is the west and north-west coasts of New Holland, as far eastward as the islands of Timor, Lomboek, and Angier, and westward to the Keeling islands, including the coast of Java.

It will be perceived how nearly these grounds coincide with the places wherein, according to the views already stated, the polar streams are obstructed by land or islands, so as either to interrupt their course, or create such an impediment as to change it.

The Sooloo sea is the only place that remains to be noticed. American ships, however, have seldom gone thither; but some English vessels are reported as having met with much success there.

There are two routes by which whale-ships can enter the Pacific: one by the cape of Good Hope and round New Holland; the other, by cape Horn.

To take the first route, they ought generally to time their departure so as to meet the season off New Zealand in March, and this is also the best course for ships sailing in the autumn from the United States. They will then reach their whaling-ground at the earliest possible season, and place themselves at once in a situation to reap the harvest of which they are in search; and they would, in all probability, have time to refit and recruit after the outward voyage. This is much more important for insuring success in this employment than very many either of the masters or owners are aware. After a few days in port, and a supply of fresh vegetables, they would find both their ships and crews in a better condition to take the sea and keep it. After remaining six weeks or two months on the New Zealand ground, until the winter season and boisterous weather approach, the vessels should pass to the northward, towards Sunday island, and thence cruise to the eastward, between the latitudes of 22° and 28° S., or even in a few degrees higher latitude. The lower latitudes are, however, found to be the most frequented by the whale. Along these parallels they proceed as far as the coast of South America, so as to arrive there in the course of the month of September, after passing part of the time to the westward of the islands of Juan Fernandez and Massafuera.

Other vessels reach the Society islands in June, and thence pass to the westward,

in order to meet the season off the Samoan and Feejee Groups; thence again without the Tropics to the south, either on the "middle ground," between New Holland and New Zealand, or to a higher south latitude, and again meet the season off New Zealand at the end of summer or in March. Those that reach the coast of Chili generally recruit in the bay of Talcahuana, or in the port of Payta, in Peru, and are ready to take up the season on the "off-shore ground" in November.

Vessels leaving Europe in the beginning of summer would do better to take the route round Cape Horn, reaching Chili or Peru in time to recruit before the month of November, at which time they repair to the "off-shore ground," where they remain for one, two, or three months; thence pass to the Marquesas islands and to the westward of them, and thence to the west, along the Equator, as far as the Mulgrave islands and the coast of Japan. Returning, they proceed to the north-west coast of America, California, and finally reach the Sandwich islands to recruit by the months of October or November. Other vessels pass directly from the "off-shore ground" to the neighbourhood of the Sandwich islands, where they spend the months of February, March, and a part of April; they then proceed to the Latitude of 30° , and continue their cruising on each side of that parallel between the meridians of 145° and 165° W., until October, when they repair to the Hawaiian islands to recruit.

CHAPTER XIII.

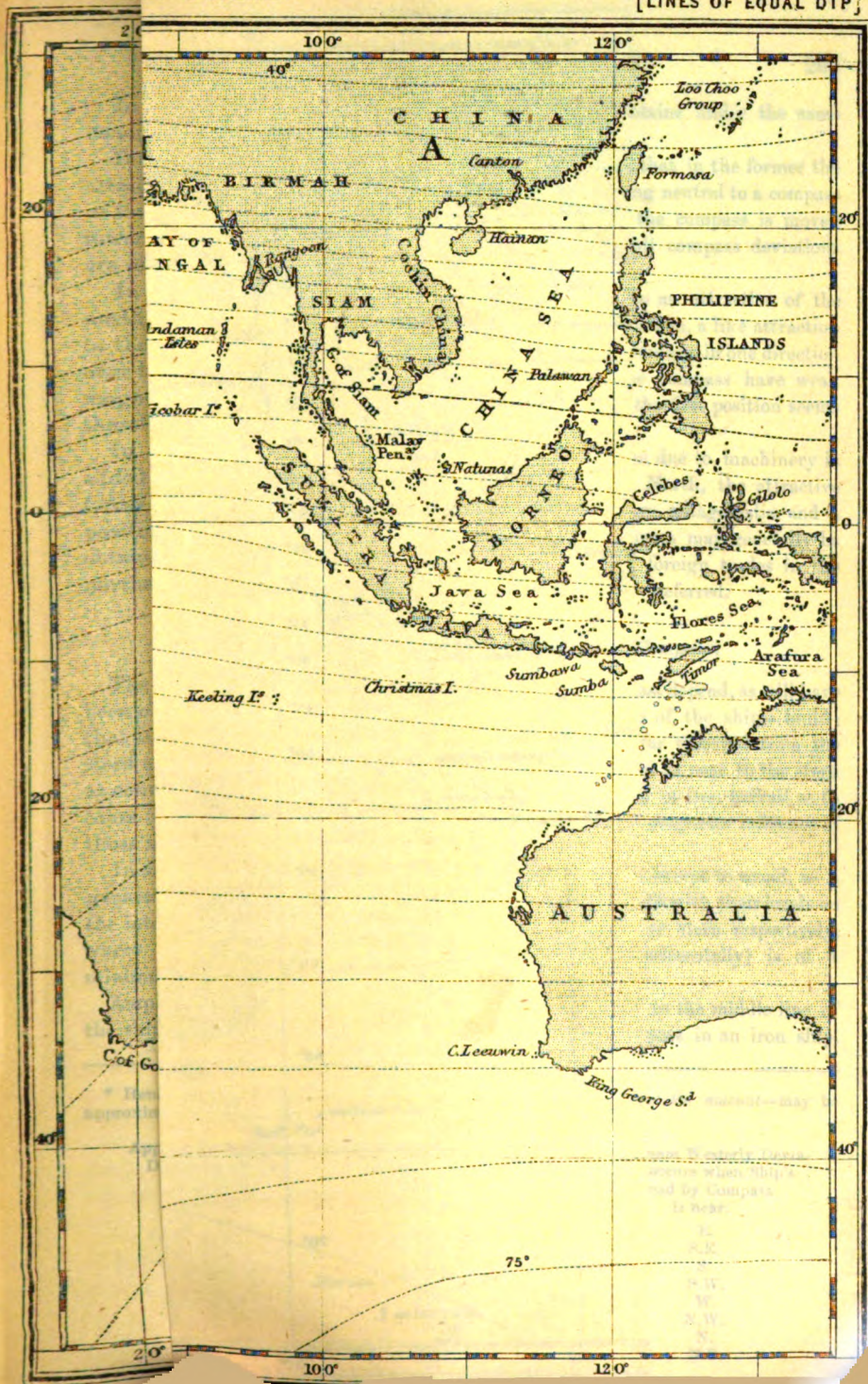
THE MAGNETISM OF IRON SHIPS.

IN "Notes on the Physical Geography of the South Atlantic" is given a general description of the various elements of Magnetism as exhibited in the "Variation" of the compass, in the "Dip" of the needle, and in the "Total Force" of which the variation and dip are component parts; it is sufficient here to refer the reader to those remarks, and to draw his attention to these magnetic elements being represented on the charts of the Indian ocean which accompany this work; observing, however, that on one of the charts it is not the Total Force which is given, for that *total* force being the expression of two forces, one "Horizontal," and the other "Vertical," it is only necessary to delineate the former,—a knowledge of which, with the "Dip," enables us to anticipate the changes that take place in a ship's magnetism, and consequently in the deviation.

This work does not propose to enter largely on the general and important subject of the magnetism of iron ships, for the seaman will find it more to his advantage to peruse and master the "Admiralty Manual" relating thereto; it may, however, be useful in this place to draw his attention to a portion of an excellent paper published in the *Philosophical Transactions*, "On the Reduction and Discussion of the Deviation of the Compass," by CAPTAIN J. EVANS, R.N.

1. On the best Direction for Building an Iron Ship.

In those built head N.E., East, West, and N.W., strong *south* polarity (or an *attractive* force on the north end of the compass needle), obtains on one side of the ship adjoining the compass as usually placed between the middle section and the stern; the resulting disturbance is not lessened as the compass is moved in a fore-and-aft line within these limits.



In vessels built head S.E. and S.W., *north* polarity obtains under the same conditions.

In vessels built head North or South, the conditions arise, that in the former the attraction is toward the stern (the topsides in their action being neutral to a compass in the middle line of the deck), and diminishes in force as the compass is moved towards the bow. In the latter the law is reversed, and small compass deviations are obtained as the stern is approached.*

In an iron *sailing* ship, built head to South, there will be an attraction of the north point of the compass to the head; and if built head to North, a like attraction to the ship's stern; and so far there would seem to be no advantage in one direction over the other. But in the first case the topsides near the compass have weak magnetism; in the second case they are strongly magnetic: the first position seems therefore preferable.

In an iron steam-ship, built head to South, the attraction due to machinery is added to that of the hull, whereas in one built head to North, the attractive forces of hull and machinery are, in the northern hemisphere, antagonistic, and a position of small, or no "semicircular" deviation for the compass may generally be obtained. To iron steam-vessels engaged on the home or foreign trades in the northern hemisphere, this direction of build is therefore to be preferred.

2. On the Position and Arrangements of the Compass.

The position of the compass, whether standard or steering, must depend, as will have been observed from the foregoing conclusions, on the direction of the ship's build; that is, in those built head North the compass must be as far removed from the stern as circumstances will permit; in those built South, placed as near to the stern as convenient, without approaching so close to the rudder-head or iron taffrail as to cause the ship's general magnetism to be overpowered by the magnetic influence of those masses.

In ships built East or West there is little choice of position, except to avoid, as a general rule, proximity to vertical masses of iron; in vessels built with their heads on the intercardinal points, a position approximating to the bow or stern respectively, where the action from the topsides (to be determined experimentally) is at a minimum, is to be preferred.

Ample elevation above the deck, and to be strictly confined to the middle line of the ship, are the primary conditions of position for every compass in an iron ship,

* Hence it follows that the *character* of the deviation—though not the *amount*—may be approximately represented in a tabular form, as follows:—

Approximate Magnetic Direction of Ship's Head while Building.	Maximum Easterly Deviation occurs when Ship's Head by Compass is near.	Maximum Westerly Deviation occurs when Ship's Head by Compass is near.
N.	W.	E.
N.E.	N.W.	S.E.
E.	N.	S.
S.E.	N.E.	S.W.
S.	E.	W.
S.W.	S.E.	N.W.
W.	S.	N.
N.W.	S.W.	N.E.

and no compass, whether steering or standard, should be nearer the iron deck beams than 4 feet : for the steering compass this arrangement could be met by the use of a vertical card for the helmsman.

The standard compass, which as a rule I should recommend to be invariably uncompensated, requires an elevation of at least 5 or 6 feet from the deck, and to be fitted on a separate and permanent pillar or stand : it is by this superior elevation that the strong magnetic power of the iron beams and adjoining topsides is correspondingly lessened.

As every piece of iron not composing a part of, and hammered in the fabrication of the hull—such as the rudder, funnel, boilers, and machinery, tanks, cooking galleys, fastenings of deck houses, &c.—are all of a magnetic character differing from the hull of a ship, their proximity should be avoided, and, so far as possible, the compass should be placed so that they may act as correctors of the general magnetism of the hull.

A compass placed out of the middle line of the deck is affected by the nearest topside, and its deviations must necessarily be much increased if that topside has the dominant polarity, as in the ships built East or West.

Experience has proved that the practical value of mast or elevated compasses has in some cases been overrated ; they are, in fact, affected by the ship's magnetism to an amount depending on their elevation and the direction of the ship's build. Thus, in ships built North or South, but especially the latter—the compass being on the mizen mast—the deviations will be large comparatively. In ships built East or West the deviations will be comparatively small, from the topside (which would affect a deck compass) being more directly under the mast-compass ; they may, therefore, be useful in the latter cases, and valueless in a ship built head to the South. The wear and tear on the pivots and agate caps of mast-compasses, from the increased motion due to their elevation, require constant attention when they are employed.

3. On Various Sources of Error affecting a Compass placed under favourable conditions.

Errors arising from changes of geographic position must of necessity occur, as also incidental causes of error due to anomalous rather than general conditions. There is, however, one source of compass-error—that arising from the heeling of the ship—which has not yet been alluded to, as the ship in all the points hereto reviewed is assumed to be on an even keel.

The few experiments made in ships of the Royal Navy tend to prove, as also does the test of experience, that when the original compass deviations are small, the errors from heeling are generally small in proportion ; and conversely, that exaggerated errors from heeling are the consequence of exaggerated errors while on an even keel. Ample elevation from the deck, in order to raise the compass above the level of the topsides and adjacent deck beams, is one of the chief conditions for reducing this source of error.

With head built North, on heeling, the north end of compass needle will be *attracted* to the weather or nearest side from its *south* polarity.

..	N.E.	..	..	the same.
..	East,	..	..	the same.
..	S.E.	..	..	the north end of needle will have but little error from the balanced conditions of north and south polarity of topsides.
..	South,	..	..	the north end of needle will be <i>repelled</i> to the lee side by the <i>north</i> polarity of nearest or weather topside.
..	S.W.	..	..	the north end of needle will have but little error, as at S.E.
..	West,	..	..	the north end of needle will be <i>attracted</i> to the weather or nearest side.
..	N.W.	..	..	the same.

These laws only hold good as long as the topsides in the immediate vicinity of the compass retain their dominant polarity due to their original direction of build in Great Britain: if in south magnetic latitudes a change of polarity takes place, the conditions of heeling correspond to such change.

The maximum disturbance on heeling in all these vessels is when their heads are (by disturbed compass) magnetic North or South, and this disturbance vanishes when the head is East or West. This law of disturbance may be thus explained: when the vessel's head is north or south on an even keel (by disturbed compass), the needle lies parallel to the topsides by their combined action, which neutralizes each other; on heeling, the nearest topside exercises its then dominant polarity at right angles to the direction of the needle, and hence the maximum error. With the ship's head east or west, whether on an even keel or heeling, either pole of the compass-needle points directly to the topsides, and is consequently unaffected except in a vertical plane.

As the amount of disturbance on heeling varies under the various conditions of direction of build, height of compass, and breadth of ship or distance of topsides, added to the prevailing permanent or inductive magnetic condition of the latter and the deck beams, each ship must have an individual character, to be determined only by experiment or observation at sea. There are, however, strong grounds for inferring that by a judicious position of the compass, so as to ensure small errors while on an even keel, the errors arising from the ship's heel will be so proportionally reduced as not practically to affect the navigation of the ship in the hands of a prudent seaman.

In conclusion, it is recommended to every master of an iron ship or steamer that he be provided with GODFREY'S "Time Azimuth Chart," whereby, with incredibly little trouble, he can determine the true bearing (within 1° or 2°) of any celestial object when its meridian distance is greater than two hours; so that by observing the object's bearing by compass at any given instant (within the limits stated), and then measuring the true azimuth on the chart, he at once knows the error on the course he is steering.

Table of the Variation of the Compass in the Indian Ocean, 1866.

LONGITUDE EAST.																										
LAT.	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°	125°	130°	135°	140°	145°
20°N.	°	°	°	°	°	°	°	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15°					-5	-4	-3	-2	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10°							-3	-2	-2	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5°N.						-5	-4	-3	-2	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	
0°					-7	-5	-4	-3	-3	-2	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	
5°S.					-9	-7	-5	-4	-3	-2	-2	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	
10°					-12	-9	-7	-5	-4	-3	-2	-2	-1	-1	0	0	0	0	0	0	0	0	0	0	0	
15°					-14	-12	-9	-7	-6	-5	-4	-3	-3	-2	-2	-2	-2	-2	-2	-1	-1	0	0	0	0	
20°				-20	-19	-15	-13	-10	-8	-7	-6	-5	-5	-4	-4	-4	-4	-4	-3	-3	-2	-2	-2	-2	-2	
25°				-23	-20	-18	-16	-14	-12	-11	-9	-9	-9	-8	-8	-8	-7	-6	-5	-4	-4	-4	-4	-4	-4	
30°				-27	-26	-24	-22	-19	-17	-16	-15	-13	-12	-12	-12	-11	-10	-8	-7	-6	-6	-6	-6	-6	-6	
35°	-30	-30	-29	-28	-27	-25	-24	-22	-21	-19	-18	-17	-17	-16	-16	-15	-14	-12	-10	-8	-5	-3	0	+3	+6	+8
40°	-30	-31	-31	-31	-30	-29	-28	-26	-25	-24	-23	-22	-21	-20	-19	-18	-17	-15	-12	-10	-7	-3	0	+2	+6	+8
45°	-30	-31	-32	-33	-33	-32	-31	-30	-29	-28	-28	-27	-27	-26	-25	-23	-21	-18	-15	-12	-8	-5	-1	+2	+6	+9
50°	-30	-31	-33	-34	-35	-35	-34	-34	-33	-33	-32	-32	-32	-32	-31	-29	-27	-23	-19	-15	-10	-7	-2	+2	+6	+10

+ Signifies Easterly Variation; and - Westerly Variation.

PART II.

SAILING DIRECTIONS

FOR THE

PRINCIPAL PORTS IN THE INDIAN OCEAN.

SOUTH AND EAST COASTS OF AFRICA.

*** THE VARIATION OF THE COMPASS IN 1864 WAS;—TABLE BAY TO CAPE AGULHAS 29° 40' W.;—CAPE RECIFE 29° 35' W.;—THE MOUTH OF BUFFALO RIVER 29° 15' W.;—PORT NATAL 27° W.;—DELAGOA BAY 24° 20' W.;—CAPE CORRIENTES 22° 30' W.;—QUILLIMANE RIVER 18° W.;—MOZAMBIQUE 14° 15' W.;—CAPE DELGADO 11° 48' W.;—PORT ZANZIBAR 10° 20' W.;—PEMBA 9° 40' W.;—MOMBAS 9° 7' W.;—CAPE GUARDAFUI 2° 40' W.

TABLE BAY.—Table Bay, at the southern extreme of the west coast of Africa, is situate on the northern side of that peninsula, the south extremity of which bears the name of the Cape of Good Hope. In the south part of the bay, at about two miles eastward from the town, is the Royal Observatory, in Latitude 33° 56' 3" S., and Longitude 18° 28' 42", or 1h. 13m. 55s. east of Greenwich. The Lion's Rump, Robben Island, and Blaauwberg may be considered as the extremes of Table Bay, which give it an extent of 7 miles from north to south, and 5 miles from east to west. In it the soundings range from 5 to 20 fathoms, the former depth being found at $\frac{1}{2}$ a mile or less from the shores, except in the southern part of the bay, abreast the town, where there are but 5 and 6 fathoms at nearly one mile from the land, towards which the water thence shoalens very gradually.

With the exception of the off-lay from the shores, the only danger to be feared is the *Whale Rock*, an isolated rocky patch over which the sea breaks, when there is any swell, but at other times the water passes smoothly over it; it lies $\frac{1}{2}$ of a mile

S. by W. from the south point of Robben Island, and has 5 and 7 fathoms close to it all round, and 4, 5, and 6 fathoms between it and the island. When approaching the bay from the southward, the rocks named the *Lion's Paws*, which lie about $\frac{1}{2}$ a mile off shore at the foot of the Lion's Head, and also the coast in their vicinity, should be avoided, by giving the land a berth of one mile or more.

ROBBEN ISLAND lies 24 miles southward of Dassen Island, $5\frac{1}{2}$ miles N. by E. $\frac{1}{2}$ E. from Green Point lighthouse, and $3\frac{1}{2}$ miles from the shore at Blaauwberg. It is low and flat, about $1\frac{1}{4}$ mile in length from N. by E. to S. by W., one mile in breadth, and bounded by reefs which from its western shore project $\frac{1}{2}$ of a mile; rocky ground deepening gradually from 5 to 10 fathoms also extends W. by N. one mile from the western extremity of the island, and causes heavy breakers when the wind blows strongly from S.W. to North. The north-east side of the island is free from danger, but the eastern shore is fronted by a rocky shoal, which extends E. by S. from the church tower to a depth of 4 fathoms, at the distance of half a mile from the land; the depths upon it are irregular, varying from 2 to 4 fathoms, and its position is well marked by an abundance of seaweed.

At the south end of Robben Island there is a hospital for lunatics. There is, or was, also a depot for convicts from the Cape, who are or were employed in quarrying lime-stone, of which the base of the island is composed. Grapes and vegetables are grown, and there are several springs of good water. The soil is sandy. The highest part of the island is Minto Hill, situate at its south end, the summit of which is 106 feet above the sea level: upon this hill there is a lighthouse (consisting of a round white tower, 76 feet high) which shows a *fixed white* light at 154 feet above the sea, visible from a distance of about 20 miles.

Few vessels touch at Robben Island, and such as have occasion to send a boat's crew to shore, anchor on its eastern side, it being unsafe to anchor on its western side on account of the heavy swell. The best landing-place is in Murray Bay, on the north-east shore of the island; another place is in the cove at its south-east side, near the lunatic establishment.

CAPE TOWN, situate in the south-west corner of Table Bay, at the foot of Table Mountain and Devil's Peak, and on the eastern side of the Lion's Head and Rump, is built upon a shelving plain, which gradually rises to the foot of those hills; the last two of which stretch out to the northward, and shelter the bay from westerly winds. The town is defended by numerous forts and batteries, and all kinds of supplies can be readily procured for shipping on reasonable terms.

The Castle, at the eastern extremity of the town, is a pentagonal fortress of considerable strength, containing some public offices, barracks, &c., and having outworks which command both the bay and the roads to the country. A little further eastward, the town has an additional protection in Fort Knockle and some fortified lines of defence. And on the northern side it is guarded by Amsterdam, Chavonne, and other batteries.

The town is regularly laid out, contains several good squares, and the streets, which are straight and wide, cross each other at right angles, many of them being watered by canals, and planted on either side with trees, in the Dutch fashion. The houses are generally two stories in height, and are constructed with flat roofs in consequence of the violent winds to which the place is subject. They are built of

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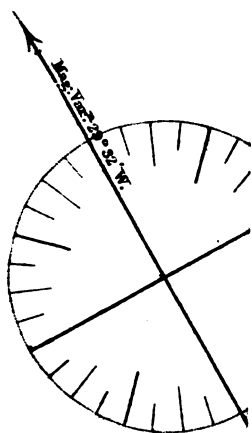


TABLE E

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stone, their exterior being either whitewashed or neatly stuccoed; their interiors are spacious and convenient, and many of them have terraces or stoeps before them. They are frequently shaded by a small row of fir-trees, which form an agreeable relief to their dazzling whiteness, and at the same time afford the advantage of a shady walk. The terrace walks in front of the houses are generally the favourite lounge of the family in the evening or during the heat of the day, and at all times they afford an agreeable promenade. The rooms are airy, but unprovided with ceiling, the naked joists being seen, with the floor above them. The floors are generally varnished; very few rooms boast of fire-places, and from the deficiency of chimneys the aspect of the town is such as to make one believe it a foreign rather than an English settlement. The Heerengracht, or Gentleman's Walk, is the principal and fashionable street of the town.

The principal public buildings are the Government House, with extensive gardens, the burgher senate-house, barracks, commercial exchange, custom-house, town and district gaol, military dépôt, and tax-office; English, Dutch, Lutheran, and Presbyterian churches; Roman Catholic, Independent, Wesleyan, and missionary chapels; Somerset Hospital, and two others; the theatre, Freemasons' Lodge, South African College, police office, &c. Cape Town is the seat of the supreme court of justice for the colony, the Vice-Admiralty Court, a court for the recovery of small debts, a Government bank called the Lombard Discount Bank; and contains a savings' bank, a public library, several public free schools, and many literary, scientific, religious, and benevolent associations. The town and district also possess several water-mills, tanneries, hat, candle, snuff, and soap factories, an iron foundry, breweries, distilleries, sawing and steam mills, &c. It is likewise plentifully supplied with good water.

British residents in India frequently resort here for improving their health; and the town has generally a gay and bustling appearance; balls and theatres are the favourite amusements. The environs are very picturesque, and between the town and mountains which surround it, many handsome private gardens have been laid out.

The *Observatory* is a large and elegant structure situate $2\frac{1}{2}$ miles eastward of the town, on a flat sandy heath. The central part of the building is allotted to the instruments, and the wings form the residences of the astronomer and his assistants. In front of this is the time-ball apparatus.

SIGNALS.—A time-ball has been erected at the flag-staff at the Observatory, for the purpose of daily communicating to ships in the harbour the instant of *one o'clock*, Cape mean time, which corresponds to 11h. 46m. 5s. (a.m.) of Greenwich mean time. As the ball attached to the Observatory is not generally visible by the shipping on the eastern side of the bay, owing to the intervention of buildings, another has been established on the Lion's Rump, where there is likewise a beacon and flag-staff.

By pointing the common ship spy-glass to the signal-ball at the Observatory a minute or two before 1h., and noting by the chronometer the instant of the fall of the ball from the top of the staff, and afterwards subtracting 11h. 46m. 5s. from the time by chronometer, the error of the chronometer, or Greenwich mean time will be obtained, which, compared with the error obtained at departure, will give the rate during the interval.

When ascertaining the rate by the time-ball on the Lion's Rump, the observer should note the time by his chronometer when that ball begins to fall, and then sub-

tract one second from that time, he will thus have the moment of 1h. *p.m.* by mean time at the Observatory.

The rate of a chronometer obtained on shore rarely agrees with the true rate at sea; this arises from the motion of the ship and other causes. It therefore becomes necessary to ascertain the sea-rate after the chronometer has been placed on board in the berth it is to occupy during the voyage, and from which it should not be removed throughout that period. The time-balls at Ascension, St. Helena, and at this place afford the requisite convenience for obtaining this important object, and that with but little calculation or difficulty. When the vessel continues a week or more in the bay, it is advisable to ascertain the existing rate. Should the rate be trifling, perhaps less than the probable errors of observation, it will then be right to diminish the latter, by dividing the observations into two or more groups, and to take the mean of each group for one observation; the differences of these means, divided by the intervals of days, will give a determination not far from truth.

The following *general signals* are shown from the Port office only when, from local experience and good barometers, a severe gale may be expected. It is strongly recommended that all commanders immediately repair on board their respective vessels, and answer them by hoisting the Answering Pendant, or the Ensign, at the peak-end, or any of the mastheads. They are repeated from the Lion's Rump signal-station. Any neglect in the observance of, or departure from, the foregoing instructions, will be reported to the agents for LLOYD's, and to the consignees:—

White, pierced blue, over Union Jack.—*Clear hawse and prepare to veer cable.*

Union Jack over white, pierced blue.—*Veer to a whole cable, and see the third anchor clear.*

Union Jack over blue, white, blue, horizontal.—*Strike lower-yards and top-masts, and rig in jib-booms.*

Blue, white, blue, horizontal, over Union Jack.—*Down top-gallant yards and masts, point yards to the wind, and see everything clear for working ship as far as practicable.*

Union Jack over No. 4, white and red, vertical.—*Shorten in cable to same scope as when first moored.*

Ships or vessels having MARRYAT's Code of Signals can make their wishes known to their agents, in blowing weather, through the Port Office; and any assistance required will be strictly attended to as far as practicable; and vessels not having the code can make the following with their ensigns:—

- 1st. Ensign in the fore-top-mast rigging.—*I am in want of a cable.*
- 2nd. Ensign in the main-top-mast rigging.—*I am in want of an anchor.*
- 3rd. Ensign in the fore-rigging.—*I have parted a bower cable.*
- 4th. Ensign in the main-rigging.—*I want an anchor and cable.*
- 5th. Wheft where best seen.—*Send off a boat.*

In order to notify to the public as promptly as possible the occurrence of casualties on the coast near Cape Town, by shipwreck or otherwise, it is directed that, whenever a vessel is known to be in need of assistance, three guns will be fired from the Chavonne Battery, at an interval of two minutes between each, to be taken up and answered by one gun from the Imhoff Battery.

Lights.—On Green Point there is a lighthouse 52 feet high, which exhibits a *white light flashing every 10 seconds*, at 65 feet above the sea, visible from a distance of 13 miles. At three-fifths of a mile eastward from Green Point, there is a lighthouse on Mouillé Point, which shows a *fixed red light* at 44 feet above the sea, visible about 10 miles. The building is a round tower 30 feet high, painted in red and white bands.

In addition to the lights on Green and Mouillé Points, two small ones have been established in front of the town;* one at the commencement of the north jetty, and the other at the commencement of the old south jetty. The *former* is coloured red, is lit from sunset to sunrise, and is intended to guide vessels running for the anchorage at night. After having cleared and rounded Mouillé Point, steer on until the light becomes visible—the course may then be altered, steering for the light, and anchor in five or six fathoms, according to circumstances. The *latter* is coloured green, and only lit during northerly gales. Should vessels part from their cables during a northerly gale, and be unable to work out, it is strongly recommended to run for the light, and beach close southward of the Castle ditch, the crews remaining in their vessels, by which means little or no danger to life is to be apprehended. It is also recommended that, in the case of such vessels taking the ground, any after-sail which may have been set in running for the beach should immediately be taken in, keeping the foresail or fore-top-sail set, as the case may be, until the vessel is firmly grounded.

The following signals may be made from the most convenient point to vessels that be stranded :—

In day-time, a number will be shown, white upon a black ground.

At night, the number will be shown transparent.

No. 1. You are earnestly requested to remain on board till assistance is sent; there is no danger to life.

No. 2. Send a line on shore by cask and look out for line from rocket or mortar.

No. 3. Secure the rope: bend a warp or hawser to it, for us to haul it on shore for the boat, or for us to send you a stout rope, to be made fast to some firm part of the wreck, that we may haul off a boat for bringing you on shore.

No. 4. Life-boat will communicate at low water, or as soon as may be practicable.

No. 5. Have good long lines ready for life-boat, and prepare to leave your vessel; no baggage will be allowed in the life-boat.

ANSWERS TO THE ABOVE SIGNALS.

By day.—A man will stand on the most conspicuous part of the vessel, and wave his hat three times over his head.

By night.—A light will be shown over the side of the vessel, where best seen. (1855.)

CURRENTS.—In the Admiralty instructions for the port it is stated that a current

* We are doubtful if these lights are now shown. A green light (visible between south, round by west, and north) is exhibited on the outer staging of the works of the breakwater now in progress of construction.

varying in strength from half a knot to two or three knots an hour, sets northward past Table Bay and Robben Island, but during the winter months, when N.W. winds prevail, a current sets into Table Bay from the N.N.W., and impinging on the south-east shore of the bay, about Salt River, divides into two streams, the one setting northward along the coast and out between Robben Island and the mainland at Blaauwberg, while the other takes a westerly course as far as the Cape-town Castle, then northerly, sweeping the south-west shore of the bay, and carrying away loose soil from the south sides of the jetties and projecting rocky points. During the summer season it has been observed, particularly during south-easters, that a gentle stream set round Mouille Point to the S.S.E. into the bay, and out by the Blaauwberg beach, as in the winter.

The rocks about the beach from Green Point to the Amsterdam Battery are bare, and always free from sand; but in the depth of the bay, from the Castle to the Salt River, vast quantities of sand and seaweed are removed from the beach by the drawback of the rollers, and carried away by the current, leaving the sea-shore a platform of rock, which is again covered to the depth of two or three feet during the months of summer.

Anchorage.—Vessels may anchor off the eastern side of Robben Island in from 10 to 12 fathoms, at from 1 to $1\frac{1}{2}$ mile from the shore; or within $\frac{1}{2}$ of a mile of the island in 6 or 8 fathoms, and obtain shelter from a S.W. swell by the island and reefs. A vessel may remain here until the wind comes to S.W. or W., which generally happens in the morning during the fair season; then weigh, and, if necessary, proceed to the anchorage off Cape Town. During a N.W. wind, a vessel will obtain good shelter under this island, when she would be quite exposed off the town.

In the Admiralty instructions for this coast it is stated that the best position for a large vessel to anchor in is "with the Whale Rock (upon which the sea almost constantly breaks) open eastward of the south point of the island, bearing S.W., and the north extreme of the island N.W. $\frac{1}{2}$ N. or N.W. $\frac{3}{4}$ N., in 8 or 9 fathoms water, sandy bottom. In this position H.M. steamer *Hermes* rode out with ease a heavy south-easter, and without undue strain upon her cable. Smaller vessels will find excellent shelter on the above bearing off the northern extreme of the island, and with the Whale Rock shut in by the south-east extreme of the island S.W. $\frac{3}{4}$ S. in 5 or 6 fathoms. Closer to the shore than this, the ground is rocky. When at anchor, Murray Bay, which has a sandy beach, and where landing can be effected, will bear between W. by N. $\frac{3}{4}$ N. and W. by N. $\frac{1}{4}$ N."

Secure berths may be had off Cape Town in the summer months, when the S.E. winds prevail. The bay is, however, much exposed to wind and sea from N. and N.W. during the winter season, when the winds prevail from these quarters, and send a heavy swell into the bay. It is, in fact, extremely dangerous to remain here after about the middle of May, for N.W. winds may then be expected to set in, and they blow so violently that no ship can possibly ride them out. N.W. gales may be experienced in every season, but it is said they seldom blow home in the bay from November to May, though several vessels have been driven on shore by them, even in the month of April. In the summer months, a ship may moor in about 6 fathoms, with Mouille Point lighthouse bearing N.W. $\frac{1}{2}$ N., and the flag-staff on the Lion's Rump W. $\frac{1}{2}$ N., at the distance of half a mile from the shore at Chavonne Battery. When N.W. winds are expected, ships should not anchor in less than

6½ or 6 fathoms, because the swell runs more regularly than in shoal water, and at these times they should ride with a whole cable or more, lest they drive, in which case it would be difficult to bring them up again. Smaller vessels anchor in 3½ fathoms with Mouille Point lighthouse bearing N.N.W., and the flag-staff on Lion's Rump W. by N. ½ N., at 4 cables' lengths from the shore and abreast Amsterdam Battery; or, still further in, in 2½ fathoms.*

There are two or three inconvenient and insufficient wooden jetties at the town, said to be half devoured by the worm, where goods and passengers land and embark. But plans for a floating steam-wharf, breakwaters, wet docks, sea-walls, &c., have been entertained, one or the other of which may probably be shortly carried out, and thus give greater security and accommodation to vessels calling.†

Mr. Webster says, "The water of Table Bay exhibits a very different appearance, according to the quarter from which the wind blows. With a N.W. wind the water is a dirty red, and turbid, as if mingled with a small quantity of blood.

* "Table Bay, as a place of discharge, and even as a place of call for refreshments, has obtained a very bad reputation. Many owners put a positive veto on their vessels going there. I think, however, its bad character is overrated, and an unnecessary degree of fear entertained with regard to the safety of vessels riding in the roadstead. I write advisedly, when I affirm that three-fourths of the wrecks which have taken place on entering this bay, have arisen from running unnecessary risks, or from the carelessness and ignorance of the parties in command. Neither would a vessel, properly moored on arrival with good ground tackle and a good stock of cable before the violence of the gale sets in, be so liable to drive or part her cables. A sufficient degree of care and attention is seldom paid to seeing anchors laid down clearly, and in a proper position. In most cases, as soon as one anchor is gone (that very likely foul from the vessel's having head-way, and overlaying it with the cable), the master goes on shore, where he remains, never thinking of mooring, in all probability, until a gale commences. It is also quite common for vessels, calling for a temporary purpose, to get huddled together in such a manner as to prevent them paying out cable when it comes to blowing. The same circumstance occurred during my present stay in the bay. The consequence was, as soon as the gale commenced, four or five vessels were all driven together; and had the gale been of ordinary violence, they must have gone on shore, and added to the unjust degree of dread with which this anchorage is viewed at the present time."—*Mexicano in Nautical Magazine*, 1842, p. 807.

"From the experience of five winters," says the Port Captain, "I am of opinion that chain cables do not answer in this bay in northerly gales; and unless a vessel has a good hemp or coir cable on board during the winter months—viz., May, June, July, and August—when such gales are prevalent, accidents must occur. In some vessels the chain cables are evidently defective, either from corrosion, or from being too small for the purpose."

The comparative merits of chain and hempen cables have been thus commented upon by CAPTAIN OWEN:—"Chain cables are to be preferred for anchoring in every situation where the bottom is foul or rocky, and in all places where anchorage is usually sought. But under any circumstances, where the ship is exposed to the ocean swell and heavy winds from seaward, hempen cables are decidedly preferable, for then a vessel's only security is to veer two or four cables, end on end; and these, by their length, lightness (being nearly of the same specific gravity as water), and elasticity, enable her to ride over the sea with buoyancy; whereas, if riding by a chain, it is no benefit to veer a long range of cable, as the chain will lie upon the ground, and not being elastic, but of great weight, it will operate against the rise of the vessel with the swelling wave, and she will be subject to the most sudden and violent shocks from the strokes of the sea, which either breaks over her, or causes her to plunge through the waves instead of riding over them. No ship liable to be so exposed should, therefore, be without two hempen cables, or, what is far better, coir, which is so much lighter than hemp that it floats upon the water. It is also strongly recommended to all vessels to use some few links of chain near the anchor, the advantages from which are obvious, especially where the bottom is rocky, as the links of chain may lie over any sharp or projecting fragment without danger of being cut in two by the friction. By this combination the cable, if well spliced, loses none of its strength; while, by the suspended but not excessive weight at the end, it obtains a greater degree of pliability, which makes the ship ride with more ease and safety.

"Many of the numerous shipwrecks in Table Bay may be attributed to the indiscriminate use of chain cables, their nature and management being ill understood; and several examples are on record where vessels have been obliged (even in the midst of a gale of wind) to slip their chains and let go in anchor with hempen cables, the necessity for so doing being pointed out by the danger of their situation."

† A breakwater is being built. It starts from the shore at Somerset Hospital, and extends in an easterly direction. (1866.)

After a S.E. wind, on the contrary, the water is so beautifully pellucid, that the anchor by which a vessel is riding in 10 fathoms, may be distinctly seen from on board."

For a general description of the Winds, see p. 69.

SUPPLIES, &c.—At Cape Town all kinds of necessities and refreshments are obtainable; there is plenty of good water, but wood is said to be scarce and dear. Sheep, oxen, and other provisions can be obtained at moderate prices; also vegetables, fruits, &c. The water is brought down to the head of the pier in pipes, and hoses are then used to convey it from the pipes to the casks in the boats.

Boat hire is expensive, but the surf is at times so very dangerous, that the reward demanded cannot be considered disproportionate. Coolies, or public porters, are stationed in the market-place, the charges for hire being regulated by the town authorities.

"All vessels bound eastward, or to the Australian colonies with passengers or emigrants, and intending to call at some intermediate port for supplies, should, in my opinion, give a decided preference to Table Bay over any harbour on the Brazil coast. Supplies at the Cape are of superior quality and moderate price, whereas in the Brazils they are very inferior and expensive. Neither in general cases would there be so much detention caused to the vessel by calling at the Cape as on the Brazil coast. Port charges are very moderate, and vessels calling for refreshments only pay one-half."—*Mexicano*.

Directions.—The following instructions for entering Table Bay were officially issued in 1864, when the light on Minto Hill, Robben Island, was first exhibited:—

"Vessels bound for Table Bay from the southward should not shut in Cape Point light with the land at Slangkop Point until Robben Island light—which will be seen before the *flashing* light on Green Point—bears N.E. $\frac{1}{2}$ E., when they may steer for it; and when Green Point light bears east, an E.N.E. course may be followed until the *red* light on Mouillé Point comes open northward of Green Point light, bearing S.E. by S. This route will clear the Vulcan Rock and the reefs in its vicinity. The course may now be altered to S.E. by E. $\frac{1}{4}$ E., which will carry a vessel one mile northward of Mouillé Point light, and within this distance no stranger should round the point at night. When Mouillé *red* Light bears S.S.W., a course about S. by E. $\frac{1}{2}$ E. may be steered for the anchorage, bearing in mind not to approach the *green* light on the end of the breakwater too close. When the *flashing* light on Green Point is shut in with the hillocks near Mouillé Point, or Mouillé Point *red* light bears N.W., distant about one mile, a vessel may anchor in from six to eight fathoms water. Small vessels may anchor in four or five fathoms, with Mouillé Point light bearing about N.W. by N.

"Vessels bound to Table Bay from the northward should give Robben Island a good berth, and not be misled by its light, for the island is low, and the dangerous Whale Rock lies S. by W. $\frac{1}{2}$ W., only $1\frac{1}{10}$ miles from the lighthouse, and nine cables from the nearest point of the island. Having sighted Robben Island light, a vessel should haul to the S.W., if the light bear anything to the westward of south, until the *flashing* light on Green Point bears S. by E. or S.S.E., then steer for it until Robben Island light bears N.E., when steer S.E.; and when Mouillé *red* light bears S.S.W. steer about S. by E. for the anchorage.

"With Robben Island light and Green Point or Mouillé Point light, a vessel may readily determine her position by cross bearings; but in working for the

anchorage the safest and easiest plan to adopt is, whilst Green and Mouillé lights are open of each other, to tack when Robben Island light bears N. by W. $\frac{1}{4}$ W., and when they approach each other or become in line, to tack when Robben Island light bears N. by W. This will prevent accidents from the low Blaauwberg beach, on the eastern shore of the bay, and its deceptive appearance at night. Little, if anything, can be lost in thus beating in by giving up the smooth water near the shore, as a constant northerly current sets out between Robben Island and the main land; added to which, the wind blows with greater violence from the S.E. on the east side of the bay than it does more to the westward, though not in such sudden and violent gusts."

The Cape of Good Hope, on approaching either from the eastward or westward, has the appearance of a large island, when you are at such a distance as not to be able to discern the connexion between its mountains. The highest and most remarkable of these is Table Mountain, at the south part of Table Bay, which is 3550 feet above the level of the sea, flat at top, and sloping almost perpendicularly down at its eastern end, where it is joined to a rugged peaked mountain, named the Devil's Peak, 3270 feet high, the division forming an apparent gap or chasm between. Table Mountain falls down also to the westward, in a similar steep and sudden manner, until it joins the foot of Lion's Head, a mountain whose elevation is 2180 feet; this is joined on the northern side by an oblong hill 1150 feet high, named Lion's Rump. These three, in fact, make but one mountain, for, though disjointed at their summits, they unite at a very considerable height above their base. The Devil's Peak appears broken into angular rugged points, while the Lion's Head is rounded similar to a dome, and looks like a work of art. They partake of the form of an amphitheatre, with its face towards the N.E., the town being situated at their base.

Should a ship, in making Table Bay, be driven northward of Dassen Island, by the current or winds, the soundings will be a good and safe guide to approach the land by, for between Saldanha and Table Bays the depths are regular, and the soundings extend several leagues from the land. From Dassen Island to Robben Island the depth of water is from 30 to 40 fathoms at five miles from the shore, and three miles from the land there are from 20 to 22 fathoms; about ten miles N.W. of Robben Island are 30 fathoms, and ten miles westward of Dassen Island, in the parallel of $33^{\circ} 30'$, are 110 fathoms.

All vessels going to Table Bay should pass between Green and Mouillé Points and Robben Island, while those going from it may pass between that island and the main, for the strong S.E. winds produce a favourable current between that island and the shore, while that between Robben Island and the points will be running into the bay.

Between the foot of the Lion's Head and Green Point, numerous rocks, visible above water, lie at some distance from shore. Give these a good berth as you run in, and you will shoalen your water pretty gradually from 36 and 34 to 26, 20, 16, and 12 fathoms. You may borrow towards Green Point lighthouse to 10 fathoms, without danger. Then steer up the bay, and you will have 11, 9, and 7 fathoms, regular but rocky soundings, till you get about a mile within Green Point, when the bottom becomes sandy and fit for anchorage.

When abreast of Green Point, should it happen that a vessel suddenly meets with furious breezes from S.E. or E.S.E., blowing so hard out of the bay that it is im-

possible to work to windward, which is frequently the case, then she must bear away for Robben Island, taking care, of course, to guard against the Whale Rock. A ship may anchor off the north side of that island in 9 or 10 fathoms; but when going to this anchorage, a good berth should be given to the north-west point of Robben Island to avoid the reef running half a mile from it.

Should a south-easter blow so strongly that a ship cannot bring up under the north end of Robben Island, and consequently be driven to sea, she should haul round as soon as possible, and make short tacks to the southward of Green Point, and lie under the high land until the violence of the wind has abated.

CAPT. HORSBURGH has observed that "the south-easter comes from the land with great fury; it is, therefore, prudent to take in a reef or two in the topsails before a ship has reached Green Point, if near or a little past noon. By neglecting this precaution, I have seen ships rounding the point with all sail set in a light breeze; then suddenly meet the fiery south-easter on opening the bay, which compelled them to let fly everything to save their masts; and one of these ships, whilst the people were aloft securing the topsails, nearly ran on shore, on the east side of the bay, in veering."

PORT REGULATIONS.—We believe they are as annexed:—

1. On the arrival of merchant vessels in Table Bay, a proper berth will be pointed out to the master thereof by the port captain, when he boards them; and no master of a merchant vessel shall shift his berth without permission from the port captain, unless in case of extreme urgency, when he shall report his having done so, as early as possible, at the port-office.

2. Should it be the intention of a master of a vessel to discharge or receive on board any considerable quantity of merchandize, a berth will be pointed out to him as close to the jetty or other landing-place as the safety of the vessel and other circumstances will admit; and the master will then moor with two bower anchors, with an open hawse to the N.N.E., taking especial care, in so mooring, not to overlay the anchor of any other ship, or in any way to give the vessel near him a foul berth.

Ships and vessels touching in Table Bay for water and refreshments only may ride at single anchor in the outer anchorage; but in this case it is particularly recommended to veer out 80 or 90 fathoms, if they ride by a chain cable, as the liability of starting or fouling the anchor, or breaking the chain, will thereby be greatly lessened; and, if riding by a rope or coir cable, to run out a stream or good kedge to steady the ship; and in both cases the other bower anchor should be kept in perfect readiness to let go. When the vessel is properly moored with bower anchors, or well secured with a bower and stream anchor, and with good cables, buoys, and buoy ropes, the master will then take the exact place of the ship by the bearing of two land-marks, and the depth of water; and should any accident occur by which the vessel may drift from her situation, or lose her anchors, a good bearing and depth of water must be taken at the time, and the same must be notified in writing to the port-captain. It is particularly recommended that vessels be kept as snug as possible, to counteract the effects of periodical winds, which at times blow with considerable violence.

HOUT BAY:—Hout Bay is about 11 miles south-westward of Table Bay; the intervening coast is high and bordered with rocks, and therefore requires a berth of two or three miles. The bay runs in to the N.E., on the eastern side of Chapman's

Head, and forms a basin about 4 or 5 miles in circumference, where, with moorings laid down, twenty sail of the line could lie land-locked in from 9 to 5 fathoms water, fine sandy bottom. High water at full and change at 3h.; rise about 6 feet. The entrance is remarkably fine, cannot be mistaken, and has deep water near to either shore within a stone's throw.

Except the rocks about Slangkop Point, or Snake's Head, and those lining the shore of Chapman Bay, immediately northward of that point, the only known danger in the way of entrance is the *Vulcan Rock* (awash at high water), which lies about 2 miles westward of the entrance of Hout Bay, and $\frac{2}{3}$ of a mile from the shore of Chapman Head; within this rock are some dangerous breakers, with an islet and reef, named Duyker Islet and Shoal. These rocks are quite out of the way of vessels approaching from the southward, and being always visible, are easily avoided by vessels coming in from the westward with a north-westerly wind.

The entrance to Hout Bay is about $1\frac{1}{2}$ mile broad, and has a depth of 18 to 12 fathoms, but rather open to the S.W. It is usual to enter along the eastern shore, which is very high and rugged, and quite inaccessible; and having passed the middle of the entrance, to luff up under the west point, and there anchor. The summit of a remarkable peak, Constantia Berg, upwards of 3000 feet in height, seen over high cliffs, brought to bear E. $\frac{1}{2}$ S. (E.N.E. true) will lead directly to the bay. On the west point, named York Point, there is a small battery, and on the opposite side there is another and a block-house, all in ruins in 1864.

CAPTAIN the HON. H. J. ROUS, of H.M. sloop *Podargus*, has described this bay in the following terms:—

"With the exception of Saldanha Bay, there is no harbour so commodious, safe, or that has so many advantages, as Hout Bay. Situate at the south-west extremity of the Cape Colony, it presents a secure retreat to ships not able to weather Cape Point in strong south-easterly winds, when they could not beat to the anchorage in Table Bay; and also in the winter, to ships meeting north-westerly gales, when they find it impossible to work into False Bay, and they dare not attempt the anchorage on a lee shore in Table Bay.

"Yet with this local superiority, situate in a rich and healthy part of the Colony, with abundance of water, a large farm a mile distant, which supplies the navy contracts with beef and vegetables, and within 10 miles of Cape Town, it is entirely neglected.

"One objection assigned is, that a heavy swell rolls into the land with a south-westerly wind. But this swell cannot dangerously affect ships lying in a land-locked harbour: and south-west winds are seldom prevalent during the dry season at the Cape.

"I presume to state my opinion that Hout Bay, in every point of view, is the proper situation for our dockyard establishment. Its great facility of ingress and egress, which was exemplified soon after the Cape first fell into our possession, by a French frigate having run in, completed her water, obtained supplies of cattle and vegetables, and again made sail with impunity; in consequence of which a fort and blockhouse was erected on the eastern shore, and a captain's guard of 130 men stationed there during the last war. The short distance from Cape Town both by sea and land, the superiority of the harbour, and rich country surrounding it, render it infinitely superior to Simons Bay, which is exactly the reverse in all those leading points. Besides the difficulty of getting to Simons Bay either in the north-west or

south-east gales, ships are liable to be detained three weeks by the latter, whereas at Hout Bay the wind blows out of the harbour every morning at daylight.

"When the numerous dangers in False Bay are considered, and the number of wrecks every year in that and Table Bay, I cannot help regretting that this excellent harbour should remain useless, and that such an indifferent situation as Simons Bay should be chosen for our Naval Arsenal."

A correspondent (CAPTAIN L. BILTON, of the *Queen of the East*) of the *Mercantile Marine Magazine*, in October, 1860, writes as follows:—

"Having for the last ten years been constantly engaged in the Australian and Indian trades, and having read an account of Hout Bay, Cape of Good Hope, by CAPTAIN the HON. H. J. ROUS, of H.M. sloop *Podargus*, describing it as a safe harbour, capable of supplying water, vegetables, stock, &c., I had often felt a great desire to make myself acquainted with it. Of late years, however, I had made Ascension my calling port on the homeward passage, which I would recommend to all masters in preference to St. Helena; and having got into the habit of going there, my wishes as to Hout Bay were never gratified until the present voyage. Being chartered by H.M. Government to take coolies from Demerara back to Calcutta, it was imperative, from a clause in the charter party, that the ship should touch at the Cape, and I at once determined that Hout Bay should be the port. I ran down my casting in 38° S., with fine weather, but, till the last week, very unsteady wind: not having a chart of the Cape Colony, and the weather being hazy, I had some difficulty in making out the entrance to Hout Bay, which is not open till a ship is close down on the breakers in Chapman's Bay; once having seen it, however, it can never be mistaken again. An irregular conical hill forms the western entrance, which is easily distinguished,—but the best way is to bring the centre of Table Mountain to bear E.N.E., and then steer right in fearlessly, and the entrance to Hout Bay will soon be visible: a ledge of Rocks called Chapman's Horns, having a good passage inside of them, will also be seen,—the sea always breaks on them, and they lie about a mile to the west of the fairway in, towards the entrance, which is about a mile in width, with no danger within a musket-shot of the shore, except a small spit about half that distance on the west side. The eastern side has many rocks lying about a quarter of a mile off, inside the bay; the eastern side, therefore, must be avoided. I anchored in seven fathoms, with the blockhouse and old Dutch buildings bearing E.S.E., and an old fort on the western shore bearing West: this is probably the best place for a large ship (the *Queen of the East* is 1226 tons), as from the prevalence of S.E. winds, which often blow strong, a vessel has room to veer out a good scope of cable, and this is also the very best position for getting under weigh. A smaller vessel should anchor about a quarter of a mile further to the W.N.W., behind the old fort, where she would be completely landlocked, and have 5 fathoms to within a cable's length of the shore—or a large ship in winter would be equally safe.

"There are two fishing stations in this bight (belonging to MESSRS. DE PASS & Co., and MESSRS. BOONZIAR), whence boats come off on a vessel entering the bay, and assist, for a moderate sum, in towing her in if becalmed. They will, also, if required, fill and tow off water from the river, at about one dollar per cask—there is no trouble in landing the casks, as, when thrown overboard, they go right ashore at the mouth of the river, at the bottom of the bay, in which the water is excellent,

and is easily accessible. Boats can enter the river at high water, for the purpose of taking off dry stores that might be injured by the surf, or they can be taken off from DE PASS's fishing station, where it is always smooth. About 20 ships can lay in Hout Bay with the most perfect security all the year round, and can procure refreshments at a much lower rate generally than in Cape Town; and were ships to use it more frequently, the enterprising proprietors, MESSRS. BOONZIAR & Co., would have supplies of everything needful on the spot. A great drawback is the bad road from Hout Bay to Wynberg, distant 7 miles, but this is about to be remedied. As it is, anything can be got to Wynberg cheaply from Cape Town, and there are always carts from Hout Bay to bring it on at moderate charges, and the whole need not occupy more than one day. It is rather a shaky business, however, riding over those roads in a cart, and let no one be so imprudent as I was on the first occasion, and refuse a pillow when one is offered, or he will return 'a wiser but a sorer man.'

"Pigs, sheep, fowls, potatoes, pumpkins, onions, butter, milk, eggs, &c., are ordinarily to be obtained at moderate prices; but from the late very wet, succeeding a very dry season, everything was much dearer than in general. Fish, fresh and salt, is to be had at the stations in the bay, at reasonable prices, and of excellent quality: there is also abundance of game, viz.,—deer, pheasants, &c.,—while rabbits are to be met with all about the neighbourhood, and plenty of fish could be caught from the ship if time admitted. The farmers in the vicinity, who cultivate the grape chiefly, and vegetables for sale at Cape Town, are hospitable in the extreme, and I may here bear testimony to the kindness and attention I received from CAPTAIN NORMAN and his family, also from the MESSRS. BOONZIAR.

"I landed all the coolies to let them wash in the river, and the benefit arising therefrom was very great in their case, as they left really in better condition than when starting from Demerara, and I was enabled at the same time to get the ship cleaned and whitewashed afresh, and both myself and DR. CHANNELL were of opinion that a better place for a ship to touch for the purposes we required could scarcely be met with than Hout Bay. We were, however, there in the summer season, and have yet to learn how it would answer in winter. One thing is certain, a ship could lay there in safety when Table Bay would be untenable. Horses or light carts are to be hired at Hout Bay and at Wynberg, at about 7s. 6d. each way, and from the latter place an omnibus runs to Cape Town every two hours during the day, fare 1s. 6d. The whole distance from Cape Town to Hout Bay can be done in four hours. Now, when it is considered that no Master can safely leave his ship long in Table Bay, it seems astonishing that Hout Bay should be almost unknown. The Cape Town people, of course, would oppose it tooth and nail; yet it seems impossible but that sooner or later it will be turned to better account than hitherto. It is necessary to report and clear at the Custom-house at Cape Town, both of which occupy but a few minutes. It certainly created some sensation my going there, as I believe no ship of the same size has ever entered the bay on any previous occasion. I found no trouble either on entering or leaving, although I left again in the dusk, very early in the morning."

CAPE OF GOOD HOPE.—From Hout Bay the coast runs 19 miles in a southerly direction to the Cape of Good Hope, and is throughout of a bold description. As this part does not appear to have been closely examined, it will

be advisable to give it a wide berth, especially as a sunken rock has been reported to lie 1 or $1\frac{1}{2}$ mile from Slangkop Point; the Cape also should not be closely rounded, because a reef extends from it about a mile to the westward.

FALSE BAY.—False Bay runs in northward between the Cape of Good Hope on the western, and Cape Hangklip on the eastern side, which capes bear from each other N.W. $\frac{3}{4}$ W. and S.E. $\frac{3}{4}$ E., distant $16\frac{1}{2}$ miles. The bay is of nearly a square form, being about 18 miles in length, and the same in breadth. The soundings in it decrease from 50, 40, and 30 fathoms in mid-channel, to 20, 15, and 10 as the shores are approached. Simons Bay is situate in the north-west part of False Bay, 11 miles within the cape, and is about $1\frac{1}{2}$ mile in extent, with depths in the offing of 11, 10, and 8 fathoms, shoaling to 15, 12, and 6 feet near the jetties of the town. Gordon Bay lies in the eastern part of False Bay, 14 miles within Cape Hangklip, and has a depth of 3, 4, and 12 fathoms.

The whole eastern coast of False Bay, from Gordon Bay to Cape Hangklip, wears a dismal, inhospitable appearance; it is one continual rocky chain, and scarcely approachable. Colebrook Bay, so named in consequence of the wreck of the *Colebrook*, is southward of Gordon's Bay; and farther southward is Pringle's Bay, where Admiral Pringle is said to have landed.

The land on the east and west sides of False Bay is high; but Seal Island and the land on the north side of the bay, from Gordon Bay to Muysenberg Mountain, is low, flat, and sandy, and can only be seen at a short distance.

The Cape of Good Hope is a precipitous cliff, with a peak, the summit of which is about 880 feet in height. Cape Hangklip, sometimes called False Cape, and at others Hottentot Point, is a steep bluff, resembling a quoin, which may be seen at 8 leagues distance, and appears to lean over to the west when viewed from southward; hence its name.

TIDES, &c.—There is no perceptible current in the bay. A current varying in strength sets round the Cape of Good Hope to the north-west from the Bellows Rock.

Lights.—On the eastern part of the extremity of the Cape of Good Hope an iron tower, 30 feet high, and painted white, has been erected, from which a *revolving white* light, showing a *bright* face for the space of 12 seconds every minute, is exhibited at an altitude of 816 feet above the mean level of the sea, and in clear weather is visible at the distance of 36 miles. It can be seen all round the compass, except between the bearings from a vessel of S.S.W. and S. $\frac{1}{2}$ E., and between S.S.E. $\frac{1}{2}$ E. and S.S.E. $\frac{3}{4}$ E., on which latter arc of 7° it is obscured by the intervention of a peak rising 64 feet above the light, at 1800 yards from the light tower. Position of lighthouse, lat. $34^\circ 21' 12''$ S., and long. $18^\circ 29\frac{1}{4}'$ E.

From the south-west Reef this lighthouse bears E. $\frac{1}{2}$ S. distant $1\frac{3}{4}$ mile; from Bellows Rock N.N.E. $\frac{3}{4}$ E. $2\frac{1}{4}$ miles; from the Anvil Rocks N.N.W. $\frac{1}{4}$ W. 2 miles; and from the Whittle Rock S.W. by W. $\frac{1}{4}$ W. $7\frac{1}{4}$ miles.

There is a lighthouse on the Roman Rocks, abreast Simons Bay, which is 48 feet high, with its upper part painted white, and the lower black. It exhibits a *revolving white* light, showing a *bright flash* for a period of 12 seconds every half minute, at a height of 54 feet above the sea, visible to the distance of 13 miles in clear weather. From this lighthouse, Noah's Ark bears S.W. by W., nearly, distant $\frac{1}{8}$ of a mile;

the Dock Yard Clock W. $\frac{3}{4}$ N. $1\frac{1}{2}$ mile; and the Castor Rock, with only 15 feet on it, N.N.E. $\frac{3}{4}$ E. 2 cables' lengths.

Dangers.—The most prominent dangers met with when entering False and Simons Bays are, the South-west Reef, Bellows, Anvil, Dias, Whittle, and Roman Rocks, the rocks in the vicinity of Seal Island, and those fronting the shore eastward of Simons Town.

The *South-west Reef* is a rocky patch one mile W. by S. $\frac{3}{4}$ S. from the south-west extreme of the Cape of Good Hope, being distant $1\frac{1}{2}$ mile W. $\frac{1}{2}$ S. from the lighthouse; between it and the shore the ground is foul and rocky. The *Bellows* is a large rock, even with the water's edge, over which the sea constantly breaks; it lies with the lighthouse on the Cape bearing N.N.E. $\frac{3}{4}$ E. distant $2\frac{1}{2}$ miles, and has deep water all round it. The *Anvil* is another rock, separated from the Bellows by a safe channel (which, however, it may not be wise to attempt) of 10 to 22 fathoms; it has 10 feet water over it, and lies with the lighthouse bearing N.N.W. $\frac{1}{4}$ W., distant 2 miles, and the Bellows W. $\frac{3}{4}$ S., 2 miles; the sea breaks upon it only at low water and with a heavy swell. A master of the navy has asserted, with evident probability, that there are other rocks near the Anvil, but we have no particulars respecting them. The *Dias* is a small rock above water, named after the celebrated navigator who first doubled the southern promontory of Africa; it lies about a cable's length from shore, and 925 yards S. by E. $\frac{1}{4}$ E. from the lighthouse.

S.S.E.-ward $5\frac{1}{2}$ miles from the Cape lighthouse is the north-western edge of an extensive bank of rocky soundings, whereon the depths are from 12 to 25 fathoms. Around and between it and the Anvil Rock are 37, 26, 40, and 20 fathoms. It has not been thoroughly examined, but is supposed to be about 3 miles in extent.

The *Whittle* is the shoalest spot on a ledge of rocks, named the Trident, which is about a mile in circumference, and has on it soundings of 4, $4\frac{1}{2}$, 5, and 15 fathoms. The Whittle is about the size of a boat, bottom upward, and the least water yet found over it is 13 feet, but there may be even less than that discovered when a more complete examination is made; from this depth the lead will suddenly drop into 7 fathoms, and, therefore, great care should be exercised when approaching it. The tide of flood and ebb sets strongly over the ledge. From the Whittle the Cape lighthouse bears S.W. by W. $\frac{1}{4}$ W. distant $7\frac{1}{2}$ miles, and the nearest point (Point Miller) of the western shore N.W. $\frac{1}{4}$ W. $4\frac{1}{2}$ miles, with from 20 to 25 fathoms between. Its position is further indicated by two beacons, the western having a staff and black ball, and the eastern a staff and white ball, and both situate on the western shore, $2\frac{1}{2}$ miles northward of the Cape lighthouse; when they are in a line W. $\frac{3}{4}$ S. they lead to the rock. There is also another beacon with a staff and white ball, near Simons Town, which, if kept in a line with the beacon on Oatland Point,* bearing N.W. by N., will likewise lead on to it. By day, if the weather be hazy and the

* The beacon on Oatland Point is triangular, 35 feet high, and painted white with a red band in the centre. It stands on a large flat-topped rock, a few yards from the shore near Oatland Point, and $8\frac{1}{2}$ cables from the white beacon, with staff and ball, on the shoulder beneath Simons Berg. From the Whittle Rock the two beacons are in line, and also in line with a large patch of whitewashed rocks on the hill north-west of Simons Town, bearing N.N.W. $\frac{3}{4}$ W. The advantage of this new beacon is, that it points out to vessels that they are westward or inside the Whittle, whilst it is kept open eastward of the beacon on the shoulder beneath Simons Berg. This was somewhat difficult with the patch of whitewashed rocks for a mark, as they were obliged to run far to the eastward before the patch opened out clear of the shoulder of Simons Berg. Vessels from the eastward will find this patch serviceable for pointing out the position of the Whittle.

latter beacons indistinct, there is a dark peak (Chapman Peak) over the southern side of Hout Bay, which if brought on with Elsey Peak on a N. by W. $\frac{1}{2}$ W. bearing will lead clear of, but close to the west side of the Whittle Rock. Or, Roman Rocks lighthouse in line with Elsey Peak will lead midway between Whittle Rock and Miller's Point.

The *Roman Rocks*, now distinguished by a black and white lighthouse upon them, are nearly level with the sea at high water, and situate in the fairway of the entrance to Simons Bay; they are about 130 yards in length from north to south, and 80 yards in breadth. A small detached rock of 15 feet, named Castor, lies 2 cables' lengths N.E. by N. $\frac{1}{2}$ N. from the lighthouse; it is marked by a beacon placed 30 fathoms north-eastward of it. Between this rock and the lighthouse are a few patches with from 19 to 24 feet over them, and from 5 to 10 fathoms between them and the Roman Rocks. Vessels should, therefore, give the lighthouse a good berth when passing round its eastern and northern sides, leaving the above-mentioned beacon to the southward.

Noah's Ark, having the form of a barn, lies nearly 3 cables' lengths from the shore, immediately under Whittle Rock Beacon, with that beacon S.W. by W. $\frac{1}{2}$ W.; it is about 10 or 15 feet above the sea at high water. Close around it there are from 5 to 6 fathoms water, and within it several rocky patches of 3 and 8 feet, so that, when passing through the channel south-westward of the Roman Rocks, the shore should have a berth of 4 or 5 cables given it, till up with the Phoenix Beacon, which marks the extremity of a dangerous reef of 3 and 5 feet only.

Sea Island, lying 14 miles N.E. $\frac{1}{2}$ E. from the Cape lighthouse, is small, and surrounded with rocks, especially on its northern side, where they extend off fully $\frac{1}{2}$ a mile, and probably the same on its eastern. A large rocky patch, named York Shoal, of from 2 to 6 fathoms, lies $1\frac{1}{2}$ mile southward of it, and there is a shoal spot $3\frac{1}{2}$ miles distant in a S.E. $\frac{1}{2}$ E. direction from the islet.

Anchorage.—Simons Bay is considered a safe retreat for thirteen or fourteen sail of ships, where they may be moored in security in all seasons. It is sheltered from winds between the N. round by W. and S.E., but, being small, cannot contain a numerous fleet sheltered from S.E. winds, though it is said that those winds coming from the bottom of the bay, or from the mountains bordering the coast—namely, between S.E., by the E. and N., never blow so strong as to endanger shipping, so that the bay may actually be looked upon as a safe retreat, wherein vessels may lie sheltered from all winds. The best situation to lie in is, with Noah's Ark S.E. by S.; the Roman Rocks E.S.E. $\frac{1}{2}$ E., distant $1\frac{1}{2}$ mile, and the time-ball * near the dockyard in Simons Town W. by S. $\frac{1}{2}$ S. In this berth, you will be distant about $\frac{1}{2}$ a mile from the shore, in $9\frac{1}{2}$ or 10 fathoms, and have sufficient room in case of driving, from whatever quarter the wind may happen to come, as you are quite sheltered by the mountains from those which blow with the greatest violence. If intending to make a long stay, or in a smaller vessel, you may anchor further in, in 8 or 9 fathoms, with Cape Hangklip entirely shut in by the eastern side of Simons Bay.

MR. C. P. BELLAMY, Master R.N., says, "You ought to moor your vessel in this road S.E. and N.W., with this particular caution, that, from the month of May to

* *Signal.*—The time signal-ball drops daily at one o'clock precisely of mean time at the Cape Observatory. Its position is 2'45 (or eleven seconds of time) W. of that observatory.

September, your stoutest ground-tackle should lie to the N.W., as the winds from that quarter blow the oftenest and with the greatest violence; on the contrary, from September to May, you ought to lay it to the S.E., because the south-easterly winds are then prevailing. However, it is seldom that any vessel goes thither in the latter season, Table Bay being at that time much preferable."*

GORDON BAY affords good shelter from S.E. and northerly winds, and has several fair landing-places from half-flood to half-ebb, but at no other time of tide, excepting at the bar, which is formed by a bank of sand, and cannot damage the bottom of the boat: this bank has generally about two feet water over it, but at low water, spring tides, it is perfectly dry. There are other landing-places which with S.E. winds are smooth; but you must always be attentive to the tide. Here there is good anchoring ground, holding well, being of coarse brown sand; vessels may anchor in from 13 to 15 fathoms, with the peak of Hangklip just open southward of the south point of Gordon Bay, and with the upper farmhouse open to the left of the lower farmhouse; small vessels may ride farther in, where the inner anchor is placed in good security, the Cape of Good Hope being shut in by Gordon Bay south point.

WINDS, &c.—For a general description of the Winds, see pp. 69, 70.

SUPPLIES, &c.—The country being mountainous, little or nothing is produced here, and there are comparatively few houses exclusive of the public buildings. All kinds of supplies may, however, be obtained, or damages repaired; there is a patent slip capable of hauling up a vessel of 1000 tons burthen; also a magazine of marine stores. Victualling and other necessaries are procured from Cape Town, which is 17 or 18 miles distant. You may wood and water here very readily; the water is both good and abundant; and, in case of necessity, a vessel may heave down by a hulk.

All the landing-places in Gordon Bay afford plenty of water, running down in streams, but the best is near the fish-house; here, although the passage is difficult and intricate, it has a spacious beach, well defended from the sea by reefs running in opposite directions, the only obstacle being the delay for the tide. Fruits, vegetables, and stock can be had here, but not expeditiously, as they must be brought from a considerable distance. If a pier were constructed here and another in Simons Bay, suitable even for small vessels, it would probably be the means of creating a market for the produce of the eastern part of the colony, more convenient than that of Cape Town.

DIRECTIONS.—The Bellows Rock always breaks; but not so the Anvil, which only breaks at low water and with a heavy swell. Sailing vessels should not pass between these dangers and the South-west Reef and the Cape, unless with a commanding breeze. The most advisable course, when coming in from the westward with a N.W. wind, is to pass southward and eastward of the Bellows and Anvil, at

* CAPT. FLINDERS has observed, "I found it to be a prevailing sentiment, that, were it not for the advantages of Cape Town, Simons Bay would, in every respect, be preferable for the Royal Dockyard and the equipment of ships of the Royal Navy. It was remarked to me, by an officer of discernment, captain of the flag-ship, that instances of vessels being driven from their anchors by winds blowing into Simons Bay were exceedingly rare. He had observed that the strain upon the cables with these winds was much less than with those of equal strength blowing off the land; and he accounted for it from the water thrown into the bay by sea-winds rebounding from the shore, and forming what is termed an undertow, which tended to keep a ship up to her anchors. This takes place in Simons Bay with S.E. winds, but not in Table Bay with those from the N.W., which blow into it, owing in part to the distance at which ships ride there from the land, and apparently, also, from the undertow passing out on the eastern side of the bay, clear of the anchoring ground."

the distance of 2 miles, or according to circumstances. From abreast the Bellows, at 2 or 3 miles, haul up no higher than E.S.E. or E. by S., until you have run 5 or 6 miles in this direction, whence you may steer E.N.E. and N.E., till the lighthouse bears W.N.W., when you will be clear of the Anvil. In advancing thus, you may always gain a proper anchoring-ground, in case of a calm or an unforeseen shifting of the wind. You may now haul up N.N.E.-ward, and pass eastward of Whittle Rock, between it and the reefs southward of Seal Island, though the western channel is undoubtedly the best for strangers. Should you, however, wish to adopt the former do not bring the Cape lighthouse southward of W.S.W., until Noah's Ark bears N.W., you will then go clear of the Whittle Rock. Do not go too near Seal Island, on account of the rocky patch which lies southward of the island, over which the sea will oftentimes break. Steer now towards the Roman Rocks, giving them a berth on either hand, as most convenient, especially their northern side; haul into Simons Bay, and anchor where before directed.

The foregoing, however, is considered by some as running unnecessarily eastward, and thereby occasioning much loss of time and ground, accordingly they recommend leaving the Bellows $\frac{1}{2}$ a mile to the northward, and steering E. $\frac{1}{2}$ S. till the Cape lighthouse bears N.W., and then haul up N. by E. to pass inside the Whittle. Having brought the southern end of the lofty Zwartkop Range (which is over the northern side of Smith's Winkle Bay) to bear N. W. by W., you should keep the Cape lighthouse between S.S.W. $\frac{3}{4}$ W. and S.W. $\frac{3}{4}$ W., until the Roman Rocks light bears between N. and N. by W. $\frac{1}{2}$ W., when you may haul towards it. These limits leave the rocks off Miller Point on the one hand, and the Whittle on the other, half a mile distant. If the Roman Rocks light is brought in a line with Elsey Peak, N. $\frac{3}{4}$ W., it will lead up midway between Miller's Point and the Whittle.

As you approach Simons Bay, Noah's Ark will soon be discerned; it is a smooth level island, appearing like a pontoon at a distance; but the most conspicuous objects, and first to be seen, are the white sand-downs, appearing like snow, in the hollows between the mountains to the north-west of Noah's Ark. You may coast along Noah's Ark, as it is steep, and has 9 fathoms close to it; in the channel between it and the Roman Rocks are 10 to 15 fathoms; hence a vessel should steer direct for the white sand-downs to the anchorage, passing eastward and northward of the Phoenix Beacon and Rock. If working with a N.W. wind, you may go northward of the Roman Rocks, taking care not to go too near them on account of the detached rocks already alluded to. This is also a clear channel, and may indeed be deemed more convenient with the winds from the N.W., as it is double the width of that between the Rocks and Noah's Ark.

MR. J. BROWN, of H.M.S. *Winchester*, says,* "When a vessel has rounded the Cape of Good Hope from the westward, the Roman Rocks light will open clear of Miller Point on the bearing of about N. by E.; and if it be intended to work up False Bay, between the Whittle Rock and the western shore, the light should not be brought westward of N. by W. $\frac{1}{4}$ W. until she is well up with the high land about Miller Point, and consequently northward of the Whittle; nor should the light be brought at any time to bear eastward of N. on account of the rocks off the western shore.

* Although these directions were written before the lighthouse was erected on the Roman Rocks, and while the lightvessel was moored on their northern side, the substitution of the *lighthouse* for the *lightvessel* does not at all affect their value.

"If the vessel is to work up eastward of the Whittle, the light should not be brought north of N.N.W. $\frac{1}{2}$ W., in order to avoid that rock; nor westward of N.W. by W. $\frac{1}{2}$ W., so as to give a sufficient berth to Seal Island and the shoal near it. But by whichever of those channels a ship approaches, short tacks should be made until certain of being within 5 miles of the light.

"With a leading wind the light may be brought to bear N. by W., which will clear the Whittle; and that course should be continued till within a mile of the light. The light must then be well opened on the port bow, so as to round it at not less than half a mile distance. When the light has been brought to bear S.S.W., steer in West for the anchorage, and bring up in 14 to 10 fathoms, according to the weather.

"When coming from the eastward round Cape Hangklip, it will be observed that the Whittle lies nearly in a direct line between that cape and Simons Bay; and therefore, if the wind be fair, bring Roman Rocks light to bear N.W. by N. and steer for it.

"These instructions are intended for seamen not acquainted with Simons Bay; those who know the passage between the Roman Rocks and Noah's Ark, will probably adopt it in the day-time, but from the position of the Phoenix Rock, and the narrowness of the passage, all ships at night should pass eastward of the light, and haul round it on the north side."

Vessels from eastward should not bring the Cape lighthouse to bear more westerly than N.W. $\frac{1}{2}$ W., by which they will clear all danger off Cape Hangklip. A tongue of low land stretches from this cape in a S.W. $\frac{3}{4}$ W. direction for $1\frac{1}{2}$ mile, rendering caution necessary in passing Cape Hangklip in hazy weather, especially if bound into Simons Bay.

If bound eastward out of Simons Bay, leave as soon as the north-westerly winds begin to blow; but if you intend to sail westward, you must wait till the north-westerly winds are on their decline, and get under sail in the roadstead, so soon as those winds shift from W.N.W. to West, for, as they most commonly veer thence successively to S.W. South, and S.E., they will prove fair for doubling the Cape of Good Hope, and lying up afterwards to N.W. The only directions to be given for leaving the bay is to reverse those for entering it.

To ships working out of Simons Bay, Gordon Bay will afford a ready shelter on the approach of night, for they can stretch into the outer part of it, and anchor for the night, well in shore, with a kedge or stream anchor; for it is generally observed, that when the wind blows strongly from the S.E. at the anchorage in Simons Bay, and other parts of False Bay, a ship will not have advanced half a mile within Gordon outer bluff before she will get into a light breeze, scarcely sufficient to carry her to the anchorage; here she may lie until daylight; then weighing and stretching out into the true wind, and work out either round the Cape of Good Hope or Cape Hangklip.

Gordon Bay will prove equally safe and advantageous for vessels standing in for Simons Bay late in the evening, and not considering it safe to run for anchorage there; for then they may stand over for Gordon Bay, and anchor for the night: they cannot mistake it, the land in the front, when standing eastward, being so very remarkable. This might easily be made a good place for shipping, for on each side of the bar are rocks, with plenty of large loose stones about them, and by piling up these stones upon the rocks, a pier might be constructed to any distance out; and if

a swinging crane were erected on the south pier, it would considerably facilitate the lading and unlading of the boats. The same plan might be pursued with the bay northward of the fort.

The harbour regulations and signals of Simons Town are similar, we believe, to those at Cape Town. See pages 276, 277, and 282.

From False Bay the coast trends 11 miles in an E. by S. $\frac{1}{4}$ S. direction, and is bold all the way, with rocks projecting from the base of the cliffs, close to or at a very short distance from which the soundings are deep, hence a good berth should be given to this part. At 9 miles from Cape Hangklip is the outlet of the *River Palmiet*, which is barred; this river is a rapid stream in winter, when fully charged with water, but is dry, or nearly so, in summer;—at half a mile eastward from it there is a small rocky cove, where a boat can land in fine weather. The coast now falls low and changes its direction to S.S.E. for about $5\frac{3}{4}$ miles, or as far as the rocky projection named Point Mudge, forming thereby an open bay called Sandown. The land immediately behind this shore is very lofty, rising into mountains, visible in clear weather many miles at sea; Sharp Peak, in Lat. $34^{\circ} 20'$ and Long. $18^{\circ} 53\frac{1}{2}'$, is estimated to reach an altitude of 2780 feet; the Crag, in Long. $19^{\circ} 1'$, 7025 feet; and Onrust Berg, over Point Mudge, 1575 feet.

Point Mudge is a low headland with rocks extending from the base of the cliffs about half a mile, close to which are soundings of 5 and 6 fathoms, rapidly deepening to 20 fathoms, the latter being at not more than $\frac{1}{2}$ of a mile from the point. A cove named D'Urban, formed by these rocks, will admit of a landing in fine weather while the wind is from the south-eastward, and a boat's crew may also land on the north side of the point at the same period; but D'Urban Cove is better and safer.

From Point Mudge a rocky coast trends E.S.E.-ward 7 miles, then a low sandy beach southward $9\frac{1}{2}$ miles, which is succeeded by a rocky coast projecting W.S.W. about $6\frac{1}{2}$ miles, the latter terminating in Point Danger, a low headland, the extremity of some low sandy land covered with bushes and stunted trees, which juts out from the base of Duin Fontein Berg, a remarkable bluff hill, 1130 feet high. The part comprised between Points Mudge and Danger, termed Walker Bay, is quite open to westerly winds, and offers no advantages to shipping.

Walker Bay is remarkable for its sandy shore and high sand hills, one of which rises to the height of 427 feet. A long heavy swell always rolls into it, and the water is deep within 1 or 2 miles of the shore. Kleine River, in the north part of the bay, is barred with sand.

DANGER POINT affords shelter to vessels during the strong south-east gales of summer, and boats may land in Stanford Cove, a small rocky inlet on the north side of the point at 5 miles from its extremity, during easterly and south-easterly winds, if care be taken to avoid the rocky patches off it; Hydra Bay, nearer the end of the point, is, however, a better place, the swell there not being so strong, but equal caution is necessary to clear outlying rocky patches. The bay is only a shallow indentation of the land, and may be easily recognised by a sand patch which marks the face of the hillock over it.

If intending to anchor in Hydra Bay, and running for it from the south-westward, the pitch of Point Danger should not be approached nearer than 2 or 3 miles, when the bluff hill of Point Mudge may be steered for until the sand patch is well open, when the rocky spit projecting from Point Danger will be cleared. Then haul up for the bay, and anchor in 12 or 14 fathoms, at about $\frac{1}{4}$ of a mile from the shore,

taking care to give a 2 fathom rocky patch in the centre of the bay, upon which the sea often breaks, a wide berth. H.M.S. *Hydra* anchored here, with Duin Fontein Berg bearing E.S.E., southerly; extremity of Point Danger S.W. by W. $\frac{1}{4}$ W.; and the sand patch in the bay S.S.E. $\frac{1}{2}$ E., southerly.

Danger Point has rocks about it extending off more or less $\frac{1}{2}$ a mile; there is also a rock 12 feet under water, known as the *Birkenhead Rock*, from the loss of H.M.S. *Birkenhead* upon it in 1852, situate W.S.W. 1 mile from the extremity of the point, whose position is generally indicated by breakers. Upon account of the Birkenhead Rock it is requisite to give the land hereabout a wide berth, especially as that danger is very steep, the lead dropping from it at once into 7 or 10 fathoms; the appearance of the shore is also deceptive, being low and backed with high land; hence Point Danger was usually termed Bluff Point, but improperly, as the high land which appears at a distance like a bluff is at least 3 leagues inside of it.

Danger Point is prolonged under water about 3 miles in a similar direction to the inclination of the land hereabout (W.S.W.), by a bank of 10 fathoms, increasing to 20 fathoms as you recede from the coast. Almost all the soundings upon this bank are of rock and coral.*

DYER AND GEYSER ISLANDS.—From the extremity of Danger Point the coast runs E. by S. $\frac{1}{4}$ S. $5\frac{1}{2}$ miles to a small barred stream, named Oilkraal, and then turns southward $3\frac{1}{2}$ miles to Sandy Point, a low projection from the coast, as its name implies. Behind this shore the country has but slight elevation, and is covered with bushes and stunted trees. Dyer and Geyser Islands are situate $2\frac{1}{2}$ miles W. by S. from Sandy Point, and almost the whole space between is occupied by a reef extending from the point, the channel left being very narrow, and safe only to those acquainted with the locality; this channel lies between the east end of Dyer Island and a rock above water inshore; it has a depth of $2\frac{3}{4}$ fathoms, and is only suitable, therefore, for small vessels,—when the wind blows from S.E. or South the sea breaks quite across it. The islands are small, low, and rocky, and hence are

* Danger Point and the neighbouring coast formed the subject of a communication to the *Cape Monitor*, by MR. MACLEAN, when engaged in triangulating the coast, previous to its hydrographical survey, dated March 4, 1852. The following is an extract:—

“One of my trigonometric stations is upon the southern extremity of the bluff or promontory of Danger Point, at the height of 1055 feet above the level of the sea. From the bluff a tongue of low land, partially covered with bush, runs out south-westerly at an angle with the meridian of $63\frac{1}{2}^{\circ}$, then submerges, forming a ridge or shoal in the same direction, gradually deepening, and extending out to a considerable distance. During a gale the water seemed to break as far as two miles or more from the extremity of the land, though the farthest out visible rock in calm weather was only about 500 yards from it.

“This projecting land, and its continuation under water, forms the west horn of an extensive bight or bay, of which Gunner’s Quoin with its projecting shoal is the eastern; it forms also the eastern horn of the sweep to Mudge Point. Dyer’s Island is situate close in on its eastern side, being separated from it by a narrow channel.

“On the south-east side of it the shore is rocky, but a boat may pass along it and through the narrow channel just mentioned, up to the sandy beach in the immediate vicinity of two farm-houses. On the north-west side the shore is also rocky, but I think less so. Close in is a stalactite cavern, immediately under the bluff; whence to Mudge Point the beach consists chiefly of sand. On this side I do not recollect having seen any house nearer than that now occupied by CAPTAIN SMALES.

“The rocks are chiefly of sandstone; but on the land this formation is combined with limestone—a characteristic of all the promontories between Capes Hangklip and Agulhas.

“With respect to geographical position, I observed the depression of the extremity of the point below the horizon of my station. From this, together with elements derived from triangulation, I find that the latitude of Point Danger is $34^{\circ} 37' 44''$; the latitude of the breakers just mentioned about $34^{\circ} 40'$, and their longitude east of the Naval Yard at Simons Bay $62^{\circ} 12''$.”

visible only at a short distance, the difficulty of distinguishing them being increased when viewed with the background of sand-hills on the adjacent shore.

Dyer and Geyser Islands, of which the former is nearer the coast, are seated on a reef which extends from them $1\frac{1}{2}$ mile in a W.N.W. direction; the edges of this reef are steep, as from them the lead at once drops into 7 or 8 fathoms. On their S.S.E. sides the islands are bold, and here the sea generally breaks with great violence, especially during the prevalence of southerly winds. The islands cannot be considered otherwise than very dangerous to vessels running along the land, and must therefore have a wide berth; a depth of 20 or 25 fathoms will be quite near enough, as these soundings will place the vessel at little more than a mile from them.

Dyer and Geyser Islands, with the reef connecting and projecting westward from them form, with the reef running from Sandy Point, a natural breakwater, on the north side of which vessels may anchor and find protection from southerly and south-easterly gales. When approaching this anchorage from the southward, great care will be necessary to clear the dangerous reef which projects from them in a W.N.W. direction, as previously mentioned, and especially when the sea is so calm that its position is undistinguishable by breakers. To clear it, keep the extremity of Danger Point in one with the valley in the high land near Cape Hangklip, and steer thus until the highest part of Geyser Island is in one with the Quoin; change the course now to the north-eastward and steer for Duin Fontein Berg (the bluff hill behind Danger Point), and when the extreme of Dyer Island is in line with the Quoin, steer for the Quoin, and anchor in 10 fathoms with Dyer Island extremes bearing S.S.E. $\frac{1}{2}$ E. and S.S.W. $\frac{1}{2}$ W., southerly; the pile on Duin Fontein Berg N. by E.; the extremity of Danger Point N.W. $\frac{2}{3}$ N.; and the pile on Gunner's Quoin S.E. The bottom is of sand, and the holding ground good, but it must be considered a very exposed anchorage and unfit to ride in when the wind blows from the S.W. quarter; it is safe only so long as the wind is not westward of S.S.W.

From Sandy Point the coast trends S.S.E. 12 miles to Quoin Point, a headland situate in Lat. $34^{\circ} 46\frac{1}{4}'$ and Long. $19^{\circ} 38\frac{1}{4}'$. It is foul more or less all the way, and the 20 fathom line of soundings is nowhere further out than 2 miles. Two shoals, which may possibly be dangerous, lie about midway between the points at a mile from the shore, with the hills named False Quoin, 888 feet high, bearing N.E. by N.; Carruther, 630 feet high, E. $\frac{1}{2}$ S.; and Gunner's Quoin, 997 feet high, S.E. by E. On the eastern of these shoals a depth of not less than 4 fathoms was found by the surveyors; but they remarked that the sea broke over them occasionally.

Quoin Point is a square projection of hummocky land, and distinguishable when viewed from the southward by two sand-hills near its extremity; from it foul ground extends out a mile south-westerly, upon which the sea generally breaks with violence. This foul ground is very steep, there being soundings of 9 and 12 fathoms close to it, which rapidly increase to 20, the latter being at not more than $2\frac{1}{4}$ miles from the point on its south-west side, and at less than $1\frac{1}{2}$ mile from it on its western side, and consequently at only a moderate distance from the reef.

The country behind Quoin Point is low and bushy. The hill Gunner's Quoin, or Buffel Jagt Berg, as it is named by the Dutch, is $3\frac{1}{2}$ miles northward from the point, and may be recognised from some positions of view by its resemblance to a quoin: it is 997 feet high. All this coast is exposed to gales from the southward, which cause

heavy breakers upon it; so violent are these breakers, that it is generally impossible to effect a landing.

There is a small rocky cove at $2\frac{1}{4}$ miles northward of the extremity of Quoin Point where boats can land when the wind is from the south-eastward. From it the pile on Gunner's Quoin bears about E. by N.

The coast eastward of Quoin Point for about 7 miles is very dangerous, being fronted by reefs which extend $1\frac{1}{2}$ mile from it; on the outermost of these are two small rocks above water. As these reefs are steep they should not be approached nearer than the depth of 30 or 25 fathoms, and it should be remembered that the country immediately behind them is low and bushy, so that an error in the estimation of distance can easily be made.* The soundings of this part of the coast as far as Cape Agulhas are shown by the recent survey of LIEUTENANT DAYMAN, R.N., to be very irregular; hence the need of more than usual caution when running along the land.

CAPE AGULHAS.—From Quoin Point to Cape Agulhas the distance is about 17 miles in a S.E. $\frac{1}{2}$ E. direction; between, the coast recedes about $2\frac{1}{4}$ miles from an imaginary line connecting those points. The Cape is the most southern projection of the continent of Africa, and is described as a headland of moderate elevation visible some miles at sea, the hills forming it rising to about 450 feet above the water. Rocks extend out from its shore from $\frac{1}{4}$ to $\frac{1}{2}$ a mile, close to which is a depth of about 4 fathoms, which rapidly deepens to 12, 15, and 20 fathoms, the latter being at 2 miles southward from the lighthouse.

SIR T. MACLEAB, in charge of the Observatory at the Cape of Good Hope, says of Cape Agulhas—"It is the rocky projection from the south-east corner of the promontory of Agulhas, the centre of which promontory is about $\frac{2}{3}$ of a mile westward of the projection, and about 200 yards more southerly, being the most southern part of Africa. The features of the land about Agulhas distinguish it from the neighbouring headlands. A ridge-shaped undulating clump rising from the flat ground is separated into four ridge-shaped hills by irregular ravines running nearly true East and West. The middle ridges enter wedge-like at the east end, and arc lost towards the centre, where the ravine widens to a mile in breadth. The middle ridges are the lowest; the northern and southern are of equal height.

When viewed at a distance from seaward, *easterly or westerly*, the north and south elevations being seen nearly end on, resemble two oblong hummocks; but the former, extending more easterly, appears the highest as seen from the eastward.

When viewed at a distance from the *southward*, the south ridge masks the others, save at their east end; but the ravines being hid, the whole appear to be united.†

The highest part of the south ridge is 455 feet above the level of the sea, and its

* In the Admiralty sailing directions for this coast, it is stated that "H.M.S. *Hydra* found tolerable shelter and smooth water, in a strong N.W. wind, at anchor under the lee of the reefs eastward of Quoin Point, and it is possible that a small vessel might find the same close under the extreme of the point, between which and the reefs there appears to be a clear but narrow passage. Between Quoin Point and Cape Agulhas the coast is low and sandy, except abreast of the flat-topped range of Zoet Anys Berg, where the shore is steep and rocky. The whole of it is exposed to the full force of the ocean swell, and landing upon it is impossible."

† Only the south and middle ridges are shown on the chart. They are all given on COLONEL MITCHELL's plan.

true meridional distance from the shore is almost exactly one mile. From this point the descent eastward is rather gradual. Westward the descent is at first steep, then slightly undulates. Southward it is steep, then undulates to within 300 yards of the shore, where the ground becomes flat.

"It is on the first undulation from the shore, which is about 55 feet above the level of the sea, that the lighthouse is built. The position of this building is nearly *true* South from the highest point before mentioned, and at N. 30° W. 520 yards from the point generally known as Cape Agulhas."

Lighthouse.—The lighthouse on Cape Agulhas is 100 feet high, and painted in red and white zones. It shows a *fixed white* light at 128 feet above the sea, visible at the distance of 18 miles in clear weather, when it bears between S.E. by E. and W. —*i.e.*, over 19 points of the compass. Its position is Lat. $34^{\circ} 49' 45''$ S., and Long. $20^{\circ} 0' 40''$ E. The following particulars relative to this light are from the official notification of its establishment:—

"If a vessel approach Cape Agulhas from the westward the light will be first seen on a S. $57^{\circ} 15'$ E. (or nearly S.E. by E. $\frac{1}{2}$ E.) bearing. The extreme end of the low ground called Gunner's Quoin Point bears N. $52^{\circ} 30'$ W. (or N.W. $\frac{5}{8}$ W.) from the lighthouse, distant $19\frac{3}{8}$ miles, but is not visible from it. The sea was remarked breaking a long way off the point; it will, therefore, be necessary to keep off the land until the light becomes visible.

"If a vessel approaching the Cape from the eastward passes Struys Point at the distance of 5 miles from the shore, and steers a W. by S. course exactly, she will pass the most southerly projection of Northumberland Point reef at the distance of $4\frac{1}{4}$ miles, and the light at the distance of $5\frac{1}{2}$ miles, and clear Gunner's Quoin. *This is the limit northward within which no vessel should be found.* It secures every advantage that could possibly be obtained by a closer course, and at that distance the light will be brilliant.

"In clear weather the light may be seen, when 5 or 6 miles eastward of Struys Point, from a look-out at the height of 35 feet; and if the vessel should then chance to be close in shore, by steering the above course she might touch the shoal off Struys Point. To guard against this, when the light is first seen it should be brought immediately to bear W. by N., and keeping this bearing of the light, the vessel will pass at 2 miles southward of any danger respecting Struys Point.

"Care should be taken when approaching the land before the light is discovered, for in hazy weather, or when there is spray with a fresh breeze, combined with the distance of Struys Point (about 15 miles), the light may be faint or altogether obscured, and the vessel may get within the line of danger. Under these circumstances the lead should not be neglected, and the depth should not be less than 20 fathoms, without putting about immediately to the south. The like precautions are required even during daylight, particularly in foggy weather, for the high land of Agulhas may be invisible while the sand-hills of Struys Bay and the breakers off Northumberland Point are distinctly seen. On these occasions it is difficult to determine whether the vessel is eastward or westward of Struys Point, because the shore features of the bay eastward of that point are similar to those of Struys Bay, although the extent is less.

"Sailing vessels in particular should adhere to these rules, for if it should fall calm, the heavy swell which constantly rolls towards the shore would carry them with it, and the only resource, that of anchoring, would probably be of no avail,

from the rocky nature of the bottom, combined with the swell. The *St. Mungo* is said to have been wrecked in this way."

NORTHUMBERLAND POINT.—From the lighthouse on Cape Agulhas to Northumberland Point the distance is $3\frac{1}{2}$ miles. Immediately eastward of the lighthouse are two indentations of the coast, of which the first bears the name of St. Mungo's Inlet; the second is wider and deeper, and the projection which separates them is called St. Mungo's Point. From the last inlet the shore runs jagged to the dangerous projection called Northumberland Point, from being the site of the wreck of the *Duke of Northumberland*, which point forms the west horn of Struys Bay.

The whole of the beach from the west side of the promontory of Agulhas to Northumberland Point consists of rugged sandstone and quartz rocks, or rocky reef, perfectly impracticable even for a boat. At the promontory, groups of rock prevail; at the cape, rocks and a rocky reef extending out $\frac{1}{2}$ of a mile; at the inlets, flat rocky reef exposed at low water for $\frac{1}{3}$ of a mile; and thence rocks to Northumberland Point, where it is sand and reef. As this iron-bound shore is exposed to the full force of the Southern Ocean, the sea breaks heavily upon it, especially during the prevalence of southerly winds—a vessel, therefore, touching upon it has not the slightest chance of escaping destruction.

Northumberland Point is low and sandy close up to the beach, and from it a very dangerous ledge of rocks projects out about a mile in a S.E. by S. $\frac{1}{4}$ S. direction, the extremity of which bears nearly E. by S. $3\frac{1}{10}$ miles from the lighthouse. Westward from the point the reefs extend out about $\frac{1}{3}$ of a mile, and break heavily when the wind is from the S.E. In one or two places it breaks further out, but in no place further than half a mile.

When surveying at Northumberland Point, MR. MACLEAB observed breakers at some distance from the land, the position of which he fixed by intersection as follows:—From Northumberland Point, S. $58^{\circ} 30'$ E. (S.E. by E. $\frac{1}{2}$ E.) $1\frac{1}{2}$ mile, and from the lighthouse on Cape Agulhas S. $81^{\circ} 40'$ E. (E. $\frac{1}{4}$ S.) $4\frac{1}{2}$ miles.

STRUYS BAY.—Struys Bay lies between Northumberland and Struys Points, which are distant from each other $11\frac{1}{2}$ miles. The coast between is low and sandy, but at a short distance from the beach there is a line of sand-hills, varying from 50 to 150 feet in height, some of which are covered with dark-coloured bush, a feature that also distinguishes the coast eastward of Struys Point as far as the next point to it. There is no high land sufficiently near to interfere with the distinguishing character of the hills northward of Agulhas as viewed from seaward.

The landing place in Struys Bay is in a small bay or cove north-westward of Northumberland Point, which is sheltered by a projecting shelf of shingle from each extremity of the cove. The jetty, constructed from pieces of wreck, renders the landing easy; but at the outer horns of the shingle there is only water sufficient for a boat at quarter flood in fine weather. Three or four huts at the head of the jetty point out its position from the bay. Immediately in the neighbourhood, on higher ground, is a stone dwelling-house with a signal staff a few yards behind it, termed the *Telegraph-staff* on the chart.

Struys Point, the eastern extremity of Struys Bay, is the outer extreme of a number of sand-hills. It bears from Northumberland Point N. $79^{\circ} 30'$ E., or

E. $\frac{1}{2}$ N., and N. $82^{\circ} 20'$ E., or E. $\frac{1}{2}$ N. from the lighthouse on Cape Agulhas.* This point is more dangerous than Northumberland Point, because reefs lie much further off its shore, and there is no high land by which a seaman may determine the position of his ship. Circumstances did not permit MR. MACLEAR to include this point in his survey of Cape Agulhas, but during a strong south-easter he observed from the summit of the sand-hills near the point that the reef extended seaward about three miles, and that breakers were then breaking upon it with violence.

Like Northumberland Point, the colour of the water off Struys Point changes to seaward from brown to light, then dark green, from which it may be inferred, together with the known shallowness of the sea off Northumberland Point, that the lead as well as the colour of the water will always warn a ship of the vicinity of danger.

In Struys Bay shelter may be obtained only during westerly or north-westerly winds, as all others blow directly on shore, consequently the bay must be avoided with the wind between S.W., round by S., and E. With any of the latter winds it is unsafe, if not impossible to ride in it, for the sea rises to such an extent as to break in 7 or 8 fathoms, a circumstance that was remarked on two occasions while H.M. steamer *Dee* was standing off waiting for the weather to moderate to enable her to anchor. At the time of anchoring, although the wind had subsided several hours, the water nearly broke in 7 fathoms, where the anchor was let go; and at the place whence she had put to sea three days before in $4\frac{1}{2}$ fathoms, the sea was breaking heavily. As a general rule, vessels seeking shelter in this bay, in a N.W. gale, should put to sea immediately after it subsides, for the wind frequently changes in a few hours from a strong N.W. to a S.E. or S. point, in which case it is very difficult to work out, in consequence of the heavy sea that rises with these winds.

When anchoring, the best place is in 5 fathoms sand, with the large stonehouse near the beach bearing W. $\frac{1}{2}$ S., and the sandy extreme of Northumberland Point S.W. by S. Here the bottom is clear, while to the westward and nearer the reef, where the water is smoother, the bottom is foul,—rocks interspersed with patches of sand. The latter is unsafe; the cable is liable to snap from fouling the rocks, an accident that befel the *Dee* while lying there in a light south-west wind, accompanied by the usual swell.

Vessels from the westward should not bring the lighthouse on Cape Agulhas to bear more westerly than W. by N. $\frac{1}{2}$ N., until Northumberland Point bears N.W. $\frac{1}{2}$ N. Then steer N.N.E. or N.E. by N., until the stonehouse previously mentioned bears W.N.W.; this will lead clear of the outer detached reefs off Northumberland Point. Proceed now to the N.W., and bring the anchoring marks on.

The light on Cape Agulhas is not visible from the anchoring ground, owing to the swell of the intervening land.

MR. MACLEAR says, "During our examination of the coast in September, 1848, no current was observed in Struys Bay, nor about the coast $2\frac{1}{2}$ miles from the shore, so far to the westward of Agulhas as the letter E on the chart; but it was confidently asserted by fishermen, and the residents at Struys Bay, that a very strong current frequently sets to the westward round Northumberland Point.

* So stated in the original official notice of the establishment of Agulhas Light, but the bearings appear to be nearly E. and E. $\frac{1}{2}$ N. by the chart.

"A ship becalmed in the offing was observed setting eastward, at a rate exceeding a knot an hour. On two other occasions, close to the shore, about 2 miles westward of Agulhas lighthouse, the stream ran during a whole night steadily to the N.W., at $1\frac{1}{4}$ knot an hour. These changes may probably be traced to the effect of the wind.

"Circumstances did not allow of the tides being observed with due accuracy. Two copper plugs were let into rocks south-west of the lighthouse, to mark the high and low water points nearly at spring tides. The comparisons with these plugs on October 15, 16, 18, 19, 28, and 29, and an observation at the jetty in Struys Bay on October 28, give the establishment and rise and fall nearly similar to what prevails in Table Bay and Simons Bay."

COMMANDER J. FOOTE, R.N., of H.M.S. *Rosamond*, in 1848, has remarked of Struys Bay:—"With any northing in the wind, vessels may find good holding ground in 7 fathoms, sand, with Northumberland Point bearing S.W.; but while there is any southing the anchorage is exposed. There is an excellent boat harbour formed by a reef of rocks, to enter which you must pass over a bar, which, when the *Rosamond* was there, did not break at all heavily, and we were informed by an inhabitant of the bay that by keeping close to the rocks to the northward of Northumberland Point, boats might enter at any time, and we found by following this direction we entered by the smoothest channel; when once in the boat harbour, the water is perfectly smooth, and the landing excellent.

"Sailing vessels should not anchor within 2 miles of this landing place. Her Majesty's steam sloop, under my command, anchored in $5\frac{1}{2}$ fathoms, at about $1\frac{1}{4}$ mile distant from it. Vessels entering this bay should give Northumberland Point a wide berth; the rollers break occasionally in 10 fathoms, and the reef extends fully 2 miles in a S.E. direction. There is only one house or building in the bay, rented by a MR. BARRY, upon which a red ensign was hoisted. There are several wells in the neighbourhood, but the water is brackish. Sand-hills studded with heath and brushwood are the prominent features of the surrounding country, but upon the hilly ground, near Agulhas and Northumberland Points, limestone is found."

At 2 miles eastward of Struys Point is a projection of the coast named *Hoop Point*, from which it is probable shoal water runs off $1\frac{1}{2}$ mile. It has been asserted that reefs or blinders extend so far as 6 miles from Struys Point, and that there is a depth of 3 fathoms on their extremity, and a channel of 6 fathoms depth between. Upon these reefs the sea has been observed to break in heavy southerly gales. A safe channel exists inside them, if it be true, as stated, that a vessel has been seen to pass through it apparently unaware of danger.

From Struys Point the coast trends nearly E. by N. $16\frac{1}{2}$ miles, and is low with sand-hills; it then turns to the E.S.E. 19 miles, or as far as *Cape Infanta*, and gradually becomes bolder as it proceeds eastward. Reefs extend from the projecting points of this shore, rendering a wide berth necessary when coasting, especially as it has not been surveyed, and from the following may be suspected to have isolated dangers off it. A rock (the existence of which was unknown until it caused the loss of the Dutch ship *Atlas*) was examined by MR. SEAD, R.N., in 1859, from which it appears that it is of very small extent, not more than half an acre, and has 3 fathoms water upon it, with 6 and 7 fathoms close to it all round at low tide; its position is two miles from shore in Lat. $34^{\circ} 37\frac{1}{2}'$, and Long. $20^{\circ} 22' 50''$, and from it

Struys Point bears W. $\frac{3}{4}$ S. 7 miles, and a triple isolated peak inland N.W. $\frac{1}{4}$ W.—the peak on this bearing resembles a cone.

ST. SEBASTIAN BAY.—Cape Infanta, on the northern side of which is St. Sebastian Bay, is of moderate height and surmounted by sand-downs, which give it a desolate appearance; its position is about Lat. $34^{\circ} 31'$, and Long. $20^{\circ} 53\frac{1}{2}'$. From it a rocky coast runs north-easterly nearly 4 miles to Point St. Sebastian, and then turns sharply round westward, forming St. Sebastian Bay. "At the bottom of the Bay, north-west of Cape Infanta, there is a valley between the mountains, through which the Infanta River descends to the sea, and there is said to be good anchorage off the River Breede, where a ship might be sheltered from north-westerly and westerly winds; but a considerable sea generally tumbles into the bay."

St. Sebastian Bay is only a very shallow indentation of the coast, which affords shelter with winds from the land, as all others send in a very heavy sea,—the exposure is from E., round by S., to S.W. The River Breede, known to the colonists as Port Beaufort, is said to be capable of receiving vessels drawing 8 or 10 feet, and it is asserted that these can ascend it 30 or 40 miles. It has been proposed to deepen the outlet of this stream, to permit the entrance of vessels of larger size, and as there is generally some water in it in the dry season, and some perceptible current, such a proposal, if carried into effect, might render it a serviceable harbour. The depth in the bay is understood to be about 9 fathoms, and at two leagues from shore 36 and 38 fathoms.

Northward of St. Sebastian Bay there is a flat table-hill, and further to the north-eastward a mountain with a hummock on it resembling a cupola.

KAFFIR KUYL RIVER.—From St. Sebastian Bay the coast runs S.E. by E. about 22 miles to Cape Barracouta, situate in about Lat. $34^{\circ} 27'$, Long. $21^{\circ} 24'$, and is rocky all the way. Deep soundings prevail along the coast, for at two miles southward of the Cape the depth is 22 and 25 fathoms. From Cape Barracouta to Kaffir Kuyl River the distance is nearly 7 miles in an E. by N. direction.

Kaffir Kuyl River is a small stream, the mouth of which is in Lat. $24^{\circ} 22\frac{1}{2}'$, and Long. $21^{\circ} 31'$. A bar, dry, or nearly so, at low tide, crosses the entrance, having passed which the depth increases to only about 3 feet, so that nothing larger than boats can frequent it. The soundings outside the bar are 4 to 6 and 8 fathoms, and here vessels sometimes anchor while the wind is from the land.

When approaching Kaffir Kuyl River it will be prudent to give the coast on each side of it a good berth, because of the reefs, which probably run off $\frac{1}{4}$ to $\frac{1}{2}$ a mile from them.

From Kaffir Kuyl River the coast trends about 11 miles in a S.E. by E. direction to Yzervark Point, which is bold and rocky and has a hill, Buffel's Kop, 740 feet high, at $1\frac{1}{2}$ mile inland from it. It may be known by a round bare sand-hill, 200 feet high, close to the sea, at $1\frac{1}{2}$ mile West of it. This hill terminates the sandy feature of the coast in the bight between Kaffir Kuyl River and Yzervark Point. Aasvogelberg, a long elevated hill, 1620 feet high, stands N. by E. $\frac{1}{2}$ E. $11\frac{1}{2}$ miles from the point, and may serve to identify it.

Between Yzervark Point and Cape Vacca, a distance of 10 miles on an E. by S. bearing, the coast consists of rude jagged rocks, on which a heavy sea is constantly beating. The land immediately at the back slopes to the height of 700 to 500 feet,

and is covered with bush and vegetation. There is a small but remarkable sand patch of a reddish colour midway between Yzervark Point and the Gouritz River, and half a mile from Bull Point. This point is not easily distinguished, as it is only a very slight projection from the general line of the rocky shore. South, three-quarters of a mile from the red sand patch, and one-third of a mile from shore, there are patches of detached reef, which break, and show at low water. At the distance of $1\frac{1}{2}$ mile from this rocky coast the soundings range from 30 fathoms off Yzervark Point, to 20 fathoms south of Cape Vacca.

GOURITZ RIVER is a small stream distant $8\frac{1}{2}$ miles from Yzervark Point and $1\frac{1}{2}$ mile westward from Cape Vacca. It has a sandy beach at its western entrance, but the breakers are generally too high to make it available as a landing place for boats. The sea breaks right across its mouth, which at the outer part is only half a mile in width; and at half a mile inside it is only 10 to 15 yards wide.

CAPE VACCA is distant 10 miles from Yzervark Point and about 24 miles from Kaffir Kuyl River, and will be recognised by being a low flat composed of rock and shingle, jutting out from a round hill over the eastern entrance to the Gouritz River, and which bears N. 62° W. $1\frac{1}{2}$ mile from the cape. The sea breaks half a mile outside the cape in rough weather, at which distance a depth of 9 fathoms was found by the surveyor, MR. SKEAD. From the discoloration of the sea, and the uneasy ground-swell in the vicinity, it is more than probable that shoal rocky ground exists there. Be cautious in rounding this low cape, as the light on Cape St. Blaize, distant 15 miles E. $\frac{1}{2}$ N., is not visible from it; hence the lead will be the best guide at night or in thick weather.

FLESH BAY.—On the north-east side of Cape Vacca is Flesh Bay, situate between the cape and Fish Point, which bear from each other N. 64° E. and S. 64° W. distant $2\frac{1}{2}$ miles. The shore of the bay is sandy throughout—except at the extremes, which are rocky. In about the middle of the bay there is a bare sand-hill, 280 feet high, just over the beach. This bay affords no shelter for vessels, save as a temporary one in N.W. gales, and it can only be used as a landing place in tolerably fine weather. The island, and the facilities this bay afforded for procuring fresh water and cattle, mentioned by VAN KEUTEN and the early Dutch navigators, no longer exist; there is no island in the bay; and very little fresh water is found near to the sea, and that is brackish. In 1862, cattle were not to be procured, the inhabitants living entirely on sheep.

FISH BAY, on the north-east side of Fish Point, is formed by a deep curve (of 3 miles) in the coast-line between Fish Point and the well-defined commencement of the rocky cliffs which extend 4 miles westward from Cape St. Blaize, and which is called Pinnacle Point. From Fish Point to Pinnacle Point the bearing is N. 82° E., and the distance nine miles. The whole shore of Fish Bay is sandy, with small patches of rock showing out about low water mark, and the breakers are generally high throughout the bay. The land at the back, at the distance of a mile, rises 400 to 500 feet in height, and is covered mostly with bush and vegetation. The bay may be used by vessels seeking shelter from N.W. gales: the best anchorage will be found $1\frac{1}{2}$ mile from the sandy shore, in 7 to 8 fathoms—Fish Point bearing S. to S. 10° W.,

and the extreme of the bluff cliffs near Cape St. Blaize E. $\frac{1}{2}$ S. It is advisable for vessels seeking shelter to put to sea as soon as the gale subsides, for then a heavy S. W. swell sets in and causes a dangerous breaking sea. The best landing is near Fish Point, in a small sandy cove, between rocks; but in fine weather boats may land in the bight under Jackson's farmhouse.

The coast between Pinnacle Point and Cape St. Blaize, a distance of 4 miles, consists of precipitous rocky cliffs of a reddish colour, about 250 feet high, with deep water close to: it is quite impracticable for boats landing. The higher land, half a mile inland, ranges from 600 to 200 feet in height towards the cape, and is mostly covered with grass and bush; Cape St. Blaize Bluff is the eastern extreme of these rocky cliffs; a windmill stands on the high land near the cape, but it is only visible to vessels approaching from the southward or the eastward. The cape itself is a tongue of low flat land fronted by rugged reef which juts into the sea 500 yards from the bluff on which the lighthouse stands. A remarkable *whitewashed* rock, the Logan stone, poised upon natural supports, stands just beneath the bluff. A sunken rock, called Blinder or Windvogel, with 15 feet water over it, lies one-third of a mile outside the cape; upon this rock there are heavy breakers at low water during rough weather.

MOSSEL BAY is bounded on the south-west side by Cape St. Blaize and on the north-east side by the mainland, which are distant from each other about 8 miles. The Blinder Rock off the cape is very steep, as there are soundings of 5 to 7 fathoms close to it, and there is a corresponding depth in the narrow channel between the rock and the cape. On the west side of the bay, at 3 miles from the cape, there is a small island near the beach, named Seal or Robben, and north-eastward of this are three rivers in succession, the Hartenbosch, Little Brak, and Great Brak. The bay is open to all winds from the southward, and these generally send in a heavy swell, especially if they have prevailed with strength for some hours. South-east gales seldom last more than one day, and generally become weakened in force towards evening. The soundings at 4 miles from shore are 22 and 20 fathoms; thence gradually decreasing to the beach, close off which they are 5 and 7 fathoms; all are of sand.*

MR. SKEAD, R.N., describes Mossel Bay in the following manner, 1864. Magnetic variation allowed $29^{\circ} 50' W.$

"The **Lighthouse** on Cape St. Blaize is a square white tower, 45 feet high, with buildings at its base for the light-keepers; it is in Lat. $34^{\circ} 11' 10'' S.$, Long. $22^{\circ} 9' 31'' E.$ It exhibits a *fixed red* light, at an elevation of 240 feet above the sea, and is visible from N.N.W. round by the East, South, and West to S. $80^{\circ} W.$, or N. $80^{\circ} E.$ from a ship 10 to 12 miles distant. As Cape Vacca bears S. $87^{\circ} W.$ from the lighthouse, vessels

* Mossel Bay is considered to be the best bay on the south coast of Africa after Simons and Saldanha bays, as a landing can safely be effected in it at almost all times; still it is exposed to heavy seas when the wind is from the southward. It has been suggested that a breakwater, supposing it possible to run one out from Cape St. Blaize, would be a great boon to vessels rounding the southern shore of Africa during stormy weather, as there is no place affording adequate shelter on all the coast. Near the shore of the bay only brushwood can be obtained, but a little way up the Great Brak River, there is plenty of large timber; the new settlement of George Town is on the bank of this river, at about 15 miles north-eastward from the bay, in Lat. $33^{\circ} 57'$, and Long. $22^{\circ} 26'$.

proceeding westward must be careful not to lose sight of the light, as they will then be either getting in towards the rocky coast westward of Cape St. Blaize, or into Fish Bay. Vessels well acquainted with the coast may take this liberty, and use Fish Bay for a smooth water board in working westward; the lead must then be a guide, but 20 fathoms is the limit within which none but a coaster should be found.

"From Cape St. Blaize the land takes an abrupt trend to the N.W. by N. for 3 miles, still retaining (with the exception of three sandy coves) its rocky coast feature; the outermost two of these coves are called Vaarkens and Mauro Bays—in the former of which landing is generally made. At the end of these three miles the coast curves to the N.E. for 3 miles, with a sandy beach, to the mouth of the Hartenbosch river, and 2 miles further on to the Little Brak river, from which to Cape St. Blaize may be considered as the limit of Mossel Bay. Just to the N.E. of the Hartenbosch river there is a large conspicuous sand patch, which extends to and beyond the mouth of the Little Brak river; this patch is useful for strangers from the eastward in identifying the bay, and from the westward for clearing the Blinder or Windvogel rock, when rounding Cape St. Blaize. In the depth of the bay, at one-third of a mile from the sandy shore, and N. 12° W. 2½ miles from the lighthouse, lies Seal Island, a small rocky islet about 15 feet high, with a depth of 3 to 4 fathoms between it and the shore; it has deep water close around it.

"Mossel Bay affords excellent shelter to vessels during the *winter* months, April to September, when heavy N.W. gales are of frequent occurrence; and it is far preferable to use it as a place of shelter than to buffet the sea about Cape Agulhas, which is 120 miles only to the westward. During the strength of these gales the water in the bay is smooth, and ships ride well, but it sometimes happens that a heavy S.W. swell sets into the bay if the wind veers to West and W.S.W., and this renders the bay unsafe, and landing very difficult or impracticable. During the *summer* season, when S.E. gales occur, the bay is exposed to the full effect of the open sea; but these gales seldom last longer than thirty-six hours, and do not blow home. A heavy breaking sea then rolls in, and ships trading to the port usually ride with a long scope of cable, secured to a coir or hempen spring to ease the strain on the cables; with this precaution vessels ride safely, and the holding ground is good. As in Algoa Bay, there appears to be a strong easterly current, or 'undertow,' which assists to ease the strain on the cables. Should a vessel, however, not wish to risk riding out a *south-easter* in the bay, by putting to sea early she will be well able to clear Cape St. Blaize by first making a good long board to the eastward, in which she will be assisted by the 'undertow.' CAPTAIN LAWS (the harbour-master) has found by observation that a rise of the barometer usually precedes a *south-easter*, and that the increase of the wind is gradual at the commencement.

"*Anchorage*.—The anchorage space is included—(1) between a line drawn from Cape St. Blaize lighthouse through the Ladies' School (a conspicuous building with a double gable point, and the only house near to the cape), bearing S. 27° W.; and (2) a line drawn from the Windmill through Barry's Store (a large two-storied stone building which stands on the mound close to the sea at the west side of Vaarkens Bay), bearing S. by W. ½ W. Small vessels may anchor in this space in from 3½ to 4 fathoms water, with the outer low point visible, bearing between S. by E. and S.E. by S.; but vessels *seeking shelter* ought not to go inside a depth of 6½ or 7 fathoms in either season of the year. The windmill in line with the new jetty is a good line for strangers to anchor upon, suiting their depth of water to the size

of their vessels and the object they have in visiting the bay. Vessels intended to load or unload may take up a berth more to the westward, and in the depth of the bay—not, however, going within the line of the windmill and Barry's Store already mentioned. Ships of war visiting the bay should not anchor in less than 7 fathoms during the summer months, the lighthouse bearing S. by W. $\frac{1}{4}$ W.; nor in less than $5\frac{1}{2}$ to 6 fathoms in the winter, the lighthouse bearing S. $\frac{3}{4}$ W. There is a substantially-built jetty in the nook or cove, called Vaarkens Bay, abreast of the anchorage. With a small outlay in making a rough stone pier from the outer point of the bay, to protect the jetty from the breaking sea that sometimes comes in, landing might be effected in almost any weather. At present the rollers render landing almost impracticable at times, endangering even the jetty itself.

Provisions.—Fresh water is supplied from a pipe at the jetty end, at the rate of about thirty tons a day. Fresh provisions and vegetables are to be had in any quantity, and it is in contemplation to erect a flagstaff at the lighthouse, so that vessels wishing to be reported can make their wishes known, and have information sent by electric telegraph either to Cape Town or Port Elizabeth.

Mossel Bay from the Westward.—Cape St. Blaize is a conspicuous bluff, the land at the back being quoin-shaped, and somewhat resembling the Bill of Portland. To round Cape St. Blaize keep Pinnacle Point open to the southward of the cliffs just to the west of the lighthouse bluff, N. 72° W., until the large patch of sand at Hartenbosch river bears N. $\frac{1}{2}$ E., or until a large stone *beacon*, which is *white* and stands 500 yards to the N.W. of the lighthouse, comes open to the northward of the Logan Stone; this will clear the Windvogel rock.

Mossel Bay from the Eastward.—Coming from the East and South-east, Cape St. Blaize is more difficult of recognition, as the land shows on each side of it; but it may now be identified by the lighthouse, which shows conspicuously against the dark background—by the Logan Stone, which is also *white*—by the windmill on the bluff—and by the remarkable sand-patch at the mouth of Hartenbosch river.

Tides.—There is no regular stream of tide in Mossel Bay."

For a general description of the Winds, see p. 70.

MR. LAWES, harbour-master at Mossel Bay, says :—" Mossel Bay derives its name from JACOB MOSSEL, who was Governor-General of Netherlands India in 1757. It was formed by a bend of the coast on the eastern side of Cape St. Blaize, which is a low point projecting from a bluff in Lat. $34^{\circ} 10'$ S., and Long. $22^{\circ} 18'$ E. A rock named Blinder or Windvogel lies about $\frac{1}{3}$ of a mile from the east end of the cape, and the sea breaks heavily upon it at low water. This bay affords complete security to vessels during the winter months of May, June, July, and August, when the prevailing winds are off the shore; south-easterly winds are then unfrequent, moderate, and of short duration. From September to April strong breezes from the N.E. occasionally prevail, bringing into the bay a heavy break of sea. These, however, seldom continue thirty hours, and vessels with good ground tackle may ride with safety, or if desirable, beat out at the usually gradual commencement of the breeze, and clear the cape in one good board. Moderate S.W. winds, even at this season of the year, are very common.

Aliwal.—The village of Aliwal stands upon rising ground on the north side of Cape St. Blaize, and consists of about 130 houses, the greater number substantially built, an episcopal chapel, and a Dutch church; various other buildings are in course of erection. The resources of trade and produce in the interior have been opened to

this port by the formation of a road called the Meirings Poort, through the gorge of the Zwaart Berg range of mountains, in 1858, and a thriving commerce is the result. The population of the village consists of above 600. The civil establishment is composed of a resident magistrate, a collector of customs, a district surgeon, and a small police force. An episcopal clergyman and a minister of the Dutch Reformed Church are resident. There is also a harbour-master and an accredited agent for Lloyd's. Several eminent mercantile houses are established, and there are three hotels, and many provision and retail stores. Postal communication is maintained with the extremity of the colony, the mail-cart departing from the village three times a week, and arriving in Cape Town in thirty-six hours. A supply of excellent water is being conducted to a new jetty for the use of shipping. No port charges exist. The arrivals throughout the year 1858 were 100 vessels.

"Cape St. Blaize may be rounded closely, taking care to avoid the Blinder Rock. A windmill on the bluff is not visible coming alongshore from the westward, owing to intervening land, but will be seen from the southward, and the bay thereby identified. On opening the bay, the town of Aliwal will be seen at nearly $\frac{3}{4}$ of a mile inside the extremity of the cape.

"The proper anchorage in Mossel Bay from April to September is in from $4\frac{1}{2}$ to 5 fathoms water on a bottom of clay with a thin covering of sand, with the village bearing S., or with Blands jetty-head S. $\frac{1}{2}$ W., and the visible extremity of the cape S.E. by S. From September to April vessels should not anchor in less than $5\frac{1}{2}$ fathoms. Ships' boats may land either at the stairs at the jetty-head, or on the beach, there being no surf.

"The heaviest gales during the year are from the W.N.W. Winter gales commence from the N.N.W. with heavy gusts, unsteady both in direction and force, then veering to W.N.W. or W. They blow very hard in continuous gales, with barometer low (29.6 inches); finally, shifting rather suddenly to the S.W., they subside with steady breezes and occasional showers. At this latter period a swell sometimes sets round the bay, but nothing to cause apprehension for the safety of vessels, or interruption to the landing with light boats.

"It is high water on the days of full and change at Mossel Bay at 3h., and the rise of tide is 7 feet."*

CAPTAIN DUNN, of the barque *Elizabeth*, of Stockton-on-Tees, in a letter dated July 15th, 1862, thus wrote of Mossel Bay:—"I put into the bay as a port of refuge, having lost sails, store-boats, water-casks, &c., and was astonished at the shelter it afforded from westerly gales, and the abundance of good provisions, firewood, and particularly good fresh water, very important in a long voyage with salt provisions. Ships can use their own boats in landing. There is now a good jetty, and another is being built, along which water will be laid on in pipes. A light-house on the cliff, to be immediately erected, will be an excellent mark by day or night, with winds from S. by E., round westerly, to E.N.E. Mossel Bay is all a mariner can desire, and were its advantages better known, no shipmaster would contend with the heavy westerly gales that prevail so long during winter."

From Mossel Bay to Knysna River the coast runs about S.E. by E. 50 miles, and

* These instructions for Mossel Bay by MR. LAWS are from his description of the bay inserted in the *Nautical Magazine*, November, 1861. Some very strong recommendations of the bay as a harbour of refuge are appended to the description, which are chiefly contributed by shipmasters who have frequented it.

includes several rivers, but there are none, we believe, sufficiently deep to permit the entrance of vessels. This is said to be a bold shore, with land near the sea of moderate height, behind which is the range of Outeniquas Mountains. At 18 miles eastward of Mossel Bay is a little cove named Dutton, which is reported to be a very dangerous and impracticable spot.

KNYSNA RIVER.—The entrance to the Knysna River is between two bold rocky headlands, immediately within which the river expands into a large bay or lake, covered with marshes, but having among them a channel, preserved by the river, deep enough for ships of considerable tonnage. The distance between the headlands is not more than $1\frac{1}{2}$ cable's length, and here, in the shoalest part, are 18 feet water at low tide, which soon increases to 48 feet; but decreases again, almost immediately, to 30 and 25 feet, the latter being at about half a mile from the sea; it is at this latter spot where ships usually anchor. The anchorage is sheltered from all winds except those blowing directly into the mouth of the river. When viewed from the southward, the rocky headlands present the appearance of the portals of a large dock.

CAPTAIN WALLIS, R.N., remarked of this river in 1817, "Any vessel drawing under 15 feet, attending to the tide, may run for this river with safety, it being 288 yards wide at the only dangerous part. It is high water on the days of full and change of the moon at 3h. 45m.; extraordinary tides rise 7 feet, ordinary 5 and 6 feet, and the ebb tide runs out at the rate of 3 or $3\frac{1}{2}$ miles an hour on the springs. The middle of the channel is the deepest water, but it is proper to keep nearest to the western head, on account of the straggling rocks lining the opposite side, which are mostly visible, excepting the Emu Rock, nearly half channel over on the east side of the entrance, and at about a cable's length south-west of Inner Obelisk Point, above which is the signal station; this rock is just outside the northernmost of the straggling rocky islets before mentioned. The brig *Emu* was lost on this rock before its position was known.

"A pilot will come off upon making the usual signal, and a boat should be ready with a line to run out to the rocks in order to steady the vessel in case of it falling calm under the high land, and your being obliged to anchor in the narrow part of the entrance. There is good anchorage outside, the depths decreasing gradually towards the entrance of the river, which affords room inside for about thirty sail of ships, and is as smooth as a dock; and, if necessary, a ship may be hove down to the steep bank, where vessels may also be built, forests of fine timber being contiguous to the river. Nevertheless, this place ought not to be attempted, except in favourable weather, and never in a large ship."

COMMANDER WALKER, R.N., surveyed the river in 1817, and described it as the best harbour in the colony. The following signals may possibly still be in use:—

Flag, white and blue diagonally, signifies—*A pilot-boat is coming out.*

Flag, red—*Ship recommended not to attempt to enter the river.*

Flag, white and red horizontally—*Ship may enter. If waiting for the tide, a red pendant will be shown over the flag at a proper time for entering*

Flag, yellow—*Pilot-boat cannot go out, but a pilot is ready to receive the ship within the bar.*

COMMANDER W. E. A. GORDON, of H.M.S. *Hermes*, 1857–60, says, “The entrance of Knysna Harbour, in Lat. $34^{\circ} 6' S.$ and Long. $23^{\circ} 7' E.$, with a depth of 18 feet in it, may be recognised by a mountain terminating in a bluff near the sea, with Seal Cape, a low black point, extending from it to the S.E. at 10 miles E.N.E. from the harbour. When the harbour is well opened, bearing N., a village with two churches will be seen. There are also two beacons for leading marks—one standing on Fountain Point on the eastern side of the entrance, the other on the western shore of Steenbok Island, within the harbour. The pilot-signals are made with flags from a staff erected on Inner Obelisk Point.

When approaching the harbour from the westward steer for the S.E. rocks, which lie S.S.E. about $\frac{1}{2}$ a mile from the entrance, and when the harbour is well open proceed towards the Needles Point on the western side of the harbour's mouth, until the two beacons come in line, which will lead up to Fountain Point. Pass this at 8 or 10 yards off, and steer for the rocky point between Green and Monkey Points, by which a depth of not less than 3 fathoms should be maintained. When abreast of Green Point, haul in for a sandy patch close southward of Rocky Point, and anchor at about 20 yards southward of it.”

PLETTENBERG BAY.—From Knysna River to Seal Cape, or Cape Delgado, on the south side of Plettenberg Bay, the distance is about 10 miles, along a bold coast, the general inclination of which is E.S.E. This cape is remarkable, being a long, narrow headland, nearly separated from the main by a gap in the cliffs at about $1\frac{1}{2}$ mile from its extremity; hence when viewed from the southward at an offing of some miles it presents the appearance of an island. The position of the extremity of the cape is estimated to be Lat. $34^{\circ} 5'$ and Long. $23^{\circ} 20'$.

The bay has an extent of about 5 miles in a north-easterly direction, but is very shallow in depth as the coast bends in westward not more than 2 miles. It is quite open to the southward and south-eastward, from which directions a very heavy swell is sent in when the wind prevails with strength; consequently, the anchorage can be considered safe only with winds from the land. South-easterly gales seldom blow longer than 24 hours. Owing to extensive forests in the neighbourhood, Plettenberg Bay is frequently visited by small vessels in the coasting trade. Landing is easy, and it is not difficult to get to sea when dangerous gales from the south-eastward are expected.

Around Plettenberg Bay the land is hilly, and inland northward of it, there is a mountain of irregular shape named Buffalo Mountain, the highest part of which is at its east end; at about 60 miles eastward from this there is, inland, another of a sharp conical form, called Peak Mountain; at 30 miles further eastward there is a table hill termed Flat Mountain; and between these is a round hill, called Round Mountain.

Several brackish rivers fall into Plettenberg Bay. The first of these, named Pissant, is at $3\frac{1}{2}$ miles from the extremity of Seal Cape, and has near it, on its northern bank, the government storehouses; beyond this is Kurboom River. At 5 miles from the Kurboom River, following the coast, is a small peaked hill close to the shore, off which are some rocks; and, at $2\frac{1}{2}$ miles from the latter, is the Kromkromma River,—all this shore consists of a rocky cliff.

The soundings in Plettenberg Bay, at 3 miles from the shore, average 30 fathoms, which decrease gradually to 4 fathoms close to the beach; the bottom consists of fine sand. It is usual to anchor in 17 or 18 fathoms, at about $\frac{3}{4}$ of a mile S. by E. $\frac{1}{4}$ E. from the governor's storehouses; or in 9 to 8 fathoms with the cape bearing S. by E. $\frac{1}{4}$ E., and the gap S.W.; here the ship will be in good ground and well sheltered from all but easterly and southerly winds.

LIEUT. RICE, R.N., who surveyed Plettenberg Bay in 1797, says:—"The only danger in approaching the bay is the *Whale Reef*, a circular shoal of rocks bearing S.E. by E. from the cape, nearly 1 mile distant; the sea in general breaks over it very high, and between it and the cape there is a channel, in breadth about $\frac{3}{4}$ of a cable's length, with 7 fathoms the least water. This channel should not be attempted but in case of necessity, as there is generally a great swell, and when it blows strongly, the wind is unsettled and baffling near the cape. By giving the cape point a berth of a little more than a mile, ships may pass safely to the southward and round the east side of the Whale, which is steep, having 18 fathoms water at about a quarter of a cable's length from it; and when the south end of the long sandy beach is open with the high rocky point on the north side of Seal Hill, they will be northward of the shoal, and if the wind permit, may haul close into the bay.

"The bay is sheltered from all winds except those at S.E. and eastward. The wind from E.S.E. to S.S.W. sends in a heavy swell, but south-easterly gales are of short duration here, as at Mossel Bay. The landing-place is on a sandy beach near the governor's storehouses, at the south end of which there is a small river that descends from a farm at the distance of $1\frac{1}{4}$ mile; but the entrance is generally closed with a dry sandy bar. At both ends of the beach rocky points project, and at a cable's length E.S.E. from the south point are some rocks, dry at low water, which break off the sea.

"Wood may be cut near the landing-place; watering is difficult, as the casks must be rolled nearly 300 yards over a heavy sand, and then rafted through the surf, which frequently runs high. Beef and poultry may be had at reasonable prices; vegetables are scarce; fish are plentiful near the cape and about the rocks off the landing-place. Vessels from Table and Simons Bays load timber here, for at 12 miles north-westward of the landing-place there is a forest where various sorts of timber may be had, some of large dimensions, proper for either house or ship-building.

"TIDE.—There is no regular stream of tide, but a southerly current generally sets in the morning between the Whale Rock and Seal Cape."

From Plettenberg Bay the coast trends S.E. by E. 75 miles to *Cape St. Francis*, and is throughout a very dangerous, inhospitable shore, with deep soundings at a short distance off. It is of moderate height near the sea, but rises rapidly inland to a range of mountains, which, meeting the warm winds from the water, gives rise to such dense fogs and mists, that it is frequently hidden from view, and consequently several vessels have been lost upon it; it is also supposed that the current hereabout sets directly on shore. At Cape St. Francis the mountain range nearest the coast gradually declines to the sea. The depth at 15 miles southward from Cape St. Francis is supposed to be about 60 fathoms.

Cape St. Francis is a bold point with rocks about it, and must, consequently, be

approached with caution; the rocks are said to extend out about a mile, but this is uncertain, for no part of the coast has been surveyed. In the French charts this cape is called the Cape of Mountains, although it is not high land; but inland, due North (*true*) from it 20 or 25 miles, there is a remarkable rugged piece of high land, the flat and round mountains before mentioned, which may have been mistaken for it in thick weather.

ST. FRANCIS BAY is on the east side of Cape St. Francis; but this term is generally applied to the whole sweep of coast between the cape and Cape Recife, the bay immediately eastward of Cape St. Francis being called Kromme Bay, from the river Kromme, or Crooked, which falls into it.

Kromme Bay is quite open to all winds from the southward and south-eastward, and is said to be a very bad anchorage, the bottom being rocky; hence necessity alone should cause a vessel to run for it.* Winds from sea, if violent, would drive a ship badly found in ground tackle on shore, when nothing could save her from destruction; added to which the landing is bad, the only place being at the entrance to the river, where there is usually a high surf. The water of the river, like that of most of the rivers on this coast, is brackish, but there is a spring of good quality at about a mile from the sea, whence supplies may be obtained by means of casks hauled through the surf to a boat anchored outside. It is said that at high water spring tides the depth on the bar of the river is 7 or 8 feet.

From Kromme Bay the coast runs nearly East (*true*) 35 miles to Cape Recife, Algoa Bay, and nautically speaking, is unknown, no survey of it having yet been made.

CAPE RECIFE.—Cape Recife, immediately eastward of which is Algoa Bay, is a low sandy point of land having a small conical hill near its extremity, which is distinguishable only at a short distance; the lighthouse on the cape is therefore an important mark to vessels approaching from the southward or eastward, as it is the chief means by which the position of this very dangerous point can be known. This building consists of a tower 80 feet high, painted in four horizontal bands, alternately red and white, which exhibits a light *revolving every minute* at 90 feet above the sea, visible 17 miles (supposing the eye 12 feet above the horizon) between the bearings from the lighthouse of N. by E., round by S. to W.; when viewed from a short offing the light appears to be *fixed*, with *bright flashes every minute*. The lighthouse stands in Lat. $34^{\circ} 1' 40''$ S., and Long. $25^{\circ} 42' 8''$ E., and from it the Cockscomb Mountain, 5400 feet high, bears N.N.W. $\frac{1}{2}$ W.

The low shore of Cape Recife is rocky, hence a wide berth should be given to it

* CAPTAIN HORSBURGH mentions that "Kromme Bay was formerly visited by some vessels in distress. The *Pigot* got water and other refreshments here in June, 1785, and the *Countess of Sutherland* remained in it (after losing her masts at sea) from July 18th to August 17th, 1801. While the latter vessel continued at this place there were frequently land and sea breezes, with strong winds at times from S.E. blowing into the bay, rendering her situation very dangerous, for the cables were much injured, and some of the anchors were broken by the rocks, although she moved from 10 fathoms on the east side to 7 fathoms on the west side of the bay to endeavour to get better anchorage. At a little eastward of the entrance of the river, the *Pigot* found a spot of 7 fathoms, sandy bottom, where she moored at a little more than a mile from the shore, the eastern extremity of the land in sight bearing E. 10° N. (*true*), and a round mount in one with the entrance of the river, which is the best situation to moor."

when running into Algoa Bay, and a still wider berth when sailing westward, the coast immediately westward of the cape having reefs about it and being as yet unsurveyed. A very dangerous reef (from its situation, being an outlying patch) in the vicinity of Cape Recife is the *Thunderbolt*, a reef $\frac{3}{4}$ of a mile in extent, the centre of which is $\frac{9}{10}$ of a mile S.W. $\frac{1}{2}$ W. from the lighthouse; this reef has close to it all round a depth of 4 to 6 fathoms, and in the narrow channel between it and the cape, soundings of 4 to 2 fathoms—outside it the water rapidly deepens to 24 and 30 fathoms, the latter being at not more than 2 miles from the lighthouse, consequently the greatest possible precaution is necessary while in its vicinity.*

ALGOA BAY.—From Cape Recife the coast trends northward about $5\frac{1}{2}$ miles to the town of Elizabeth, and thence north-eastward and eastward 42 miles to the Bird Islands, the whole space comprised within these limits being considered Algoa Bay—the direct bearing and distance from the lighthouse on Cape Recife to the lighthouse on the Bird Islands is E. $\frac{1}{2}$ S. 30 miles, so that the shore of the bay bends in considerably from a straight line supposed to be drawn between those objects. The general depths are 40, 36, 28, 20, and 10 fathoms, the last being found at from 1 to $1\frac{1}{2}$ mile from the shore, except off Port Elizabeth, where similar soundings are obtained so far out as $2\frac{1}{2}$ and 3 miles. The bay is of a horse-shoe form, well protected from the violence of winds, except between E. $\frac{1}{2}$ S. and S. by E. $\frac{1}{2}$ E., and is considered the best and safest roadstead on the Cape Coast during the winter months.

Riy Bank.—In the entrance to Algoa Bay in the direction of E. by S. $\frac{1}{4}$ S. from Cape Recife, there is a bank of 6 to 10 fathoms, named Riy Bank, the shoalest part of which, 6 fathoms, is situate $8\frac{1}{2}$ miles from the lighthouse at the cape on that line of bearing. It is rather more than a mile in extent, and appears to consist of an eastern and western bank, bottom rocky and foul, with 12 to 20 fathoms between and around. The sea breaks heavily after S. W. gales, especially over its north-west or shallowest part.

The coast northward of Cape Recife is fronted by a reef which extends out from $\frac{1}{2}$ to $\frac{3}{4}$ of a mile, but the 5 fathom line of depth is not more than $\frac{1}{2}$ a mile from the beach; hence this shoal is very dangerous, and especially so as there is an outlying shallow patch, named the *Dispatch Rock*, so far from the land as one mile. This reef consists of numerous heads of rock rising above a bed of rocks fully 500 feet long, the least water over which is 8 feet. There are 9 and 10 fathoms close to it on its eastern, and 5 and 6 on its western side. It lies $2\frac{3}{4}$ miles N.N.E. $\frac{1}{4}$ E. from Cape Recife lighthouse, with that building in one with a red beacon situate north-eastward of it, and two beacons,† placed a little within high-water mark at $2\frac{1}{2}$ miles northward

* "No vessel should approach the coast for 4 miles westward of Cape Recife, nor the cape itself nearer than $2\frac{1}{2}$ miles, and then only in a commanding breeze or in a steamer, as the reefs extend nearly $1\frac{1}{2}$ mile from the shore, and because there is a very decided and dangerous indraught towards them.

"Neither should any one be tempted, by the absence of breakers, to approach nearer the east side of Recife lighthouse, as it often occurs that it does not break upon a 7-foot patch a mile from the lighthouse, and yet it will, without previous warning, break in 7 fathoms, and even in 10 fathoms. It is seldom prudent to get less than 13 fathoms water while still outside of Recife. When the height of the lighthouse subtends an angle of $23'$, the distance from it will be $2\frac{1}{2}$ miles, and, therefore, no greater angle should be obtained."—*Nautical Magazine*, 1856.

† These two beacons are each 25 feet high, surmounted by a ball, and painted in alternate bands of red and white. They are distant from each other 1200 yards on an E. $\frac{1}{4}$ N. and W. $\frac{1}{4}$ S. bearing.

of the lighthouse, in a line with each other—it is consequently a mile from the nearest land.*

Port Elizabeth.—From Beacon Point, off which is the Dispatch Rock, to the town of Elizabeth, the distance is about $2\frac{1}{2}$ miles along a sandy coast covered with bushes. Port Elizabeth is the principal port of commerce on the south coast of Africa next to Cape Town. The town is not extensive, compared with European cities, but it is rapidly increasing in importance. Water and refreshments of all kinds can be procured at moderate prices, and leaky and dismasted vessels are sometimes hove down, repaired, and refitted at their anchorage off the town. It is the practice of merchant vessels regularly trading for wool cargoes to moor on arrival, and to strike their top or top-gallant masts, and unbend sails. They are found with ground-tackle superior to ordinary merchant vessels, and ride out in safety the summer gales from the S.E. The port captain assigns the berths, and shipmasters are bound to attend to his orders. There is a jetty at the mouth of Baaken River, where a landing can always be effected except in rough weather from the south-eastward.

The surf constantly beats on the beach of Port Elizabeth, and sometimes with extreme violence. At times, it is almost impossible to land.

A lighthouse is situated on a hill behind the town at nearly 25 yards S. $\frac{1}{2}$ E. from Donkin Monument. It shows a *fixed* light at 225 feet above the level of high water, visible about 12 miles between the bearings, when viewed from sea, of N.W. and S. W. From sea it appears *red* between the bearings of N.W. and N.W. by W.; *white* between N.W. by W. and S.W. by W.; and again *red* between S.W. by W. and S.W.†

There is anchorage in 6 to 8 fathoms in front of Port Elizabeth, and it may be remarked, as a general rule, that a sandy bottom and good holding ground will be found anywhere in 7 fathoms. When taking up a berth, however, room should be left to admit of veering to 100 and even 130 fathoms, as less than this quantity should never be tried; and, indeed, it is seldom judicious to use less than this quantity anywhere, unless the harbour is landlocked and the water much less than 7 fathoms in depth. There is a little foul ground in the south-west part of the bay. Vessels may anchor in about 6 fathoms, grey sand, with the south-east angle of Fort Frederick bearing W. $\frac{1}{2}$ N., and the Bird Rock at Beacon Point S. $\frac{1}{4}$ E.;—or further out in 8 fathoms, similar bottom, with these objects respectively W. $\frac{1}{4}$ S. and S. by W.

* The Dispatch Rock appears, from the survey made in 1855 by LIEUTENANT DAYMAN, R.N., to be the only outlying danger between Cape Recife and Port Elizabeth; but it should be mentioned that in 1819 a rock was reported by CAPTAIN HUNN, of H.M.S. *Redwing*, the cross bearings of which, as given, place it further in the bay than the Dispatch Rock, and in a position where not less than a depth of 6 fathoms is shown on LIEUTENANT DAYMAN'S chart. The report was as follows:—"The reef appeared to be about 8 fathoms in length and 2 or 3 fathoms in breadth, having $2\frac{1}{2}$ fathoms upon it, the least water, with 8 fathoms close to it. When upon it, the extremity of the breakers off Cape Recife bore S. 8° E.; Cape Recife S. 2° E.; Bird Island, off Beacon Point, S.; Fort Frederick W. $\frac{1}{2}$ S.; and St. Croix, north-easternmost island, N.E. by E. $\frac{1}{2}$ E. It was off shore about $1\frac{1}{2}$ mile." Notwithstanding this circumstantial account, the rock is believed by the residents at Port Elizabeth to have been the Dispatch Rock, the correct position of which has now been fully determined by LIEUTENANT DAYMAN.

† As it is possible that in consequence of its elevation this light may occasionally be seen by vessels approaching Algoa Bay from the eastward before the revolving light on Cape Recife comes into view, care should be taken not to bring it southward of W. until that light can be clearly distinguished; which it will be, immediately it is above the horizon, by its greater brilliancy, as well as by its revolving once a minute.